Appendix QQ

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(54) **HIGH RESOLUTION PRE-EVENT RECORD**

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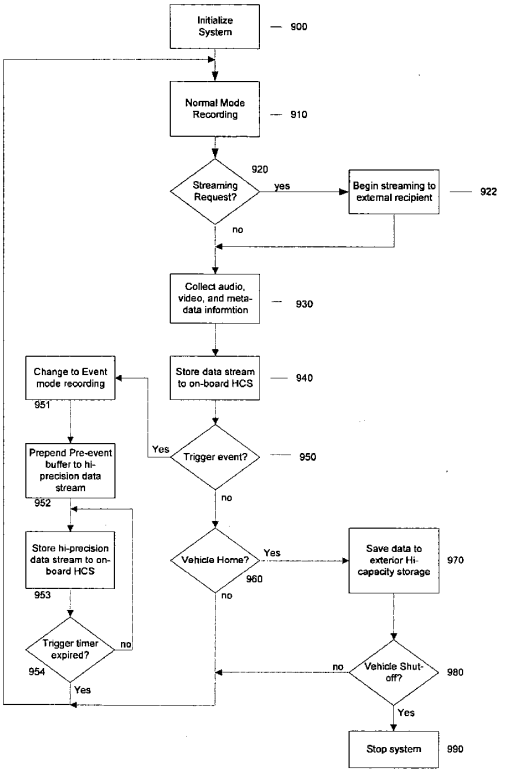
Publication Classification

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H04N 7/18 (2006.01)
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(52) **U.S. Cl.** **348/143**

(57) **ABSTRACT**

The High Resolution Pre-Event Record system is an innovative means for collecting audio, video, and meta-data in a mobile vehicle platform and continuously recording this information stream to a high-capacity storage device at different levels of data resolution based upon the status of a trigger event. The occurrence of a trigger event will cause the system to store higher resolution data to an on-board high-capacity storage device prepended by a configurable amount of high resolution data previously recorded into a pre-event data buffer. The data stream may later be downloaded to an external storage device for future review and analysis.



Control Process Flow Diagram

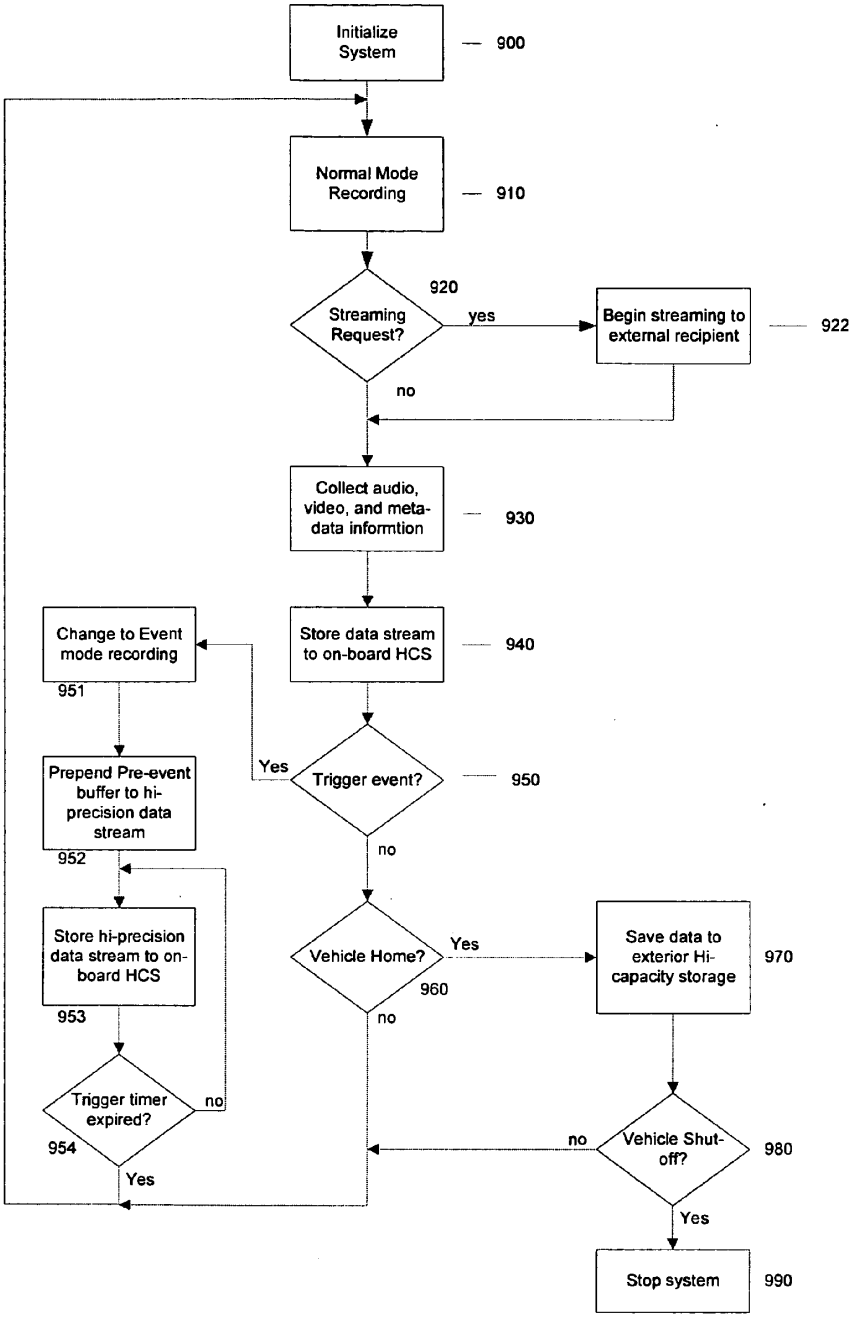


FIG 1: Control Process Flow Diagram

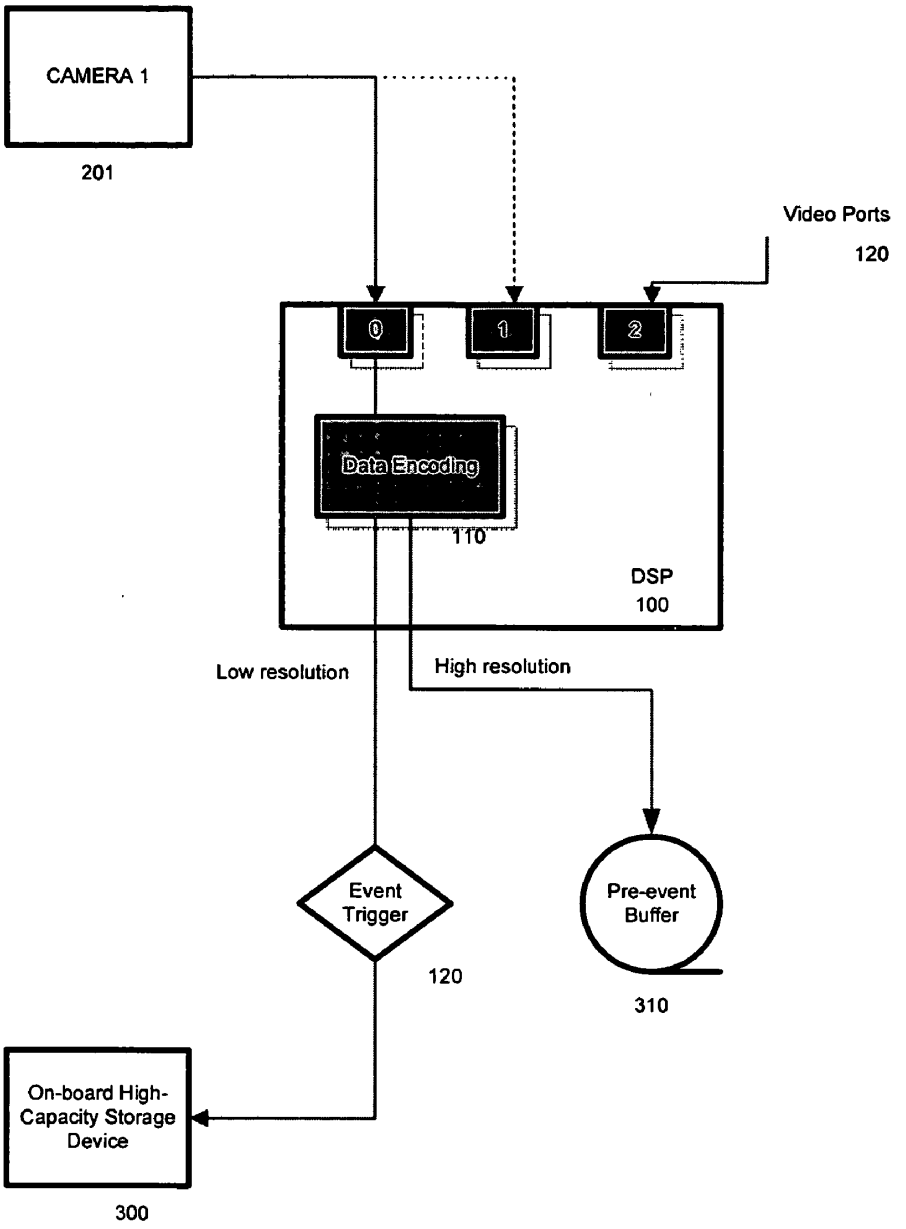


Figure 2: Normal mode Operation

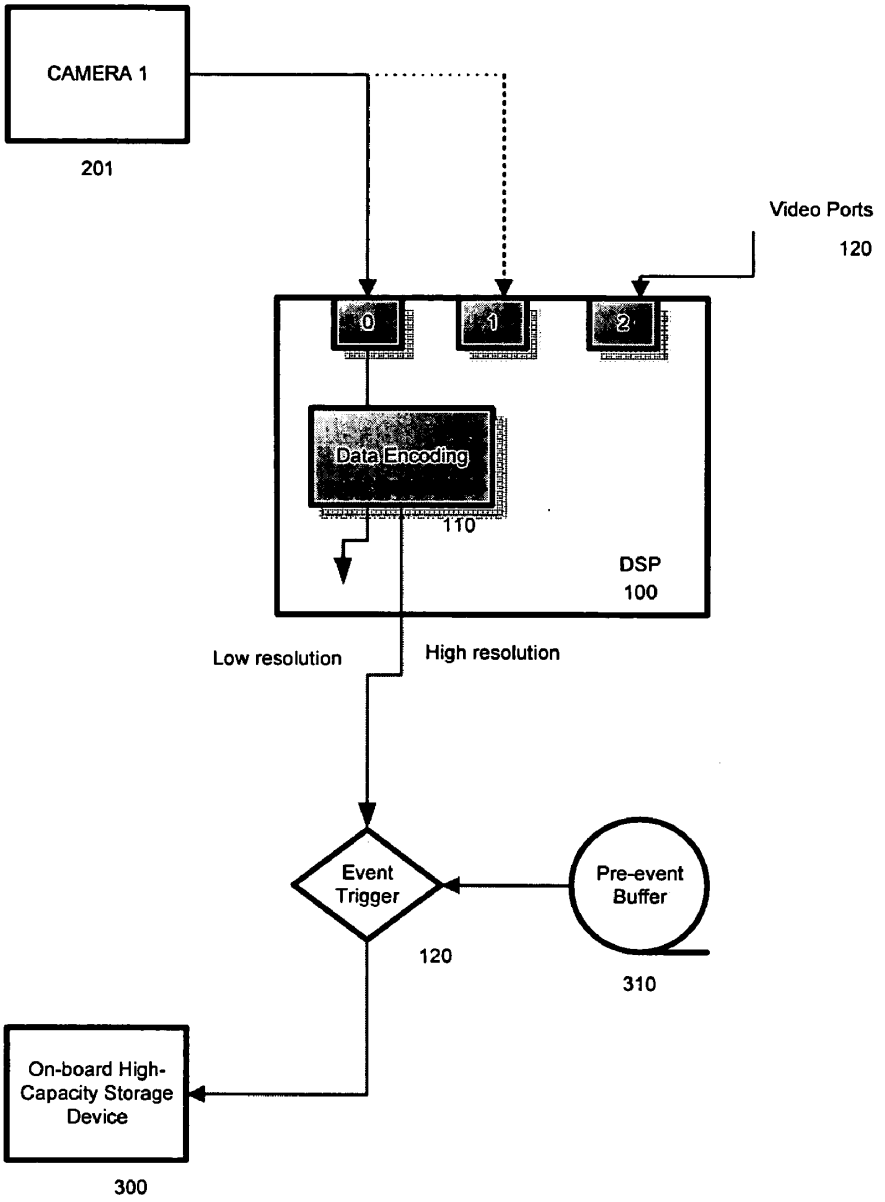


Figure 3: Event mode Operation

HIGH RESOLUTION PRE-EVENT RECORD

[0001] This application is a Continuation-in-part of co-pending application Ser. No. 10/703,258 which was filed Nov. 7, 2003, and claims priority to U.S. provisional application serial No. 60/709,111 which was filed Aug. 18, 2005.

BACKGROUND OF THE INVENTION

[0002] In mobile security and surveillance systems that record video and audio, the ability to provide a buffer of information prior to a trigger event is known. However, current recording systems typically record video at single resolution during any given time period, either low-resolution or high-resolution, and also typically have no ability to modify the resolution of the recording regardless of the importance of the event to be captured except under manual control. In addition, current systems typically record in an intermittent fashion, for example a patrol car that records data only when an event occurs or only as required under manual control. The problem of recording continuously and switching the resolution of recording from lower resolution to a higher resolution as needed to capture an event, or even recognizing an event that triggers such a switch in recording resolution, are not addressed by the current pre-event recording solutions implemented primarily as periodic recording systems.

[0003] The present invention addresses these problems, as well as issues of implementing a system under full programmatic control for automated data capture based upon trigger events. The current invention provides an elegant solution that captures an integrated data stream of recorded data in a continuous fashion, switching resolution to capture events that trigger a need for higher resolution recording, and recording the integrated data stream for later review and analysis.

TECHNICAL FIELD

[0004] The present invention is directed toward a means for preferentially recording a high resolution integrated stream of data composed of audio, video, and meta-data based upon a trigger event within a mass transit vehicle, the integrated stream of data being saved to an on-board high-capacity storage device.

SUMMARY OF THE INVENTION

[0005] The invention is installed within a mass transit vehicle such as, for example, a city bus, train, or school bus in which a low resolution integrated steam of data delivered from a Digital Signal Processor (DSP), an audio codec, and another internal meta-data source is continuously being recorded to a high-capacity storage device. Simultaneously, a high resolution instance of the same integrated data stream is being stored to a circular data buffer of configurable length. Upon experiencing a trigger event, the high resolution integrated stream of data replaces the low resolution data stream thus improving the quality of the recorded data stream stored to the high-capacity storage device. In addition, a buffer containing a configurable quantity of the integrated data stream recorded from the circular data buffer prior to the trigger event is prepended to the high resolution recording. In this fashion, the recorded data stream contains a high-quality, high resolution integrated data stream from a time prior to the trigger event and continuing through to the end of the time period for recording required by the trigger event. At the expiration of the set trigger event record time period, the system reverts to the steady-state operation of the low resolution integrated data stream being recorded directly to the high-capacity storage device, and the high resolution integrated data stream being recorded into the configurable length circular data buffer.

[0006] The integrated data stream, in both normal and event modes, is stored to an on-board high-capacity storage device and later downloaded to an external high-capacity storage device to free storage in the on-board high-capacity storage device for reuse.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The above objects and advantages of the present invention will become more apparent by describing in detail preferred embodiments thereof with reference to the attached drawings, in which:

[0008] **FIG. 1**: illustrates the control software that starts, monitors, and stops the system

[0009] **FIG. 2**: illustrates the steady-state, or normal, mode for system operation

[0010] **FIG. 3**: illustrates the event mode of system operation after a trigger event

DETAILED DESCRIPTION

[0011] The High-Quality Pre-event Record function collects an integrated stream of information consisting of audio, video, textual data and meta-data information and stores this information stream to a high-capacity storage device located on-board a mass transit vehicle such as a security vehicle, city bus, train, or school bus. The recorded integrated data stream receives video data from a Digital Signal Processor (DSP) **100** that receives input and provides output from at least one digital video camera **201**. The application module that controls the process of receiving output from the DSP **100**, creates the integrated data stream and records said data information stream into a high-capacity storage (HCS) **300** device is the transitcam application.

[0012] When the transitcam application is running the Mobile Digital Video Recorder (MDVR) is continuously recording. The system records data in two modes; a normal mode **910** and an event mode **951**.

[0013] The system can record the integrated data stream at three levels of resolution, each level of which is configurable based upon a combination of parameters shown below. The resolution levels are low-resolution, medium-resolution, and high-resolution and are set as system configuration variables by the system administrator. The resolution level is set as a combination of the following parameter settings:

[0014] Frames per second rate (between 1 and 30)

[0015] Bitrate (in bits/second)

[0016] Rate Control: VBR (Variable Bit Rate) or CBR (Constant Bit Rate)

[0017] Compression algorithm: ISO-MPEG4 SP/ASP/AVC, ITU-H.263

[0018] Scene Complexity: Hi, Low or Medium

[0019] Image Resolution: D1, Half-D1, VGA, SIF, etc.

[0020] Number of key frames per second

[0021] Because the parameters combining to form a resolution level are configurable, high-resolution recording files have the greatest visual clarity and largest recorded file size. Medium-resolution recorded files are grainer in terms of visual clarity and recorded file sizes are smaller than those of high-resolution recordings. Low-resolution recorded files have the grainiest visual clarity and smallest file sizes of each of the levels of resolution. With this characterization in mind, the user is free to define low, medium, and high resolution levels as any combination of the above parameters that preserves the relationship of low, medium, and high resolution data information recording.

[0022] As an example, an administrator of the system could choose to record low-resolution video at the rate of 5 frames per second. This frame rate produces a choppy video steam, but saves a great amount of space in the on-board HCS **300** allowing a larger mean time between downloads for the HCS **300**. The administrator could then set the high-resolution video record rate at 30 frames per second, requiring much larger files to be stored on the HCS **300**, but also providing real-time recording quality for the length of the event timer(s).

NORMAL MODE

[0023] Upon system initialization **900** the system begins operating in normal mode **910**. The system begins collecting audio, video, and meta-data information **930**, combining the video data information from Camera **1201** with input audio and meta-data information into an integrated data information stream and storing the integrated data information stream in an HCS **300** device **940** located on-board the mass transit vehicle. This data information stream is defined as being either low-resolution or medium-resolution. There is a trade off between recorded quality and file size. Although the quality is lower, low-resolution or medium-resolution data information stream files are stored directly to the HCS **300** during normal mode because they are smaller and allow for a larger number of files to be stored in the HCS **300**, providing a longer time for recording before the HCS **300** must be downloaded into external storage, freeing the HCS **300** to begin accepting new data information files.

[0024] Simultaneously, a high-resolution data information stream is being recorded from Camera **1201** through data encoding means within a DSP **100** and into a circular buffer of configurable length, called the Pre-event buffer **310**. The length of the buffer may be set to store between 1 and n number of seconds (n is typically between 30 and 180) of data information stream files based upon the needs of the user. This guarantees that only a fixed amount of storage in the HCS **300** will be consumed by the larger data information stream files generated by high-resolution recording. When the end of the data buffer **310** is reached, the data information stream files are written to the beginning of the buffer **310** once again, overwriting the previous data information stream files and progressing through the buffer **310** once again in circular fashion.

[0025] Therefore, during normal mode **910** operation, the system records one lower-resolution data information stream in the HCS **300** and one higher-resolution data information stream in the pre-event circular buffer **310**.

EVENT MODE

[0026] When a trigger event occurs **950**, the system changes the recording mode to event mode **951**. Trigger events are defined within the system database as those events that a user of the system is interested in capturing in high-resolution for later analysis and possible evidentiary use. The system has a database and a rules engine module for storing a plurality of trigger event definitions and deciding, based upon input operational characteristics and meta-data captured by the system, when the threshold for a stored trigger event has been reached. Once a trigger event threshold has been met, a trigger event is declared and the system changes the recording mode to event mode **951**.

[0027] In this mode, the high resolution data information stream recorded by Camera **1201** is stored in the HCS **300**. The Low Resolution recording for Camera **1201** is not retained on the HCS **300**. In addition to the high resolution recording from Camera **1201**, the integrated data stream information that has been previously stored in the pre-event buffer **310** is saved to the HCS **300** device prior to the high-resolution recorded information from Camera **1201**. The integrated data stream is encoded by the DSP into at least two resolution levels, a high resolution and a lower resolution. For example, the two resolution levels may be accomplished through the use of a video splitter to feed the same camera output to two instances of the compression algorithm resident within the DSP **100** or by transcoding or transrating encoding of the higher resolution data so as to generate the lower resolution data as a result of the encoding process thus conserving DSP **100** resources. As stated above, high resolution integrated data files are characterized as those having a larger recorded file size than low resolution integrated data files. The desired recording resolution for each level of encoding is selectable by the system administrator or other designated user. The combination of the high-resolution recording output from Camera **1201** and the contents of the pre-event buffer **310** are saved in the high-capacity storage **300** device as a set of files that are referenced as a single event.

[0028] At the expiration of a timer associated with said trigger event **954**, the system returns to recording data information in normal mode. If a second event occurs prior to the expiration of the first event timer, the timer is reset to its original value to capture the second event in its entirety. The system returns to normal mode recording at the expiration of any or all overlapping event timers.

[0029] Moving saved data files from the on-board HCS **300** to an exterior High-capacity storage **970** is accomplished when the mass transit vehicle stops at a facility equipped with a Transitcam Video Management Server (TVMS) and high-capacity storage equipment. This transfer is accomplished in one of two methods; (1) physically removing the on-board HCS **300** from the mass transit vehicle or (2) transmitting the saved data files from the on-board HCS **300** to the TVMS over wired or wireless data communication means.

[0030] In the first method, the on-board HCS **300** is contained in a ruggedized, removable enclosure that is electrically connected to the on-board MDVR. When the mass transit vehicle returns to a maintenance facility, the driver or other designated user physically removes the on-board HCS **300** enclosure and transports said enclosure

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into the facility. The user then inserts the on-board HCS **300** enclosure into a rack-mounted slot designed to receive said enclosure. The rack-mounted slot maintains an electrical connection to a system server. The on-board HCS **300**, when inserted into the rack-mounted slot, is electrically connected to the system server through a dedicated connector located within said rack-mounted slot. Once the on-board HCS **300** achieves electrical connection with the system server, the user presses a toggle switch to initiate the process within the system server to transfer all data files from the on-board HCS **300** to the external high-capacity storage **970**.

[**0031**] In the second method, when the mass transit vehicle returns to a maintenance facility, the driver or other designated user will connect a network communications wire to establish network communications from the on-board MDVR processor to the TVMS located within the maintenance facility. Alternatively, the MDVR may establish a wireless networked communication connection with the TVMS located within the maintenance facility. Once communication has been established, the on-board MDVR processor initiates the transfer process through a software module dedicated to file transfer to transfer all data files from the on-board HCS **300** to the TVMS and the associated storage device.

[**0032**] Regardless of whether the above method 1 or method 2 is used for data transfer, if the mass transit vehicle must leave the maintenance facility before all of the files have been transferred from the on-board HCS **300**, the files that have not been successfully transferred are maintained within the on-board HCS **300** and will not be overwritten. When the mass transit vehicle returns once again to the maintenance facility, said maintained files are the first files to be transferred to the TVMS and the associated high-capacity storage device.

[**0033**] While this invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

We claim:

1. A mobile digital video recording surveillance system installed within a public transport vehicle comprising:

a plurality of data capture devices for continuously capturing video, audio, and meta-data comprising at least two separate data streams;

a memory device including a permanent memory area and a memory buffer to permanently store a first one of said captured data streams in said permanent memory area and temporarily store a second one of said captured data streams in said memory buffer;

a trigger device to monitor the operational environment for pre-configured trigger event conditions;

a logic device pre-configured to switch recording from a first data stream to a second data stream and directing said second data stream to said permanent memory area in the presence of a trigger event;

a timer set for a pre-configured duration which is initiated upon reception of a trigger event;

wherein the system continues to capture and record said second data stream during the duration of said timer and, at the termination of said timer duration, switches said second data stream recording to said memory buffer and resumes recording said first data stream to said permanent memory area.

2. A mobile digital video recording surveillance system according to claim 1 further comprising:

a device for recording a first data stream at a lower data resolution than a second data stream.

3. A mobile digital video recording surveillance system according to claim 1 further comprising:

a logic device pre-configured to record data in a normal mode and an event mode, wherein the system records data in normal mode until a trigger event occurs and then the system switches to event mode.

4. A mobile digital video recording surveillance system according to claim 3 further comprising:

a logic device pre-configured to record data from a first data stream to a permanent data area and to record data from a second data stream to a temporary memory buffer area when recording in normal mode;

wherein said lower resolution first data stream is recorded to a permanent memory area during normal mode as a means for conserving space in a digital memory device.

5. A mobile digital video recording surveillance system according to claim 3 further comprising:

a logic device pre-configured to record data from a second data stream to a permanent data area when recording in event mode;

wherein said higher resolution second data stream is recorded to a permanent memory area during the presence of a trigger event as a means for providing a higher quality recorded data stream for later evidentiary use.

6. A mobile digital video recording surveillance system according to claim 5 further comprising:

A logic device pre-configured to record the data stream from the memory buffer into the permanent memory area prior to recording said second data stream in the presence of a trigger event.

7. A mobile digital video recording surveillance system according to claim 1 further comprising:

A logic device pre-configured to extend the duration of time limit for an event upon the indication of a subsequent trigger event received prior to the expiration of the time limit for a previous trigger event.

8. A process for initiating a mobile digital video recording surveillance system installed within a public transport vehicle to record a preferred data stream comprising:

continuously capturing video, audio, and meta-data comprising at least two separate data streams;

initiating a permanent memory area and a memory buffer to permanently store a first one of said captured data streams in said permanent memory area and temporarily store a second one of said captured data streams in said memory buffer;

monitoring the operational environment for pre-configured trigger event conditions;

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directing said second data stream to said permanent memory area in the presence of a trigger event;

setting a timer for a pre-configured duration which is initiated upon reception of a trigger event;

wherein the system continues to capture and record said second data stream during the duration of said timer and, at the termination of said timer duration, switches said second data stream recording to said memory buffer and resumes recording said first data stream to said permanent memory area.

9. A process according to claim 8 further comprising:

recording a first data stream at a lower data resolution than a second data stream.

10. A process according to claim 8 further comprising:

recording data in a normal mode and an event mode, wherein the system records data in normal mode until a trigger event occurs and then the system switches to event mode.

11. A process according to claim 10 further comprising:

recording data from a first data stream to a permanent data area and recording data from a second data stream to a temporary memory buffer area when recording in normal mode;

wherein said lower resolution first data stream is recorded to a permanent memory area during normal mode as a means for conserving space in a digital memory device.

12. A process according to claim 10 further comprising:

recording data from a second data stream to a permanent data area when recording in event mode;

wherein said higher resolution second data stream is recorded to a permanent memory area during the presence of a trigger event as a means for providing a higher quality recorded data stream for later evidentiary use.

13. A process according to claim 12 further comprising:

recording the data stream from the memory buffer into the permanent memory area prior to recording said second data stream in the presence of a trigger event.

14. A process according to claim 8 further comprising:

extending the duration of time limit for an event upon the indication of a subsequent trigger event received prior to the expiration of the time limit for a previous trigger event.

* * * * *

Appendix RR

US 20070035632A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2007/0035632 A1**

Silvernail et al. (43) **Pub. Date: Feb. 15, 2007**

(54) **MOBILE DIGITAL VIDEO RECORDING SYSTEM**

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(21) Appl. No.: **11/269,636**

(22) Filed: **Nov. 9, 2005**

Related U.S. Application Data

(60) Provisional application No. 60/707,523, filed on Aug. 12, 2005.

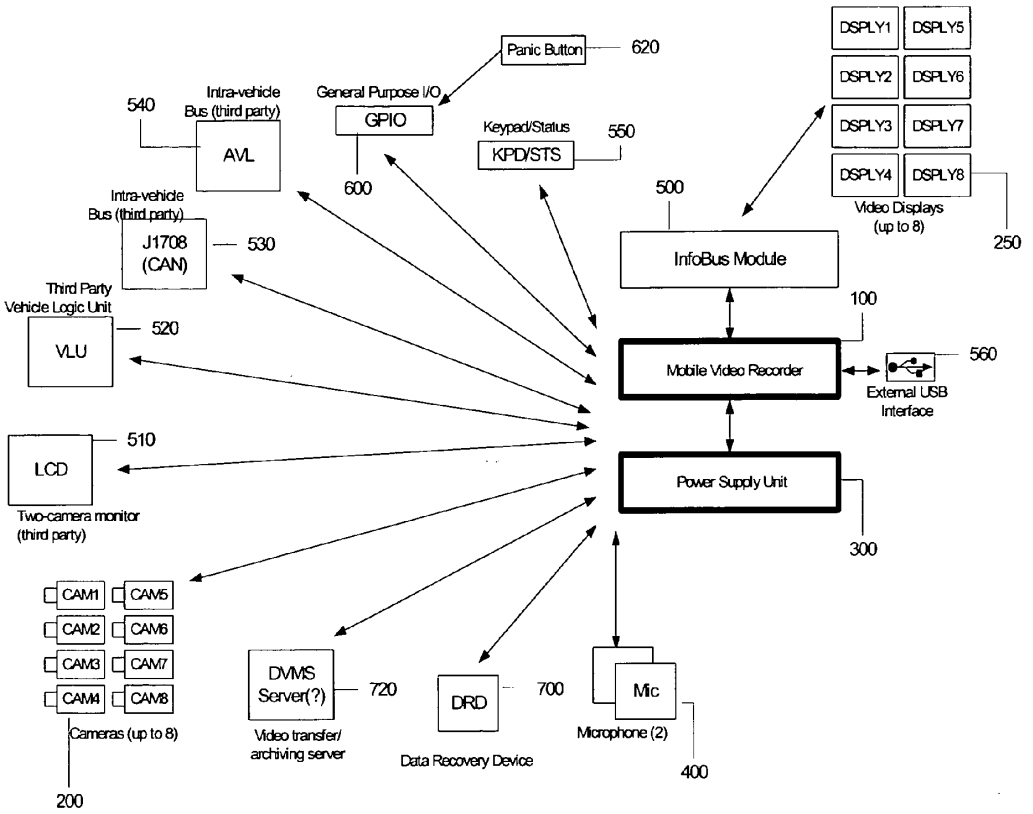
Publication Classification

(51) **Int. Cl.**
H04N 7/18 (2006.01)
H04N 5/232 (2006.01)

(52) **U.S. Cl.** **348/211.3**; 348/148

(57) **ABSTRACT**

The Improved Mobile Digital Video Recorder (IMDVR) system is a ruggedized, multiple camera video and audio recording system that is installed within a public transit vehicle to record, store, and manage an integrated data stream of data captured within and exterior to the transit vehicle. The system is focused on multiple person vehicles and the capture of an integrated data stream for use in transit security, liability, and evidentiary processes.



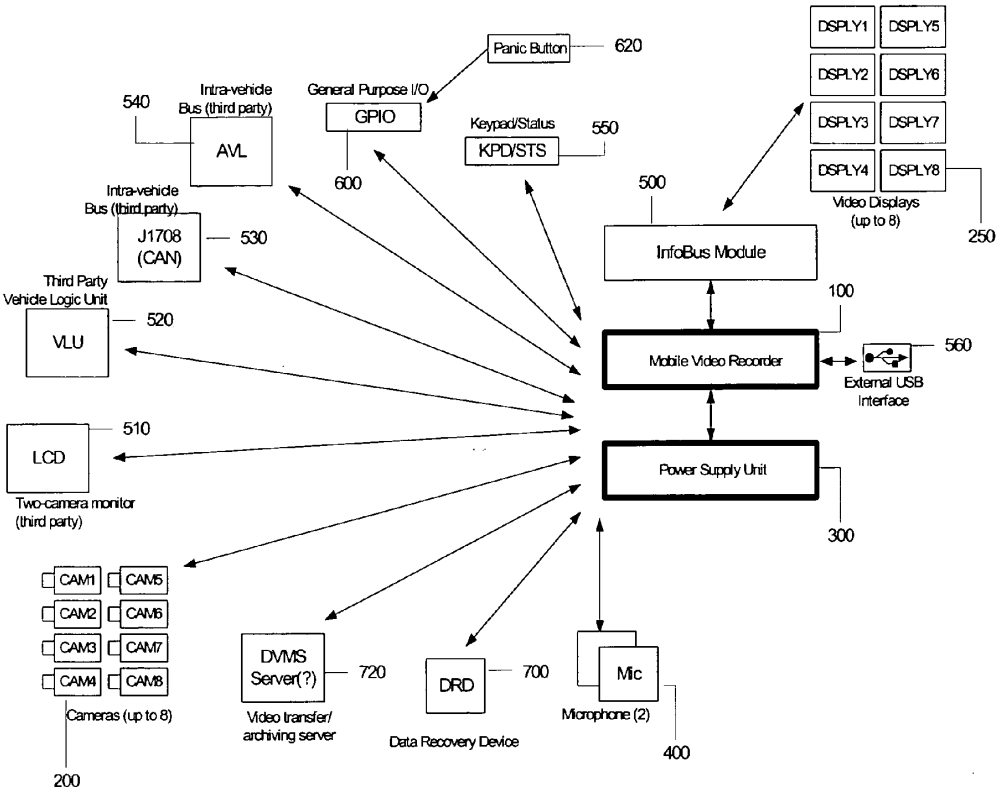


Figure 1: IMDVR System Diagram

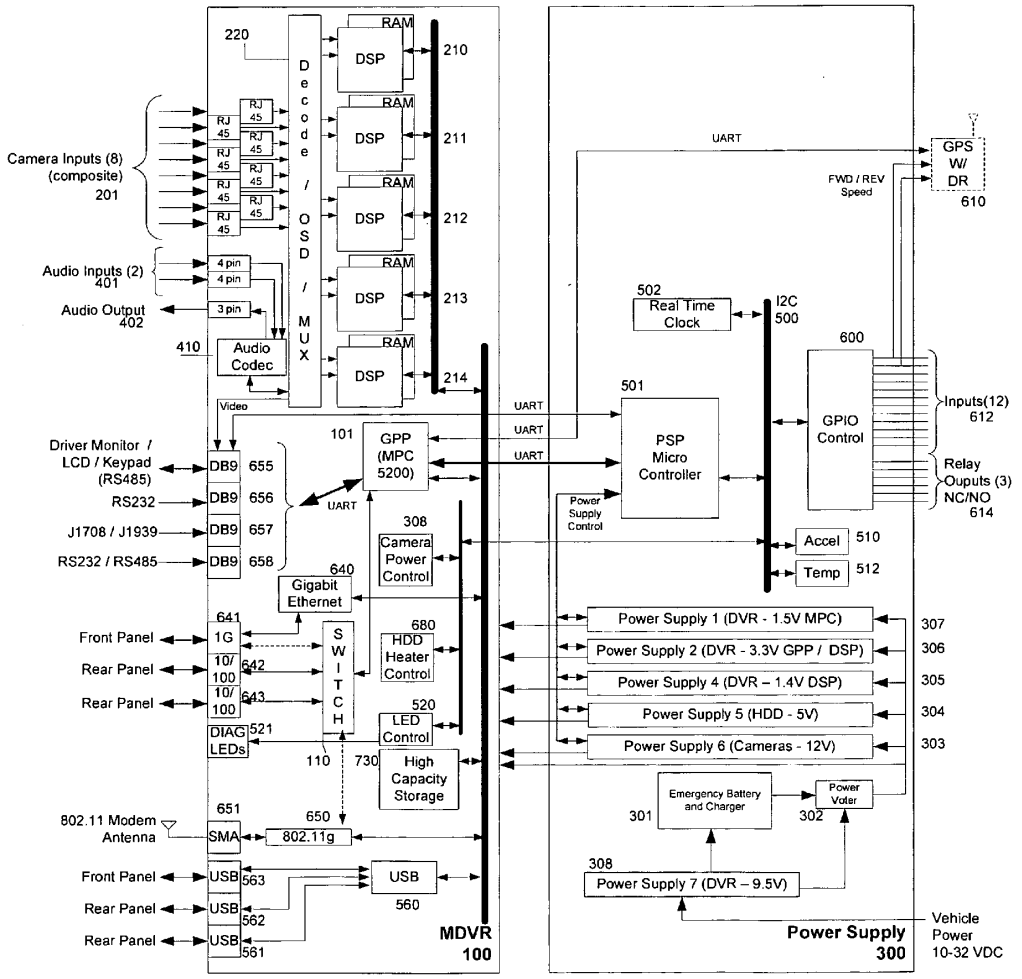


Figure 2: Component Diagram

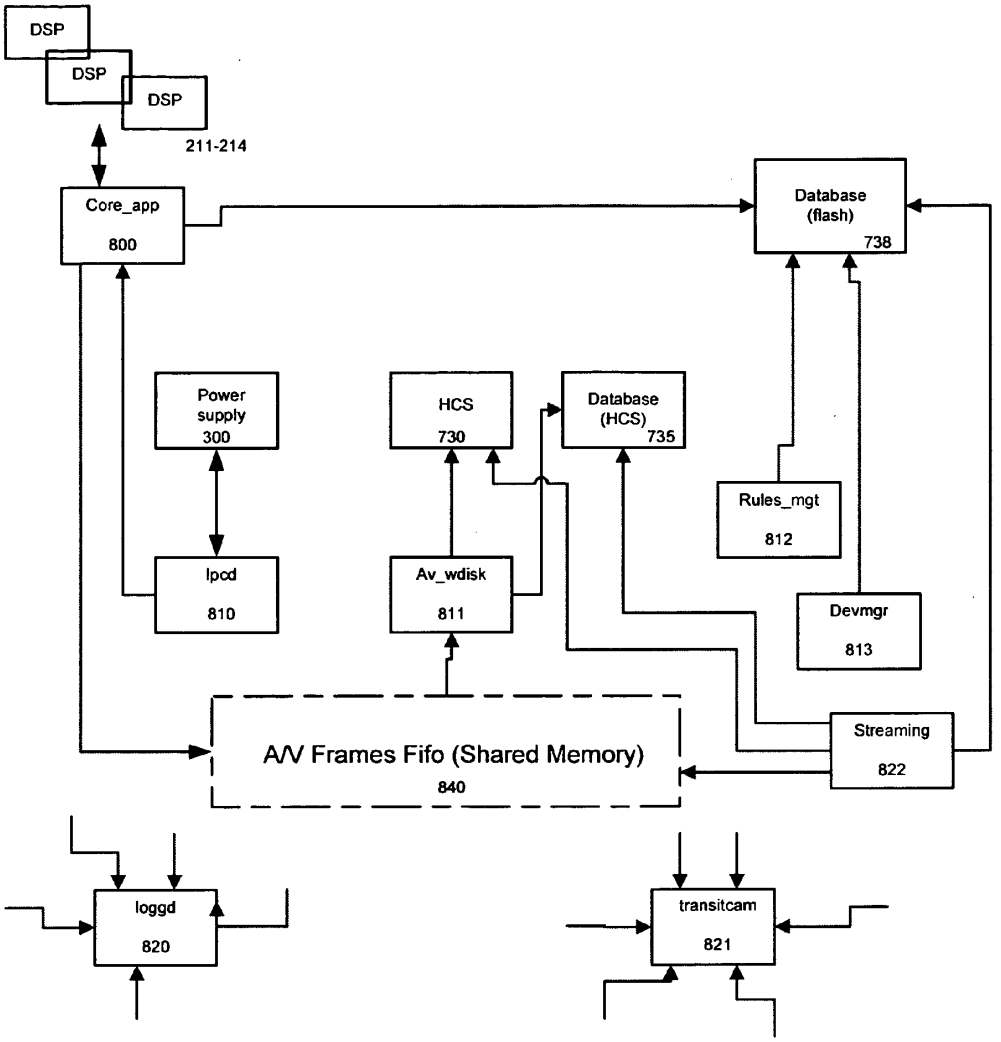


Figure 3: System Software Components

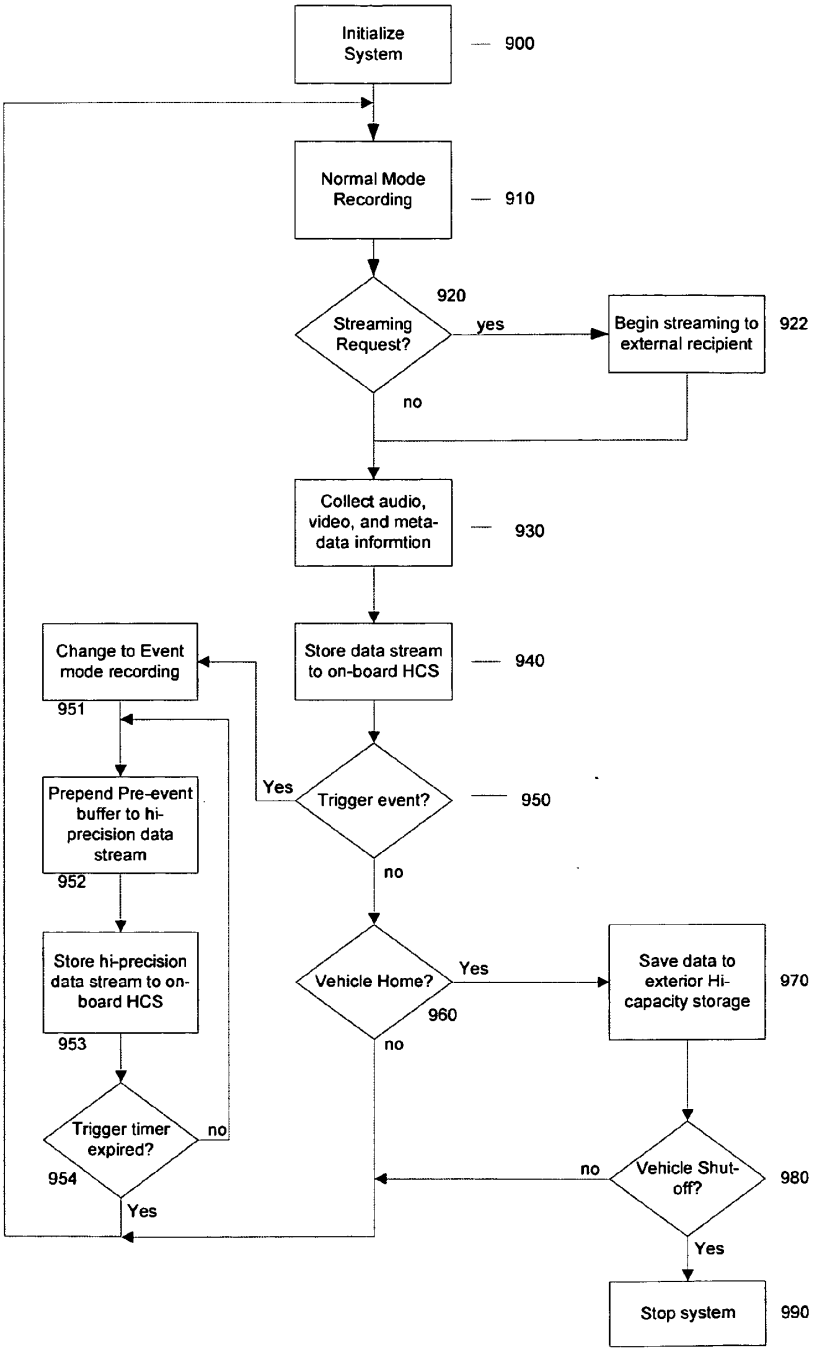


FIG 4: Control Process Flow Diagram

MOBILE DIGITAL VIDEO RECORDING SYSTEM

PRIORITY

[0001] This application claims the benefit of priority to U.S. Provisional Application 60/707,523, filed Aug. 12, 2005.

TECHNICAL FIELD

[0002] The 2nd Generation Mobile Digital Video Recorder (MDVR) is referred to as the Improved Mobile Digital Video Recorder system or TransitCAM Platform. The TransitCAM Platform consists of the MDVR and all possible components and configurations necessary to support safety and surveillance activities requiring audio, video, and transaction data of evidentiary quality. Various configurations of the TransitCAM platform will serve two primary markets, Public Safety and Transit. This document defines the Product Design Specification for the TransitCam Product developed by Integrian, Inc. The TransitCam product is focused on the Transit market—Municipal Bus, Commuter Rail/Light Rail and ParaTransit/School Bus—with a priority on the safety and surveillance needs of the Municipal Bus market.

BACKGROUND

[0003] This invention relates generally to a mobile security system for mass transit vehicles in which multiple cameras capture a plurality of images that are integrated with sound and data of interest and saved to a storage device. The cameras continuously record images from a plurality of directions and points of view that are of interest in protecting the vehicle and the occupants of the vehicle, monitoring the interior of the mass transit vehicle, and providing a video, audio, and data record of events that are preset as trigger events, such as a collision.

[0004] Installing a camera in a security vehicle such as a patrol car is known in the art. Attaching a digital video recorder to capture video, audio and text is also know as is shown in U.S. Pat. No. 6,831,556, issued to Boykin et al. However, these systems are intended to provide a record of activities that are from a single point of view, that of the operator of the patrol car, that may be used later in evidentiary proceedings. The systems in the prior art do not address multiple points of view within and surrounding vehicles composed of multiple components, such as those composing a train, or that are more that 40 feet long. Prior art systems also do not address data streams integrated together to provide a complete picture of all activities occurring within the viewing envelope, a continuous record of all imagery, sound, and data for said envelope of interest, with all of the information stored in digital media for real time and after-the-fact viewing by interested parties, such as a transit supervisor or security expert.

[0005] The Improved Mobile Video Recordation System addresses the shortcomings in the prior art with innovations that develop and hold a defensive audio and video envelope for the protection and safety of the users of a mass transit vehicle. In addition, the imagery data, including audio and other types of data, is continuously recorded to a storage device, with higher quality video automatically stored as the result of a trigger event.

[0006] The present invention is an elegant solution to the problems inherent in systems that are designed as an adjunct to law enforcement activities and not intended for the broader needs of private companies and agencies charged with providing for the safety and security of users of all types of mass transit.

SUMMARY OF THE INVENTION

[0007] The Improved Mobile Digital Video Recording (IMDVR) System was created as a means to provide for security and safety for users of all types of mass transit systems. The primary means for gathering information about the interior and immediate exterior proximity of the mass transit vehicle is through the use of from two to eight video cameras and a plurality of audio microphones per vehicle or car. The input audio and video data information from these devices is synchronized and combined with data from other input devices that gather operational, control, maintenance, analytic and telemetry data to produce an integrated information data stream. This integrated information data stream is stored in real-time to hi-capacity storage devices installed within a mass transit vehicle, and, in addition, to hi-capacity storage devices located external to the mass transit vehicle. Transfer of the integrated information stream to an external hi-capacity storage device is effected through wired or wireless communication channels.

[0008] Power is provided to the system from the vehicle power source. The power system includes a separate battery, which is used for smoothing the power profile to the IMDVR system, and emergency charger to insure continuous operation of the recording function. The power supply system also includes a software controlled voting function that decides whether to supply power to the IMDVR from the vehicle source or the battery backup based upon the instant power profile. The power supply system is responsible for adjusting input power to provide a plurality of voltage levels required by the various sub-systems within the IMDVR.

[0009] The primary mission of the IMDVR is to capture continuous video, audio, data and meta-data information from the moment the system comes online until some time after the vehicle is shut down, said time span being configurable by the user. In support of this mission, the IMDVR utilizes two modes for recording—normal mode and an event mode. Each mode records two separate integrated data streams simultaneously with one integrated data stream recoded in low-resolution and a second integrated data stream recorded in high-resolution. The definitions of low-resolution and high-resolution are user configurable and dependent upon the frame rate, bit rate, and image resolution chosen for each level of resolution, however, low-resolution is configured to result in a smaller storage file size than high-resolution.

[0010] In normal mode, the low-resolution integrated data stream is saved to the on-board high-capacity storage device in non-erasable data files, and the high-resolution integrated data stream is saved to a portion of the high-capacity storage device that has been constructed as a ring buffer with a configurable storage limit. The storage limit may be set to hold between 1 and 180 seconds of continuous recording of the high-resolution integrated data stream. At the end of the configurable storage limit, the data stored at the beginning of the buffer is overwritten with the most current data from the

integrated data stream. This process continues with the most current data overwriting the next position in the buffer such that the buffer always contains the most recent recording of the integrated data stream. This circular buffer therefore contains the most recent 1 to 180 seconds of the high-resolution integrated data stream.

[0011] Event mode is triggered by a plurality of pre-set events, such as notification by an integral rules engine that a certain speed has been exceeded, a crash has occurred, or the driver hits a panic button, for example, or multiple events such as the opening of a vehicle door when the speed is greater than zero. In event mode, the high-resolution integrated data stream is redirected from the circular buffer directly to the high-capacity storage device in place of the low-resolution integrated data stream. In addition, the circular buffer, containing the previous 1 to 180 seconds of the high-resolution integrated data stream is prepended to the data files created on the high-capacity storage device such that the data from the integrated data stream record now contains a full data record from the configurable time prior to the trigger event until the event mode times out. At which time the IMVDR system returns to normal mode recording.

[0012] The IMVDR system internal communication is supported by the MDVR data bus and the Inter-Integrated Circuit (I^2C) bus. The I^2C bus communicates with the General Purpose Input/Output (GPIO) controller and systems external to the IMDVR that provide data or control information critical to the operation of the IMDVR. These systems include sensing ignition of the mass transit vehicle, the real-time clock, a Global Positioning System (GPS) input, vehicle forward/reverse and speed sense, etc. The MDVR data bus provides communication between all other components of the IMVDR system.

[0013] The IMVDR communicates stored data files to an external high-capacity storage and retrieval server through wired or wireless communication channels. In wired mode, a user may attach an Ethernet cable to an Ethernet port integrated into the front or rear panel of the IMVDR or, optionally, retrieve the removable on-board high-capacity storage device. If an Ethernet connection is established, data files are transmitted from the on-board high-capacity storage device to the external server, which then saves the files to the high-capacity storage device on the external server. If the removable on-board high-capacity storage device is removed it is then docked with the external server and the files downloaded into the high-capacity storage device on the external server. In wireless mode, the IMDVR establishes a network communication path with an external server through the use of an integral wireless modem. Once the wireless communication path is established, data files are transmitted from the on-board high-capacity storage device to the external server, which then saves the files to the high-capacity storage device on the external server.

[0014] In addition to the input data streams from video and audio devices, the IMVDR provides standard connectors for a plurality of external systems. These connectors include DB9 and Universal Serial Bus (USB) connectors for attaching external devices to support the mission of the IMDVR. For example, these devices can include a monitor, keypad, output from intra-vehicle data sources such as the Society of Automotive Engineers (SAE) J1708 and J1939 buses, or other devices deemed necessary to the optimal operation of the IMVDR.

[0015] The invention also involves a computer server and software modules required to configure, operate, maintain, and administer the IMVDR system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. **1**: a view of the system diagram.

[0017] FIG. **2**: a view of the component diagram.

[0018] FIG. **3**: a view of the software system components.

[0019] FIG. **4**: a view of the process flow diagram

DETAILED DESCRIPTION

[0020] The functionality can be seen split between the MDVR **100** and the power supply **300** unit. There is a serial communications link between the two components for accessing and controlling the various functions. This interface is a 2-wire serial interface.

Real Time Clock Operation

[0021] The real-time clock **502** and associated battery are located in the power supply unit **300**. Access to clock functions will be over an I^2C interface **500** to the Power Supply Processor (PSP) **501**. The real time clock **502** is polled at power up to set the time for the system. The real time clock can be updated through GPS time data or Network Time Protocol (NTP) during docking. Standard functions include current time and current date. If the MDVR **100** is off, a periodic, repeatable, wake-up alarm (with configurable duration) is used to implement a "wake up and look" scheme for the WiFi interface.

Accelerometer Operation

[0022] The Accelerometer will be located in the MDVR **100** unit. It is a single 3-axis device accessed by the PSP **501** over the I^2C bus **500**. The accelerometer will measure at minimum 3G with a 0.01 G resolution.

[0023] The accelerometer can be pre-configured with a threshold. If this threshold is exceeded the PSP **501** will be notified and in turn the PSP **501** will notify the GPP **101** so that appropriate action can be taken. Polling of the accelerometer by the PSP **501** will occur at a maximum of 10 milliseconds.

GPS Operation

[0024] The GPS module **610** will be mounted externally to the power supply **300**. The electrical interface will be via the DB-15 connector located on the power supply interface board.

[0025] The GPP **101** will communicate directly with the GPS module **610**. The module will generate location messages as well as data reliability information so that an assessment of the readings can be made in software. These will include signal strength, EPE, number of satellites, etc.

[0026] The GPS **610** incorporates Dead Reckoning (DR) as not only a backup for positioning when satellites are not in view, but also as a sanity check for GPS information in urban canyon environments. To accomplish the DR function, a gyroscope will be used. The gyroscope can accurately measure inertial changes in the X and Y axis. Since the unit

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can be mounted in either the horizontal or the vertical plane, the gyroscope must also be mounted with the X and Y axis in the horizontal plane.

General Purpose Input/Output (GPIO) Operation

[0027] Twelve general purpose inputs **612** are provided to interface external trigger devices to the system. These inputs are read over the I^2C bus **500** of the PSP **501**. Through configuration, the inputs can be set for either active high or active low operation.

[0028] Three general purpose outputs are provided to control devices external to the system. Control of these devices is accomplished via on board relays. Relay contacts are rated for 24 VDC at a maximum current of 1.0 amp.

[0029] Control of outputs and notification of input triggers is accomplished by the PSP **501** and passed to and from the GPP **101** over the serial interface.

[0030] Access to the GPIO **600** is done through the terminal block connected to the DB-37 connector on the power supply.

Power Supply Operation

[0031] The power supply **300** generates all primary power used by the system. In consists of six switching power supplies, generating 9.5 VDC **308**, 3.3 VDC **306**, 1.4 VDC **305**, 1.5 VDC **307**, 5.0 VDC **304** and 12.0 VDC **303**. These power supplies are enabled/disabled by a microcontroller **501**, which is powered by its own 3.3 VDC LDO regulator. Additionally, a back up battery **301** is provided that maintains full operation of the system for 10 minutes in case the primary power to the unit is interrupted.

[0032] The microcontroller **501** not only controls the individual power supplies, but also monitors/controls GPIO **610** external to the unit. It monitors current to the cameras and fans, while also enabling/disabling them as required.

Pre-Event Buffer Operation

[0033] The Pre-Event Buffer is used only in non-event mode (Video only): in this case, two recording for the same video source (one camera per DSP) are performed, one in low-resolution (saved to High-Capacity Storage (HCS **730**)), and the other in high-resolution mode (saved into the pre-event buffer). Note that the pre-event buffer is using the HCS **730** only, and not the memory. There is one HCS file for all video frames between 2 I-Frames, e.g. if the pre-event buffer is configured to hold 30 seconds, and there is one I-frame each 30 frames (30 fps recording), there will be 30 files for each camera input using a pre-event buffer. This method allows an easy file roll-over.

HCS Cache Operation

[0034] An HCS **730** buffering scheme has been implemented in order to minimize the access to the HCS **730** and improve performance. A DSP delivers the Audio/Video (A/V) compressed frames to the core_app **800** program, which queues the frames into a FIFO (Shared Memory Queue). The av_wdisk **811** process reads the frames from the Shared Memory Queue and writes them to the HCS **730**.

[0035] Instead of writing frames directly to the HCS **730**, the frames are saved in memory, at a location where a dedicated software component can retrieve them at a later time and then save them to the HCS **730**. This process optimizes the disk access time and minimizes the time the HCS **730** is in use, saving electrical and processing power. The HCS cache is implemented as a C++ class, which accepts several parameters to determine operational limits and timing for the process. These parameters include the amount of total memory allocated for the cache, and the percentage of cache used before the data must be stored to the HCS **730**.

[0036] The HCS cache maintains statistic information that the main application can query and use for information, debugging and tuning purposes such as the maximum cache space utilization, average cache space utilization, minimum, maximum, and average cache flush time, and the average disk writing time (MB/sec).

OSD Operation

[0037] An On-Screen Display (OSD) is provided via a hardware OSD chip placed in line between the video inputs and the hardware video decoders.

[0038] The OSD inserts text into the video prior to compression. The text includes date, time, and camera name up to 12 characters. OSD information is provided on a per camera basis.

[0039] The OSD hardware chip may also be placed directly within any one of the DSP's (**210-214**), in order to minimize the number of chips required in the system.

Wireless Modem

[0040] The embedded wireless modem is 802.11 g. It is used for video and data transfer to the external system server (TVMS) during docking. The wireless modem is also used for local streaming. In this case a computer with 802.11 g capability in close proximity to the MDVR **100** can view real time video from any camera **250** within the system.

[0041] Primarily the wireless modem used is from DPAC, which has an Ethernet interface. Additionally, an 802.11 g PCMCIA card may be used.

Streaming Operation

[0042] Live and stored streaming both use the Session Description Protocol (SDP) to describe a streaming session and all media to be viewed within that session. Streaming descriptions include elements from the core SDP standard, RTP/AVP standard, MPEG4 elementary stream standards, and custom attributes defined by the streaming server. A custom library handles SDP generation and parsing. Streaming descriptions are retrieved via HTTP. The client will request the streaming description either 1) when the user initiates playback of one or more video streams, or 2) when the MDVR discovery process determines that live streaming should be started.

[0043] Live streaming uses a custom RTSP-like command set over HTTP to setup, play, pause and teardown the streaming session. Video and audio elementary stream data are transported using standard RTP packets; the MDVR **100** pushes the packets to the client(s) as live content become available.

[0044] The stored streaming process uses HTTP to transport video, audio, and data frames to an output device. The client pulls frames as needed from the MDVR **100** using custom URL queries and HTTP headers.

Streaming Server

[0045] The streaming description and control interfaces use the same HTTP server framework as device manager, allowing the streaming server to leverage the same encryption and authentication mechanisms as well. This takes advantage of database and file system access routines from the device manager in order to generate session descriptions and send back stored frame data. The streaming server implements custom handlers within the HTTP server framework for each of the required control and data requests.

File Transfer Operation

[0046] For retrieval of video and audio frames and per-frame information, docking relies on the streaming server and uses the same HTTP requests as the streaming client in order to transfer all or part of an elementary stream.

Driver Display Operation

[0047] An interface to a driver video display is provided **655**. This interface contains power, video, RS-485 communications and contact closure interfaces. A button on the driver display will allow live video viewing to be switched between any of the connected cameras. Depending on the display control interface, this can be accomplished either through the RS-485 communications link or through pulling one of the contact closure lines low.

Audio Processing

[0048] Input audio processing is handled through a stereo codec **410**. This allows up to two channels of audio input to the system. Each audio input can handle either line or microphone levels. The input level selected will be determined by the audio input on the appropriate pin on the connector. Digital audio will be passed from the codec to a DSP for MPEG4 (AAC-LC) compression.

[0049] Output audio process is also handled by the same codec **410** as the audio input. In this case, the stereo audio is summed to produce a mono audio output at line level. Audio output contains information from a streaming input from a device external to the unit. The audio output does not present live or pre-recorded audio from the MDVR **100** unit itself.

Video Processing (Recording)

[0050] When the TransitCam application **821** is running (which is normally the case after the MDVR **100** has booted), the MDVR **100** is always recording in either non-event (normal) or event mode.

[0051] Each camera is configurable for recording in low-quality, medium-quality, or high-quality video record mode. The recording modes are configured using parameters such as the frame rate per second (1 to 30), the bit rate (bits per second), and the image resolution (D1, Half-D1, VGA, SIF, etc.). In addition, each camera responds to advanced settings such as the rate control (Variable Bit Rate or Constant Bit Rate), the profile (ASP, SP, or H263), the Scene Quality (low, medium, or high), and the number of I-frames per second.

[0052] Two cameras are connected to a DSP (up to 8 cameras **200**, and 4 DSPs **210-213** are used for video recording). As mpeg-4 encoding is very CPU intensive, it is possible to encode only one of the two cameras connected to the same DSP in the highest-resolution. A video splitter is implemented to allow compression of two separate qualities for one of the cameras connected to a DSP.

Normal Mode

[0053] In this mode the high quality recording for a first camera is stored into the Pre-Event Buffer, on the hard-drive, which can hold a configurable number of seconds of A/V frames. This buffer will begin to be overwritten when the data stored in the buffer exceeds the pre-determined size.

[0054] Simultaneously, the video frames from a first camera are compressed in the Low (or medium) quality and 'permanently' stored to the HCS **730**. The video output from a second camera is also compressed in low (or medium) quality and stored onto the HCS **730**.

Event Mode

[0055] Upon detection of a pre-configured event trigger, the 'overwriting' of the pre-event buffer will stop and high quality recording for the first camera is appended and stored 'permanently' on the hard-drive. The 1 low (or medium) quality recording for the second camera continues to be stored onto the HCS **730**.

[0056] The MDVR **100** continues to operate in the current mode until the event trigger is reset and the post-event timer has expired, at which time the MDVR **100** reverts to Normal Mode.

Communication Ports Operation

Ethernet

[0057] Three Ethernet ports (**641-643**) are provided for connection to external devices. Two of the ports (**642-643**) are located on the rear of the unit. They will operate at 10/100 speed. These ports may be used for an external radio modem, mobile communications router, or for interface to a vehicle logic unit/mobile data terminal.

[0058] One Ethernet interface is provided on the front of the unit **641**. It will be capable of operating at 10/100 speed and up to Gigabit Speed (Gigabit Ethernet). This port is primarily used for video file retrieval when a wireless method of retrieval is not available or desired.

USB

[0059] Three USB 2.0 ports are provided for connection to external devices. Two of the ports **561**,**562** are located on the rear of the unit. These ports may be used for an external GPS, external radio modem, mobile communications router, or vehicle logic unit/mobile data terminal. Potentially, these ports may also be used for connection to an external mass storage device such as an external high capacity storage server.

[0060] One USB 2.0 port **563** is located on the front of the unit. This port may be used as for video file retrieval in lieu of the front panel Ethernet port.

J1708/J1939

[0061] The J1708 interface **657** serves as a general-purpose serial data communication interface. The software interface will give the host application the ability to listen to several stand alone modules attached to the serial chain. In a typical J1708 interface, the J1708 protocol serves primarily as the physical and media access functionality. SAE

J1587 provides application layer functionality. As defined in the SAE J1708 spec, the software interface will be able to interpret messages matching the 1708 defined format parameters such as the Message Identification Character (MID), data characters, and a checksum.

[0062] The software will also have the ability to handle message type defined by both SAE J1708 (MID's 0-127) and application messages defined by SAE J1587 (MID's 128-255).

[0063] The J1939 interface is also known as the Car Area Network (CAN). Newer heavy equipment vehicles may use both J1708 and J1939 as a general purpose communications interface between vehicle systems. The J1939 is intended to replace J1708 in the future. The J1939 interface differs from the J1708 in the physical interface as well as the software protocol. The MDVR **100** supports both J1708 (J1587) and J1939.

RS-232

[0064] One RS-232 only port **656** is provided on the rear of the unit. The port will be capable of speeds up to 115.2 kbps. The port will not only support data transmit and receive but also two hardware handshaking lines; request to send (RTS) and clear to send (CTS). Additionally the control line, data set ready (DSR) will be provided so that the MDVR can detect that something is connected to the port.

RS-232/RS-485

[0065] One port **655** is provided that can support either RS-232 or RS-485. The RS-232 will support only data transmit and receive; there will be no hardware handshaking support. The RS-485 will support a two wire differential connection.

Hardware Overview

Processors

[0066] The MDVR **100** unit contains three processors;

[0067] The General Purpose Processor (GPP) **101** is a Freescale MPC5200, which contains a Power PC (PPC) core and some integrated peripherals. The GPP **101** manages data between memory (HCS and DDR) and peripherals on the PCI bus (DSP, IDE, USB, etc.),

[0068] The Digital Signal Processors (DSPs **210-214**) are Texas Instruments DM642. The DSPs will be responsible for video and audio compression. They will place the compressed data on the PCI bus, where the GPP **101** directs it to the appropriate device,

[0069] The Power Supply Processor (PSP) **501** manages the individual power supplies. It will also monitor all GPIO **600** connections to devices external to the unit. The PSP **501** also monitors camera and cooling fan current as well as controlling power to each camera, fan, and heater. The PSP **501** monitors the integrated accelerometer and temperature sensing circuitry.

Peripherals and Interfaces

Accelerometer

[0070] The accelerometer will be a single device, monitoring acceleration in all three axes. The accelerometer will be located on the power supply board and monitored by the PSP **501** over the I^2C bus **500**. The accelerometer will be capable of measuring up to 3 G at 1 mG resolution.

Real-Time Clock

[0071] The Real-Time Clock (RTC **502**) is responsible for keeping time. It has a battery back up so that time is kept even when power is removed from the system. The RTC **502** can be updated periodically (once a day) via the GPS **610**, Network Time Protocol (NTP) during docking, or from time supplied by the vehicle logic unit. At startup, the RTC time information is transferred to the GPP **501** and then used to synchronize all activities of the unit (elementary stream time stamps). The RTC **502** communicates with the PSP **501** over the I^2C bus **500**.

GPIO

[0072] General Purpose Input/Output (GPIO) **610** is monitored/controlled by the PSP **501** over the I^2C bus **500**.

[0073] Twelve inputs **612** are monitored and can be configured as either active high or active low through software control at boot up. The inputs are connected to the system via the external connector block. Each input can handle 0 to 32 VDC. The switching threshold is at 3.3 VDC. Input one is configured for ignition sense, so that the system will boot up whenever the vehicle ignition is on. Inputs eleven and twelve are not only routed to the PSP **501** but also to the GPS module **610**. These inputs are used for vehicle forward/reverse sense and speed sense respectively.

[0074] Three outputs **614** are provided that are used to drive internal relays. The normally closed, common, and normally open contacts of the relays are routed to the connector block, external to the unit. Each relay is capable of handling 1 ampere of current at 32 VDC.

[0075] Both the input and the outputs are monitored even when the system is in the 'off' state, as long as vehicle power is connected to the unit. This facilitates monitoring ignition sense. This feature also facilitates unit activation in a security application by monitoring motion sensors or door contact closures if so configured through software.

GPS

[0076] A Global Positioning System (GPS) **610** receiver is provided as a customer option in the system. The GPS employs Dead Reckoning (DR), which improves position accuracy and provides constant position when the satellite signals used for GPS **610** are blocked by tunnels or urban canyons.

[0077] The GPS unit **610** is mounted external to the unit and is interfaced to the unit via the DB-15 on the power supply board. The GPS **610** uses two signals from the vehicle; forward/reverse sense and speed pulses (both from the transmission). A gyroscope is used in the GPS unit **610** to detect change of direction. The gyroscope must always be mounted upright; therefore the GPS unit **610** can be mounted either vertically or horizontally depending upon the desired orientation within the mass transit vehicle.

[0078] Power for the GPS module **610** comes from the unit power supply **300**. Communications with the system is handled over a serial interface to the GPP **501**.

Power Supply

[0079] Power is provided to the system from the vehicle power source. The power system includes a separate battery **301**, which is used for smoothing the power profile to the IMDVR system (FIG. **1**), and emergency charger to insure continuous operation of the recording function. The power supply system **300** also includes a software controlled voting function that decides whether to supply power to the IMDVR **100** from the vehicle source or the battery backup based upon the instant power profile. The power supply system is responsible for adjusting input power to provide voltage levels of 12V **303**, 9.5V **308**, 5V **304**, 3.3V **306**, 1.5V **307** and 1.4V **305** as required by the various subsystems within the IMDVR **100**.

MDVR

[0080] The Mobile Digital Video Recorder (MDVR) **100** is provided as the central record and storage engine within the system. The MDVR **100** includes a microprocessor for inter-process communication and control of all components connected to a primary information bus **101**, which includes all of the following components. The MDVR **100** comprises up to eight cameras **200** strategically mounted in locations to observe interior and exterior scenes of activity in and around the mass transit vehicle. The MDVR **100** also comprises an input for each camera into a video codec **220**, a multiplexer for joining video input and transferring to Digital Signal Processors (DSPs **210-214**). Each DSP receives input from two cameras. The MDVR **100** includes two audio inputs and an audio codec for integrating audio data into the stored information stream. The MDVR **100** also comprises inputs from exterior data sources including a monitor output, keyboard input **655**, input from serial ports supporting third party data sources such as the SAE J1708 and J1939 vehicle area network inputs **657** for recording data and meta-data comprising vehicle performance data, communication connections for external communications such as Ethernet **642-643**, Gigabit Ethernet **641**, wireless connectivity through a wireless modem antenna **651**, Universal Serial Bus (USB) connections to external equipment control panels **561-563**, and Diagnostic LEDs. The MDVR **100** comprises connections to on-board high-capacity storage devices **730**, and heating **680** and cooling devices to provide for retaining operating temperatures for the storage devices within environmental operational limits. The MDVR **100** is tied together operationally through two high-speed, high-capacity communication buses to provide inter-process communication under GPP **501** control throughout the system.

OSD Module

[0081] On-Screen Display (OSD) is accomplished with a hardware OSD chip. OSD is only in-line with the recorded input. The chip is capable of integrating OSD information on eight inputs. A two-way multiplexer is used to switch between real-time video and OSD on a frame by frame basis, recording OSD video information on one-half of the frames. The OSD chip is controlled by the GPP.

[0082] Additionally, the OSD hardware can be replaced with a DSP algorithm that will add OSD to every recorded frame.

Wireless Modem

[0083] An internal 802.11 wireless modem **650** is provided in the system. This modem is connected to an internal Ethernet port on the GPP **651**. This modem is the primary means of transferring recorded video, audio, data, and meta-data. Additionally, this modem can be used for video streaming as long as another 802.11 device is in range. The 802.11 **650** can make connections via infrastructure or ad hoc on an as needed basis.

[0084] External wireless modems are also supported. These modems communicate over the cellular network. They are primarily used for streaming low resolution (low frame rate) video to a central point. Connection to the wireless cellular modems may be accomplished over USB **563**, Ethernet **642**, or RS-232 **658**.

Ethernet Module

[0085] Ethernet support is part of the integrated peripherals of the GPP **101**. The Ethernet functionality goes through an Ethernet switch **110** that provides four ports. Two ports go to RJ-45 connectors on the rear of the unit **642-643**. One port is reserved for an 802.11 internal wireless module **651**. The last port is a spare, but routed to the front panel board connector as a backup to the Gigabit Ethernet **641**.

[0086] Gigabit Ethernet **641** support is provided by an Ethernet chip on the PCI bus. This port is routed to the front panel board connector for connection to the front panel RJ-45 connector.

USB Module

[0087] Universal Serial Bus (USB) support is accomplished by a USB 2.0 host controller on the PCI bus. This controller supports three USB ports: two on the rear of the unit **561-562** and one on the front of the unit **563**.

High Capacity Storage Device (HCS)

[0088] The MDVR **100** supports a plurality of High Capacity Storage Devices **730** including up to four 2.5 inch Hard Disk Drives, or high-capacity flash memory. The HDDs are mounted such that two drives are serviced by one connector on the main board. The HDD are controlled via a HDD IDE controller connected to the PCI bus. The high-capacity flash memory is connected to the PCI bus and controlled by the MPC 5200 through PCI device controls.

Audio Codec

[0089] The audio codec **410** processes both input and output audio to/from the system. Setup for the audio codec is accomplished over the I^2C bus **500** connected to the servicing DSP **210-214**. Audio input and output are stereo line level. Audio inputs at microphone level require filtering and amplification to line level for proper operation. The audio output left and right stereo channels are summed together to provide a monaural output.

Video Multiplexers

[0090] There are three 8:1 video multiplexers **225** used in the system. One multiplexer routes analog video to the live video monitor for real time viewing of video from the selected camera. The other two multiplexers route analog video to the two video decoders used for streaming.

Video Decoders

[0091] Ten video decoders are used in the system. One of the video decoders (eight total) is associated with each camera. Two additional video decoders are used for stream-

ing. Each of these decoders is connected to the cameras through an 8:1 multiplexer. Two video decoders feed each DSP.

HDD Heaters

[0092] HDDs used in the system are capable of operating between −20° C. and 85° C. The low temperature specification for the system is −30° C. At boot-up, heaters **680** are used to raise the temperature of the HDD from below −20° C. to −20° C. at a rate of 1° C. per minute to achieve the proper temperature operation profile. The heaters have an integrated thermistor.

Software Processes

TransitCam Application

[0093] The transitcam process **821** starts, stops, and monitors all processes of the TransitCam application. Monitoring the processes consists of polling the system to check if all applications are running. If not, the missing process will be restarted, and the incident will be logged. The transitcam process **821** also monitors how much the CPU is used by the processes, and will adjust the priority of an 'offending' process if it consumes too much of the CPU. For instance, recording the A/V files onto the HCS should run at higher priority than the HTML server (configuration). If after adjusting the priority of the process, it is still using 100% of CPU for a 'long' period of time (more than 20 seconds), the process will be stopped, then restarted.

Shared Memory

[0094] Shared memory **840** is a first in, first out (FIFO) queue. This queue provides temporary storage of A/V frame for distribution to other applications. The size of this queue is approximately 4 MB, which will allow enough time for the programs reading this FIFO to handle the frames (saving to the HCS, streaming, etc.).

Logger Daemon

[0095] The application logger daemon (loggd) **820** logs events sent by the application processes. The communication between the loggd process **820** and all other application processes is done through shared memory **840**.

[0096] Depending of the type of the log (system or application), the log will be saved either into a daily text file (system level log), or into a database (application level log):

IPC Daemon

[0097] IPC Daemon **810** handles the communication between the GPP **101** and the PSP **501**. It runs as a separate process on the GPP **101**, and is loaded at a very early stage during system initialization so that some primitive diagnostics are performed on the PSP **501** even before the main application starts.

Core Application

[0098] The core application (core_app) **800** is the main application process. It is primarily responsible for controlling and handling the recording of the A/V streams and provides the A/V compressed frames to the other processes that need them. This application is the only process that interfaces with the DSP **210-214** (configure and control). The core application **800** also handles the alarms. The core application **800** is responsible for changing the format of the A/V files, which are recorded according to the state of the system (event mode or non-event mode).

[0099] The core application **800** stores the compressed A/V frames into Shared Memory, which enables one writer process (core_app program **800**) and several reader processes (streaming, av_wdisk **811**).

Rules Management Process

[0100] The rules management process (rules_mgt **812**) receives input data from various sources (I/O, etc.) and applies a set a configurable rules to determine the status of the system (mainly alarm or non-alarm mode). This information is then be forwarded to the other processes. The rules management process also initiates the generation and collection of meta-data that is incorporated into the integrated data stream and stored in the HCS.

A/V Recording Process

[0101] The A/V files recording process (av_wdisk **811**) is responsible for writing the integrated data stream onto the hard-disk. It gets the frames from the core application via shared memory.

[0102] In event mode, this process writes the A/V frames onto the HCS **730** from the pre-event buffer.

[0103] If the HCS **730** is not available, this process will allow the MDVR **100** to continue recording, but will not save the integrated data stream files until the hard-drive will become available. When the HCS **730** becomes available again, this process will allow the MDVR **100** to start writing the integrated data stream files onto the HCS **730**.

Streaming Server

[0104] The streaming server (streaming **822**) is responsible to stream out the A/V streams to the streaming client. It gets the A/V frames from the core application via shared memory.

Device Manager

[0105] The Device Manager (devmgr **813**) is responsible for the Server to MDVR **100** interaction. It also handles the system configuration through the HTML interface.

Time Zone

[0106] All events time stamped within the MDVR **100** (A/V frames, log events, etc.) are using UTC time, and not local time. An environment variable is used by the System to change the way the time is locally interpreted.

GPS

[0107] The GPS interface **610** communicates with the TransitCam platform via NMEA defined messages. In several different NMEA messages, UTC time is available. These messages include the following:

[0108] BWC—Bearing and Distance to Waypoint

[0109] GGA—Global Positioning System Fix Data

[0110] GGL—Geographic Position, Latitude and Longitude

[0111] RMC—Recommended minimum specific GPS/Transit data

[0112] From the UTC time fix in any of these messages, and the time zone setting of the system, time sync can be achieved.

RTC

[0113] The Real Time Clock (RTC) **502** is a battery-backed clock that is external to the PSP **501**, communication between the two occurs via I^2C **500**. Upon boot up of the MDVR system **100**, the PSP **501** receives the current value of the RTC **502**. The PSP **501** passes the time information to the GPP **101**. RTC **502** data is supplied to the GPP **101** on a periodic basis and when requested. The RTC **502** is calibrated with the GPS **610** or with network connection during configuration/upload. The RTC **502** data is very accurate and has a difference of +1 second.

MDVR Discovery

[0114] The MDVR **101** and other system level devices that intend to discover it use Zero Configuration Protocols (Zero-conf) to support addressing, naming and service discovery. When an MDVR **101** joins a network or its discovery information (including status) changes, it will push the updated information to all listening clients, who can choose to take further action depending on the information received. A new client who joins the network can query the network for all attached MDVRs **101** and receive their discovery information back immediately.

Link Local IP Addressing (IPv4LL)

[0115] In the absence of a DHCP server or static address configuration, an MDVR **101** assigns itself a random IPv4 address in the 169.254/16 subnet. It is then able to communicate with existing operating systems (including Windows) that already implement this feature, allowing ad hoc local networks to be formed effortlessly.

Multicast DNS

[0116] Multicast DNS (mDNS) provides a mechanism for naming and service discovery on a local link where a DNS server may not be present. DNS queries and responses are instead sent to a locally-scoped multicast address (224.0.0.251, port 5353). It can be used whether an MDVR is configured with any of a link local, dynamic or static IP address. Every MDVR assigns itself a unique name in the .local domain based on its serial number. Each advertises its own A and PTR DNS records for forward and reverse lookups, respectively, as well as service discovery records described below.

DNS Service Discovery

[0117] Each MDVR **101** registers PTR records for service types it offers (such as _mdvr_tcp) and SRV records (such as MdvrId._mdvr._tcp) giving the address and port of the service. TXT records provide additional parameters for each service, such as the URL path to access the service or status flags so a client can determine if the MDVR needs attention.

Inputs/Rules/Events

Input Definition

[0118] Inputs are values read from peripherals, including among other things the data from GPS **610**, the messages received from the J1708/J1939 bus **657**, and the values read from the GPIO lines **612**.

[0119] Each of the GPIO lines can be configured to have different meaning (e.g., ignition sense, door open . . . etc.)

Rule Definition

[0120] A rule is an input plus an operator plus a value. Some examples may be "Door open ==true", "Speed>=65".

Event Definition

[0121] An event is one or more rules logically ANDed together, and can be associated with zero or more actions. When all of the rules are satisfied for an event, the event is said to be "triggered". When an event is triggered, a log entry corresponding to that particular event will be logged. In addition, the actions (if any) associated with the event will be carried out. Some event examples may be "(Panic button pressed ==true)=>Start high-res recording (on pre-configured cameras)", "(Door open ==true) AND (Speed>=10)=>Notify the control center".

High-Quality Recording

[0122] One possible action for a triggering event is to start recording in high-quality mode. If this action is enabled, when the specific event triggers, the pre-configured cameras will switch to high-quality recording mode. A timeout period will be associated with each event (if high-quality recording is enabled) to resume normal recording mode after the timer has expired.

[0123] In the case of overlapping triggers (i.e., multiple triggering events whose actions result in the same camera going into high-quality recording mode), the normal recording mode will not resume until the last timer of the group of triggering events has expired.

Trigger Notification

[0124] Another possible action for a triggering event is to notify the control center. If this action is enabled when the specific event triggers a notification will be sent through an internal communication mechanism to a predefined host.

Rule Engine

[0125] The Rules Engine **812** is a separate program that uses the Input Definition and Rules Definition to generate the Triggers, according to the Triggers Definition. Each time a new I/O event is received, the rules are then checked to determine if there is a need to generate a trigger.

[0126] The Rules Engine program **812** is a high-priority process, designed with optimizations and performance in mind. For instance, for performance reasons, the Rules Engine **812** is using a local copy in memory of the Database tables involved.

[0127] The Rules Engine program **812** receives input information from the ipcd **810** program, applies rules to computer the Triggers state, and sends the Trigger state to a pre-defined set of programs within the system. The pre-defined programs are the main program (core_app **800**), the streaming program (streaming **822**), and the Device Manager (devmgr **813**).

Audio/Video Analytics

[0128] The collection and storage of audio, video, and meta-data provides opportunities for the IMDVR to provide a number of functions as a result of analyzing the stored data stream in conjunction with the rules engine to search for

specific activities and provide indicators when such activities have occurred. Activities that can be recognized and reported upon include:

[0129] Automatic License Plate Recognition

[0130] Recognizing a Man Down

[0131] Weapons Brandishing/Violent Motion

[0132] Gun Shot Detection

[0133] Multi-Camera Rendering

[0134] People Counting

[0135] Slip and Fall

[0136] Motion/Pattern Recognition and Tracking

[0137] Unique face Extraction

[0138] Motion Stabilization/Frame Averaging

[0139] Noise Cancellation

Recording

Normal Mode

[0140] In this mode the High Quality recording for the Camera **1** is stored into the Pre-Event Buffer (on the pre-event section of the HCS), which can hold a configurable number of seconds of integrated data stream frames. Only the Low Quality recording for a first camera and a second camera stored onto the Hard-Drive.

Event Mode

[0141] In this mode the High Quality recording for camera one is stored on the hard-drive, along with the Low Quality recording for camera **2**. The Low Quality recording for the first camera is thrown away.

Pre-Event Buffer

[0142] The Pre-Event Buffer is used only in non-event mode (Video only): in this case, two recordings for the same video source (one camera per DSP) are performed: one in low-quality (saved to the HCS), and the other in high-quality (saved into the pre-event buffer). Note that the pre-event buffer is using the HCS only, and not the memory. There is one HCS file for all video frames between 2 I-Frames, e.g. if the pre-event buffer is configured to hold 30 seconds, the record speed is set to 30 frames per second, and there is one I-frame each 30 frames, there will be 30 files for each camera input using a pre-event buffer. This method allows an easy file roll-over.

[0143] When an event occurs, which triggers Hi-Quality recording, the video output from the Hi-Quality camera is now saved to the HCS **730** and the pre-event buffer is prepended to the camera output to provide a configurable (from 1 to 180) number of seconds of Hi-Quality data recorded prior to the trigger event

HCS Buffering

[0144] In order to minimize the access to the HCS **730** and improve performance, a Hard-Drive buffering scheme is implemented. The following is the flow of the A/V frames, from a DSP to the HCS **730**:

[0145] The DSP delivers the A/V compressed frames to the core_app **800** program

[0146] The A/V frames are queued into a FIFO (Shared Memory Queue **840**)

[0147] The process av_wdisk **811** reads the frames from the FIFO (Shared memory Queue **840**) and writes them to the HCS **730**.

A/V Files Format

[0148] The A/V files are split into two files:

[0149] The Elementary Stream (ES), which is Audio or Video

[0150] The Frame Information.

[0151] The ES file is a MPEG-4 Video or Audio file.

[0152] The Frame Information file is a binary file, with a proprietary format, that provides:

[0153] Frame Type (I-frame,P-frame, B-frame): one byte

[0154] Offset into the ES file: 4 bytes

[0155] The A/V files are stored into a sub-directory. The group of files (A/V ES files, A/V frame information files) is called batch files. To keep files with a reasonable size, a new batch file is created each 15 minutes (this is a system value configurable in the database). A new batch file is also created when the system switch from non-event mode to event mode, or from event mode to non-event mode, whether the trigger is configured or not to generate Hi-quality recording.

[0156] The integrated data stream files are stored in an off-vehicle storage system and follow the long term retention and review policies of each client.

Data Retrieval

Streaming

[0157] Live and stored streaming both use the Session Description Protocol (SDP) to describe a streaming session and all media to be viewed within that session. Streaming descriptions include elements from the core SDP standard, RTP/AVP standard, MPEG4 elementary stream standards, and custom attributes defined by the streaming server. A custom library handles SDP generation and parsing. Streaming descriptions are retrieved via HTTP. The client will request the streaming description either 1) when the user initiates playback of one or more video streams, or 2) when the MDVR discovery process determines that live streaming should be started.

[0158] Live streaming uses a custom RTSP-like command set over HTTP to setup, play, pause and teardown the streaming session. Video and audio elementary stream data are transported using standard RTP packets and the MDVR **100** pushes the packets to the client(s) as live content becomes available.

[0159] Stored streaming uses HTTP to transport video and audio frames. The client pulls frames as needed from the MDVR **100** using custom URL queries and HTTP headers.

Streaming Server

[0160] The streaming description and control interfaces use the same HTTP server framework as device manager, allowing the streaming server to leverage the same encryption and authentication mechanisms as well. It takes advan-

tage of database and file system access routines from device manager in order to generate session descriptions and send back stored frame data. The streaming server implements custom handlers within the HTTP server framework for each of the required control and data requests. The live streaming transport **822** runs as a separate task that receives recently encoded video and audio frames from the DSP task. Based on the status of client connections, this task packages relevant frame data into RTP packets and sends those packets out to waiting clients. A custom library handles packaging and sending RTP packets.

Docking

[**0161**] The HCS **730** located within the mass transit vehicle will require downloading when it is full. One method for retrieving the integrated data stream files from the HCS **730** and freeing the storage on the HCS **730** for further use is known as 'docking'. Docking the HCS **730** is to physically remove the HCS **730** from its cradle within the mass transit vehicle and place the HCS into a similar cradle attached to an off-vehicle storage server. The server then retrieves all of the stored data from the HCS by downloading it into the off-vehicle storage.

[**0162**] For retrieval of video and audio frames and per-frame information to an off-vehicle storage server, docking relies on the streaming server and uses the same HTTP requests as the streaming client in order to transfer all or part of an elementary stream.

J1708/J1939

[**0163**] The J1708/J1939 serves as a general-purpose serial data communication interface for vehicle telemetry. The software interface will give the host application the ability to listen to several stand alone modules attached to the serial chain. In a typical J1708 interface, the J1708 protocol serves primarily as the physical and media access functionality. SAE J1587 provides application layer functionality. As defined in the SAE J1708 spec, the software interface will be able to interpret messages matching the 1708 defined format listed below:

J1708 Message

[**0164**] Message Identification Character (MID)

[**0165**] Data Characters

[**0166**] Checksum

[**0167**] The software will also have the ability to handle message type defined by both SAE J1708 (MID's 0-127) and application messages defined by SAE J1587 (MID's 128-255).

AVL

[**0168**] AVL stands for Automatic Vehicle Location which is a term used for naming a system able to track vehicles, vessels, and mobile assets such as trailers, containers, and equipment, plot their coordinates into one or more computer generated maps and be able to interact with them in several ways. The TransitCam platform will have an AVL interface available to it as a customer option. The AVL interface will attach to the TransitCam via one of the available interfaces; Ethernet, J1708, USB, RS-232 or RS 485.

Log/Audit/Alert

There are three kinds of log information:

[**0169**] System log:

[**0170**] The System Log collects log information from the kernel and various system applications and is useful to troubleshoot any system related issue. This log file is stored onto the hard-drive in a text file format. As many as the last seven days of system log are saved based upon the desired level of data to be saved, which is configurable by the user from one to seven days.

[**0171**] Application Debug Log:

[**0172**] This log collects logging information from the TransitCAM application **821** and only intended for the development team to troubleshoot any issue. This log file is saved with the System log file.

[**0173**] Application Log

[**0174**] The Application Log collects log information from the TransitCAM application **821**. This log file is stored on the HCS **730**, in a SQLite database format. Different types of information are logged:

[**0175**] Error and unexpected events

[**0176**] Events triggering an alarm

[**0177**] All Operations such as:

[**0178**] Configurations Changes

[**0179**] Playback (streaming) Audit

[**0180**] Docking Audit

[**0181**] A/V files export

[**0182**] If the HCS **730** is not available, no logging information is then saved, until the HCS **730** becomes available. But 128 K of memory is used to buffer (FIFO) the log messages and this buffer will be flushed to the HCS **730** when it becomes available.

Diagnostics

[**0183**] The diagnostics utility has a broad overall description and purpose. In the very basic sense, one could run diagnostics to simply give information on the current state of some piece of architecture. In this case, however, the diagnostics package is expanded to include utilities for manufacturing tests, in-service tests and initial power-on tests.

[**0184**] The diagnostics description is divided into two major sections. The first describes differences between different levels of diagnostics, and their implications and dependencies to the system. The second lists the various targets of the diagnostics utility.

Test Levels

Manufacturing Diagnostics

[**0185**] Manufacturing tests are by far the most destructive tests to a usable environment. This is not to say that a device will be left completely unusable. Instead, it should be specifically noted that the end user should not expect a system to keep any personalization if this level of tests are performed. The manufacturing tests should restore a usable system to a default state. This includes initial HCS **730** configuration and initial image loading into flash.

Local/Off-Line Diagnostics

[0186] This level has the opportunity to be destructive, as the test implies that a unit has been returned by an end customer because of some sort of problem. In that sense, the end user cannot be guaranteed that user specifications will be saved. Therefore, these tests may not be as destructive as Manufacturing tests, but there is no guarantee that there will not be significant changes.

Remote/Off-Line Diagnostics

[0187] For any remote tests, it is assumed that the end user personalization will not be changed. However, this test set is in general a superset of remote on-line diagnostics. This means that while user data will not be lost, a user would have a more-complete test if they return their system to a very basic state. For example, if a user needs to run HCS tests, then it is recommended the user remove any saved data streams. This will allow for more areas of the disk to be tested, extending the test coverage.

Remote/On-Line Diagnostics

[0188] This level is a set of tests that are kept very short, in order to look for basic system state while the device is in use. This level, along with POST, is run in the background to look for errors in the system. These tests are not destructive, and the user should not be concerned with configuring their device in any specific way.

Power-On Self Test

[0189] In general, the Power-On Self Test (POST) is written to be a very short and basic test of the system each time the system is initialized. The end user will most likely always prefer a system that starts as fast as possible to avoid needless delays.

Power On Self Test (POST)

[0190] The main idea behind POST is to provide a working system to the main operating system. This is analogous to the BIOS test in a PC. Each step in the POST has a different path to take based on the result of the test. The details for each test are given in this section.

Configuration

[0191] POST must be configurable with three test options are available: No-Test, Quick-Test and Full-Test. The No-Test option tests ONLY the communication between the PSP **501** and GPP **101**, as this must be verified on each power-on to ensure the very basic communication path between the two boards. The Quick-Test performs a limited test of each of the applicable components of the boards. The Full-Test is a superset of the Quick-Test, in that some components will be tested exactly the same for both tests, but will also include a higher grade of test for other components.

[0192] Each of the test images has responsibilities to complete certain portions of POST. This is due to the requirements of each image.

FPGA Unit

[0193] The Field Programmable Gate Array (FPGA) unit is used within the system to provide maintenance and elemental level of control for devices within the TransitCAM system. The FPGA is connected to the primary data bus and interfaces with the primary processor to issue commands for device control, such as switching views between cameras, synchronization of timing for integration of audio, video, and data streams, and providing ad hoc maintenance access for technical and maintenance crews. This unit is field programmable and field upgradable and may be used to monitor and modify primary level commands within the TransitCAM system.

Interface with Device Manager/Core Application

[0194] The diagnostics application is responsible for running tests, logging results and updating the database with those results.

[0195] The Device Manager (DM) will write to the database and instruct the Core Application to rescan the database to start a specific diagnostic. The DM will monitor the database for status and results (as given by the diagnostics application).

[0196] The Core Application **800** sends a command to the diagnostics application to start a specific test.

[0197] It is assumed that when a user wishes to run a diagnostic, the DM disables critical operations that could possibly invalidate a diagnostic, or which a diagnostic could corrupt data that would otherwise be considered valid.

Flash Database

[0198] As a means of communicating between the diagnostics utility and the DM, a common flash interface is used. The DM tells the core application to rescan a certain section of the database when specific operations are desired. As an extension, when a user wishes to run a specific diagnostic, they select an operation in the DM, which then changes a database value. The core application **800** then reads the database, and sends a command to the diagnostics daemon. This daemon is then responsible for either running the test, or sending a message to the PSP **501**.

External Control Description

[0199] A single external control is required. This control should be a push button located on the front panel. The push button will be used to notify the system that a device plugged into the front panel USB port is about to be removed. The system will gracefully close any connection to the front panel USB port.

External Indicator Description

[0200] Four external bi-color LEDs will be provided on the front panel. These LEDs are capable of displaying three colors: Red, Green, and Yellow (Red+Green). The following sections describe the meaning and indication of each LED.

LED#1, Self-Tests

We claim:

1. A mobile, ruggedized, high-resolution, high-capacity, multicamera digital video and audio recording and storage system comprising:

a high-resolution digital video recorder ruggedized for installation within a mobile, mass transit vehicle;

a plurality of high-resolution cameras installed on and within said mass transit vehicle and separably connected to said digital video recorder through wired means, said cameras aimable to capture video infor-

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mation data within said mass transit vehicle and video information data of exterior views in proximity of said mass transit vehicle;

a high-resolution display for displaying imagery of views composed from video information data within and of the exterior proximity of said mass transit vehicle, wherein said imagery is provided as input to said displays from said digital video recorder;

a plurality of high quality microphones connected to said digital video recorder and capturing audio data, wherein said audio data is converted to digital format and synchronized with said imagery data;

means for integrating captured audio, video and meta-data information into one data stream;

at least one high-capacity storage device for storage of all captured video, audio and input data and including meta-data wherein said meta-data comprises at least analytic and telemetry data;

an information bus electrically interconnecting each of the components of the system one with another wherein interprocess communication and data transfer to and from each component of the system occurs through the electrical connections maintained by said information bus;

a power supply module electrically connected to the power supply system of said mass transit vehicle and containing a separate battery wherein said power supply module is configured to transform vehicle power into a plurality of power levels and said battery is configured to maintain a smooth power profile necessary for proper operation of said mobile digital video system;

a general purpose input and output interface and control module;

user controls and a user interface display;

means for processing video image data and video information data for storage and transmission over wired or wireless communication channels;

a plurality of interface connection access points for a plurality of separably attachable external and internal standardized components and information bus connections, wherein said standardized components and information bus connections are supplied by third-party vendors;

a microprocessor-based server comprising software modules for at least the archiving of said audio, video, data and meta-data to a storage device within or outside of said mass transit vehicle and controlling the transfer of said data over wired or wireless communications channels;

said microprocessor-based server also comprising a software module for executing rules from a rules engine wherein said rules comprise rules for monitoring system operational parameters, performing system administration tasks, and providing system alert settings and alert indicators;

and said microprocessor-based server comprising at least a software module for processing audio and video data as said data is collected in real-time, a software module configured to transfer said data within or exterior to said mass transit vehicle, and a software module configured to stream said collected data in real-time to a display located within or exterior to said mass transit vehicle.

2. The digital video and audio recording and storage system according to claim 1, wherein the system is ruggedized to meet the environmental requirements recited in the Society of Automotive Engineers (SAE) standard J1455 or equivalent.

3. The digital video and audio recording and storage system according to claim 1, further comprising at least two, and as many as eight, RJ45 camera input connections.

4. The digital video and audio recording and storage system according to claim 1, further comprising at least two, and as many as eight, high-resolution cameras.

5. The digital video and audio recording and storage system according to claim 1, further comprising at least one 8:1 video multiplexer.

6. The digital video and audio recording and storage system according to claim 5, further comprising a first video multiplexer to route analog video data to an operating analog video monitor display, and at least two additional video multiplexers to route analog video data to a plurality of video decoders.

7. The digital video and audio recording and storage system according to claim 6, further comprising a plurality of video decoders wherein each video decoder receives video input from one of said video multiplexers and each of the video decoders is associated with either a camera or a streaming video data output channel.

8. The digital video and audio recording and storage system according to claim 7, wherein said means for processing video image data and video information data further comprises a plurality of Digital Signal Processors (DSPs) wherein each DSP receives the video image data and video information data output from two video decoders.

9. The digital video and audio recording and storage system according to claim 1, further comprising an audio codec with a plurality of input connections for said microphones and a plurality of audio output connections wherein said output connections include at least an external audio channel and an audio data connection to any one of a plurality of DSPs through any of said video multiplexers.

10. The digital video and audio recording and storage system according to claim 9, further comprising synchronizing said audio data with said video data.

11. The digital video and audio recording and storage system according to claim 1, further comprising a high-capacity storage device wherein the storage device is at least one of a hard disk drive or high-capacity flash memory.

12. The digital video and audio recording and storage system according to claim 11, further comprising means for integrating audio, video, data and meta-data information into a single integrated data construct wherein said construct is stored in said high-capacity storage device.

13. The digital video and audio recording and storage system according to claim 1, further comprising power supply output levels of at least 1.4V, **1.5**V, 3.3V, 5V, 9.5V and 12V.

14. The digital video and audio recording and storage system according to claim 1, further comprising system

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connections for externally provided devices that comprise any of a keypad, a wireless modem, an analog monitor, or an LCD display.

15. The digital video and audio recording and storage system according to claim 1, further comprising a plurality of interface connection access points that comprise any of Universal Serial Bus (USB) connectors, SMA connectors, 10/100 Ethernet connectors, Giga-bit Ethernet connectors, DB-15 connectors, and DB9 connectors, wherein said connectors provide for electrical connectivity between external devices and said digital video and audio recording and storage system.

16. A digital video and audio recording and storage process for installation in a mobile platform comprising the steps of:

collecting audio, video, data and meta-data information;

executing rules from a rules engine to monitor system operational parameters,

perform system administration tasks, and record system alert indicators;

transforming audio, video, data and meta-data into digital format;

combining said transformed audio, video, data and meta-data into a single, integrated data stream;

storing said integrated data stream in a high-capacity digital data storage construct;

communicating said integrated data stream to a computer server over wired or wireless communication means;

wherein said integrated data stream is continuously recorded and stored from the moment said process is initialized and wherein said integrated data stream is indexed for later retrieval and use in security and surveillance activities.

17. A digital video and audio recording and storage process according to claim 16, the collecting process step further comprising:

means for collecting data including system status, maintenance data, operations data, alert data and indicator data;

means for collecting meta-data comprising analytic, telemetry, and function control data.

18. A digital video and audio recording and storage process according to claim 16, the executing rules step further comprising:

means for executing rules to create meta-data associated with analytic measurements from system operation, administration, and alert rules processing.

19. A digital video and audio recording and storage process according to claim 16, the transforming step further comprising:

means for transforming audio data from an analog input format into digital audio format by processing through an audio codec;

means for transforming video data from an analog input format into digital video format by processing through a DSP,

and means for transforming meta-data into digital format wherein such meta-data is not already in digital format.

20. A digital video and audio recording and storage process according to claim 16, the recording step further comprising means for recording and storing said integrated data stream in a normal mode and an event mode wherein data storage files produced during normal mode recording and storage are smaller in size than data storage files produced during event mode recording and storage.

21. A digital video and audio recording and storage process according to claim 20, wherein said normal recording mode is the standard means for recording said integrated data stream during ongoing system operation.

22. A digital video and audio recording and storage process according to claim 20, comprising means for recording said integrated data stream in event mode as a result of a trigger event.

23. A digital video and audio recording and storage process according to claim 22, comprising means for continuing event mode recording until event mode is terminated as a result of reaching the end of a pre-set event trigger time period.

24. A digital video and audio recording and storage process according to claim 23, wherein said pre-set event trigger time period is configurable.

25. A digital video and audio recording and storage process according to claim 16, said communicating step further comprising:

means for streaming a live or stored integrated data stream to an external user over wired or wireless communication means.

26. A digital video and audio recording and storage process according to claim 25, the live streaming further comprising a set of function commands to setup, play, pause, and teardown the streaming session.

27. A digital video and audio recording and storage process according to claim 25, the stored streaming further comprising a set of function commands to retrieve and buffer stored video data wherein said function commands operate to provide a smooth display of said stored video data.

28. A computer program product embodied in a computer readable medium for enabling a computer server to manage video, audio, data and meta-data recording and storage within and from a mobile platform comprising:

a program module for collecting audio, video, data and meta-data information;

a program module for executing rules from a rules engine to monitor system operational parameters, perform system administration tasks, and record system alert indicators;

a program module for transforming audio, video, data and meta-data into digital format;

a program module for combining said transformed audio, video, data and meta-data into a single, integrated data stream;

a program module for storing said integrated data stream in a high-capacity digital data storage construct;

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a program module for communicating said integrated data stream to a computer server over wired or wireless communication means;

a program module for indexing said stored integrated data stream for retrieval;

wherein said software modules are operable to continuously record and store said integrated data stream from the moment said process is initialized.

* * * * *

Appendix SS

US006614408B1

(12) **United States Patent**
Mann

(10) **Patent No.: US 6,614,408 B1**
(45) **Date of Patent: Sep. 2, 2003**

(54) **EYE-TAP FOR ELECTRONIC NEWSGATHERING, DOCUMENTARY VIDEO, PHOTOJOURNALISM, AND PERSONAL SAFETY**

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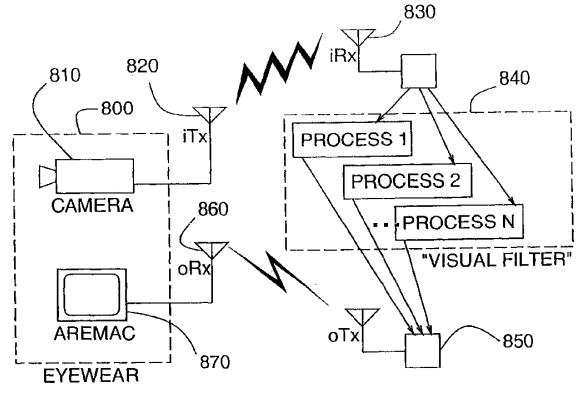
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Primary Examiner—Vijay Shankar

(57) **ABSTRACT**

A novel system for a new kind of electronic news gathering and videography is described. In particular, a camera that captures light passing through the center of a lens of an eye of the user is described. Such an electronic newsgathering system allows the eye itself to, in effect, function as a camera. In wearable embodiments of the invention, a journalist wearing the apparatus becomes, after adaptation, an entity that seeks, without conscious thought or effort, an optimal point of vantage and camera orientation. Moreover, the journalist can easily become part of a human intelligence network, and draw upon the intellectual resources and technical photographic skills of a large community. Because of the journalist's ability to constantly see the world through the apparatus of the invention, which may also function as an image enhancement device, the apparatus behaves as a true extension of the journalist's mind and body, giving rise to a new genre of documentary video. In this way, it functions as a seamless communications medium that uses a reality-based user-interface.

43 Claims, 19 Drawing Sheets



SYSTEM ARCHITECTURE

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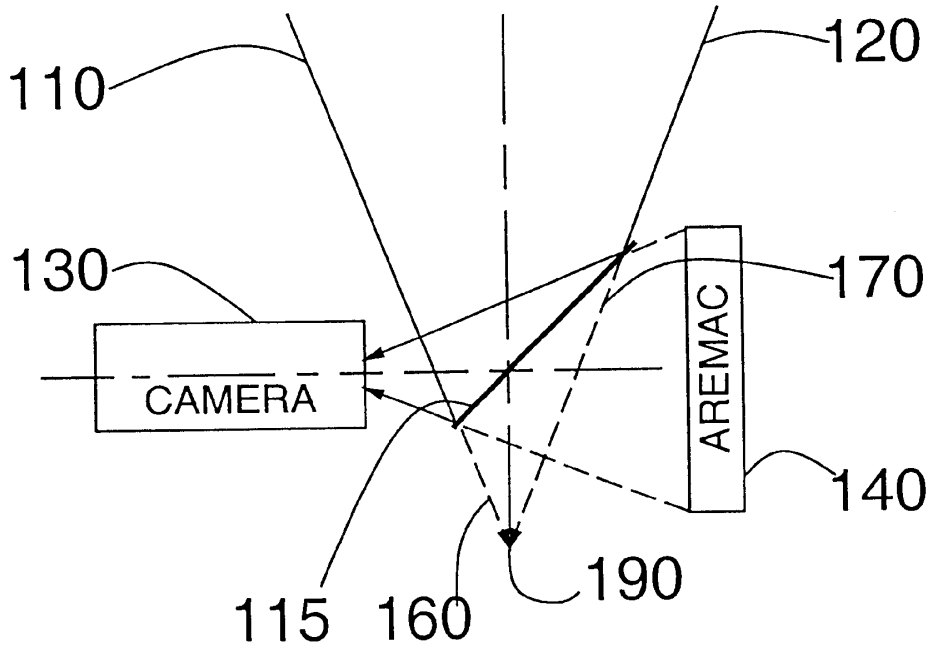


FIG. 1a – EYE–TAP CAMERA

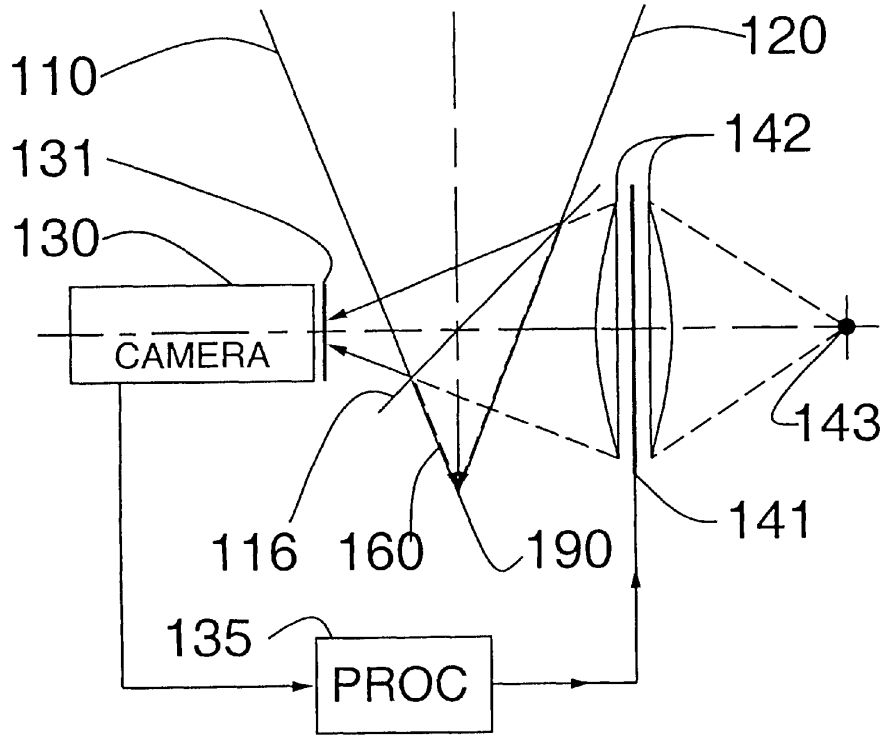


FIG. 1b – EYE-TAP CAMERA WITH INFINITE DEPTH OF FIELD

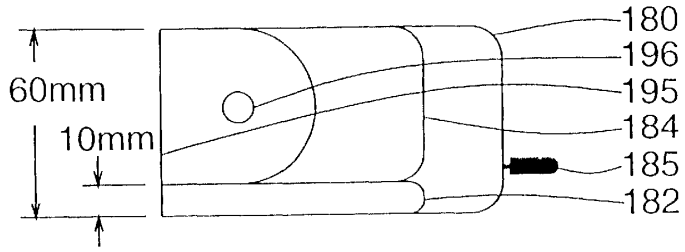


FIG. 1c – NEWSGATHERING PHONE FOLDED

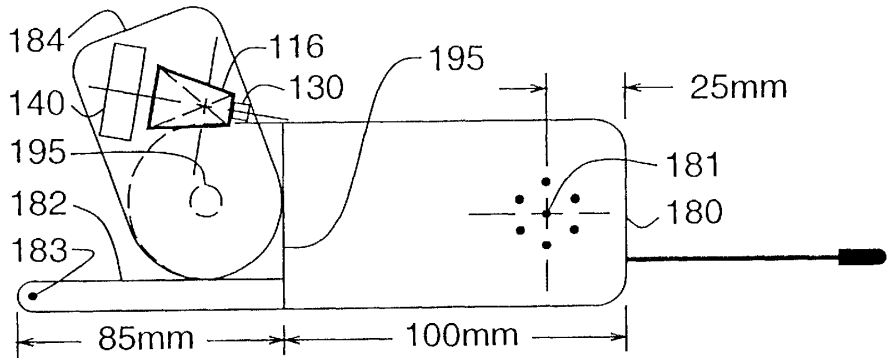


FIG. 1d – NEWSGATHERING PHONE OPEN

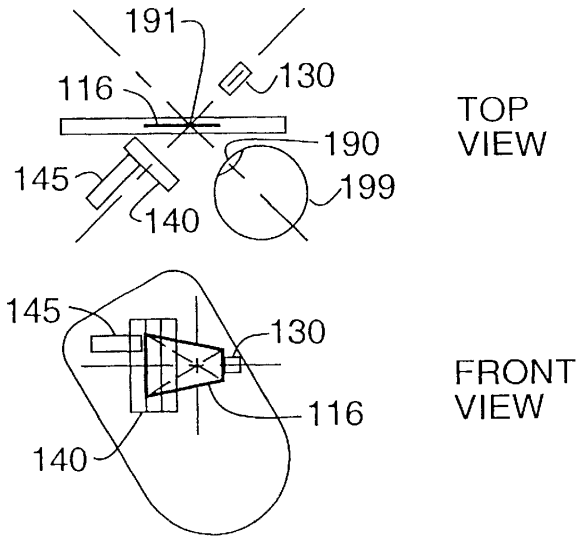


FIG. 1e – NEWSGATHERING PHONE DETAIL

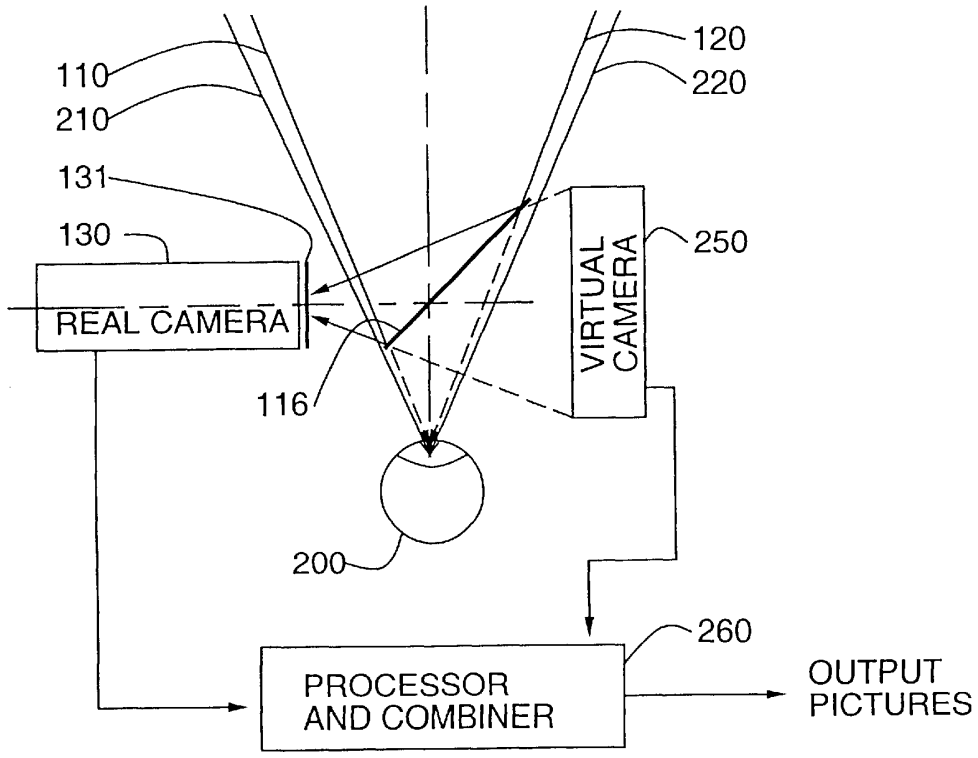


FIG. 2a – EYE-TAP CAMERA WITH FORENSIC OR EYE CONTROL

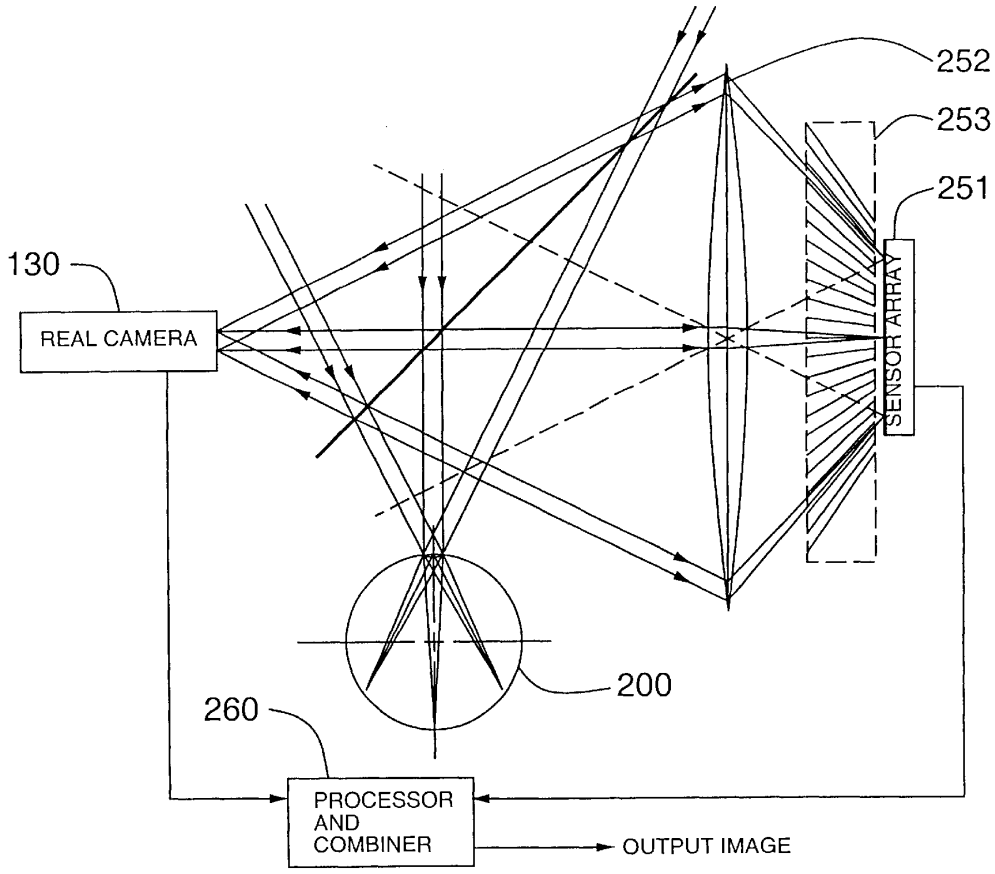


FIG 2b – EYE–CAMERA

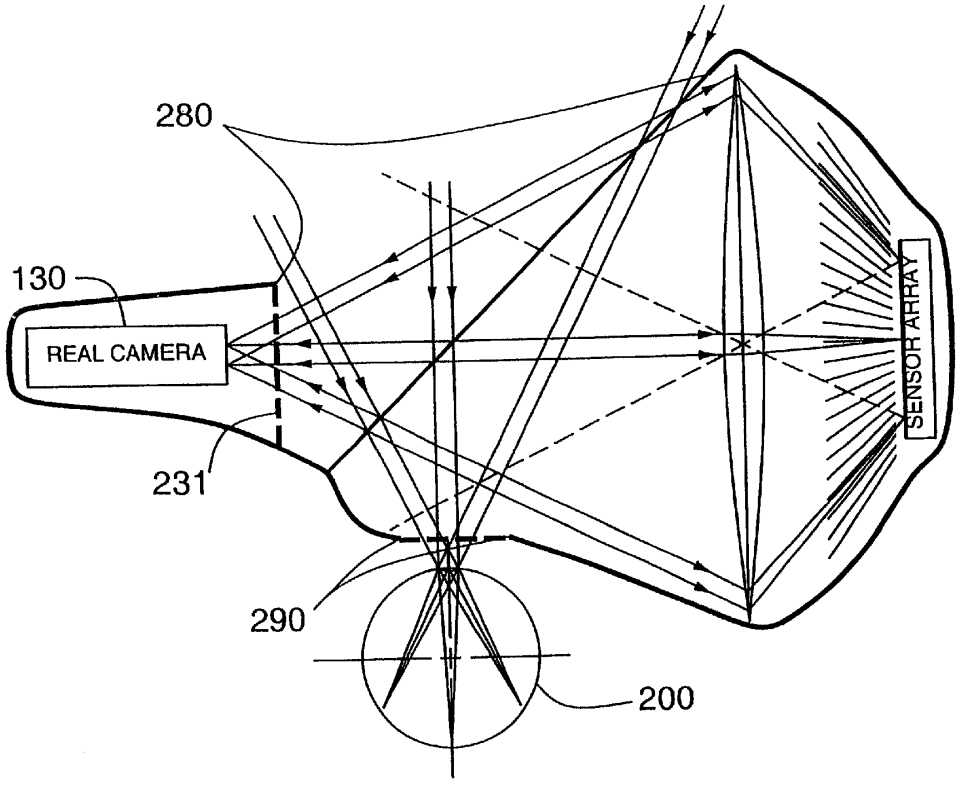


FIG 2c – HOUSING FOR EYE–CAMERA

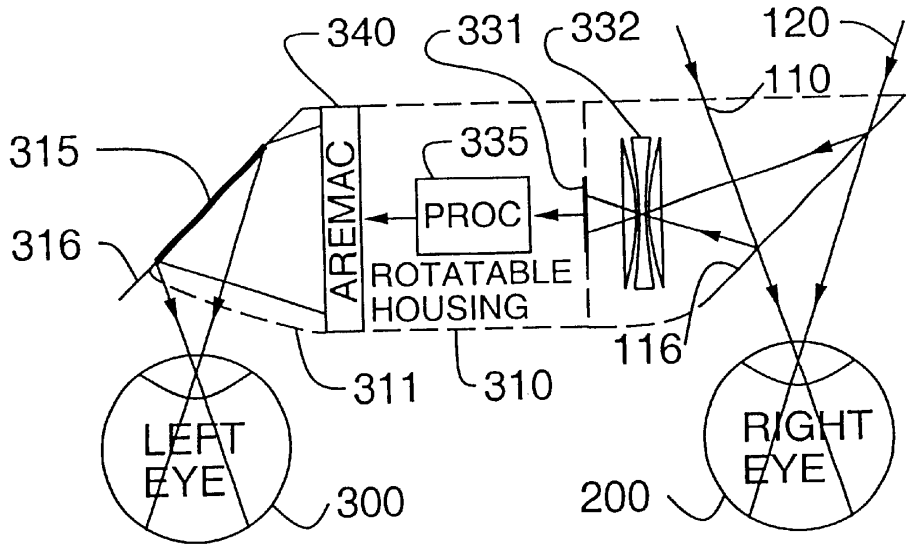


FIG. 3a – CROSSEYE–TAP CAMERA

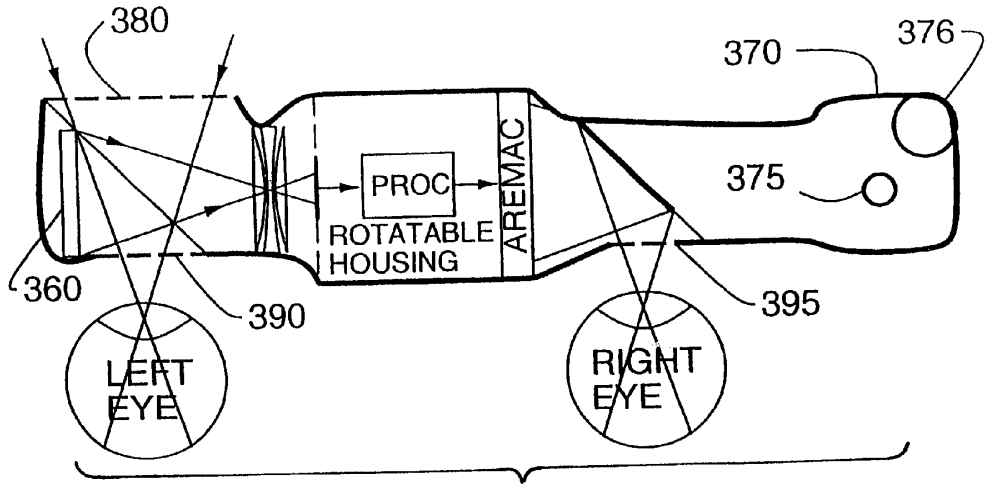


FIG. 3b – HAND–HELD
CROSSEYE–TAP CAMERA

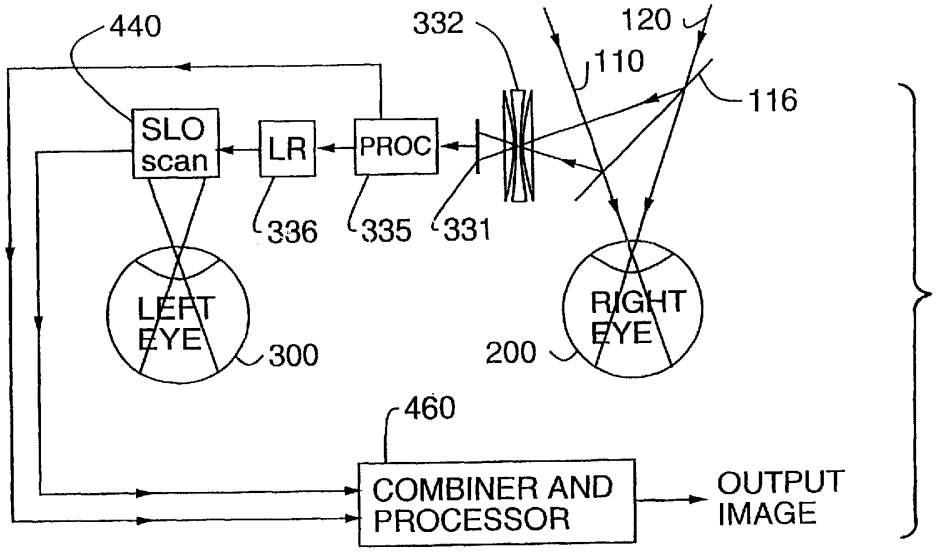


FIG. 4a – CROSSEYE-TAP CAMERA WITH SCANNER

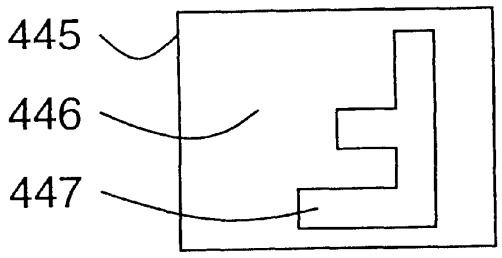


FIG. 4b – CROSSEYE–TAP SCAN AND DISPLAY, LEFT RETINA

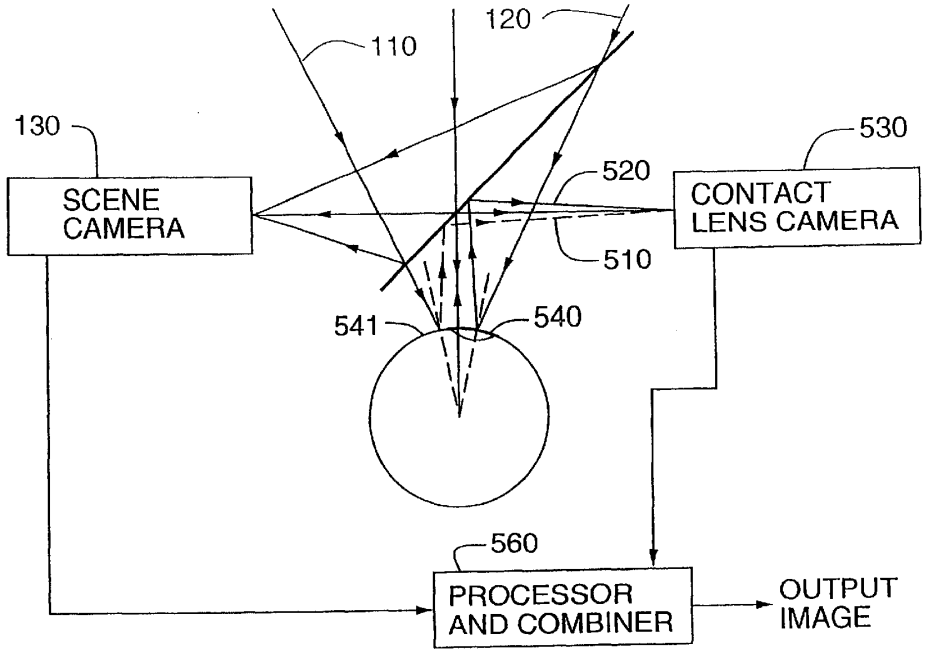


FIG. 5a – CAMERA BASED ON CONTACT LENS

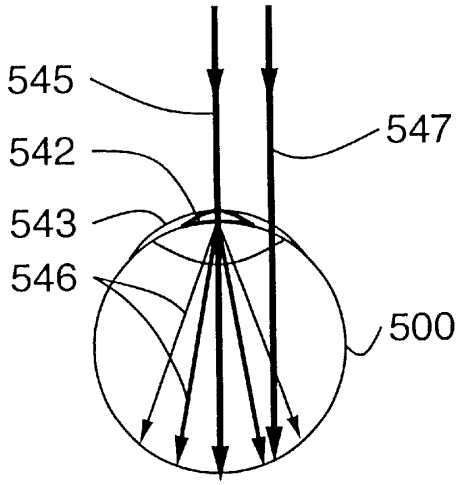


FIG. 5b –
DISPLAY BASED ON CONTACT LENS

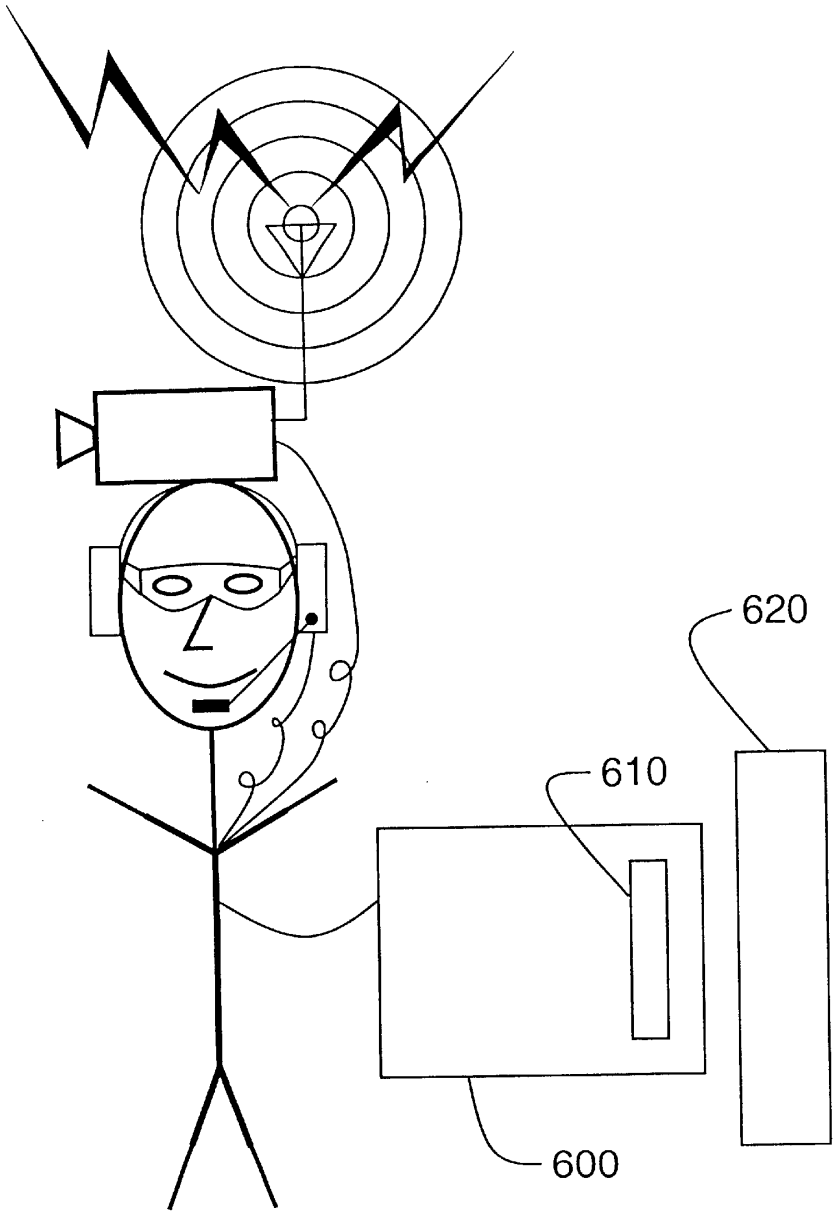


FIG. 6 – CAMERA AUTHENTICATION WITH IMPLANTABLE COMPUTER

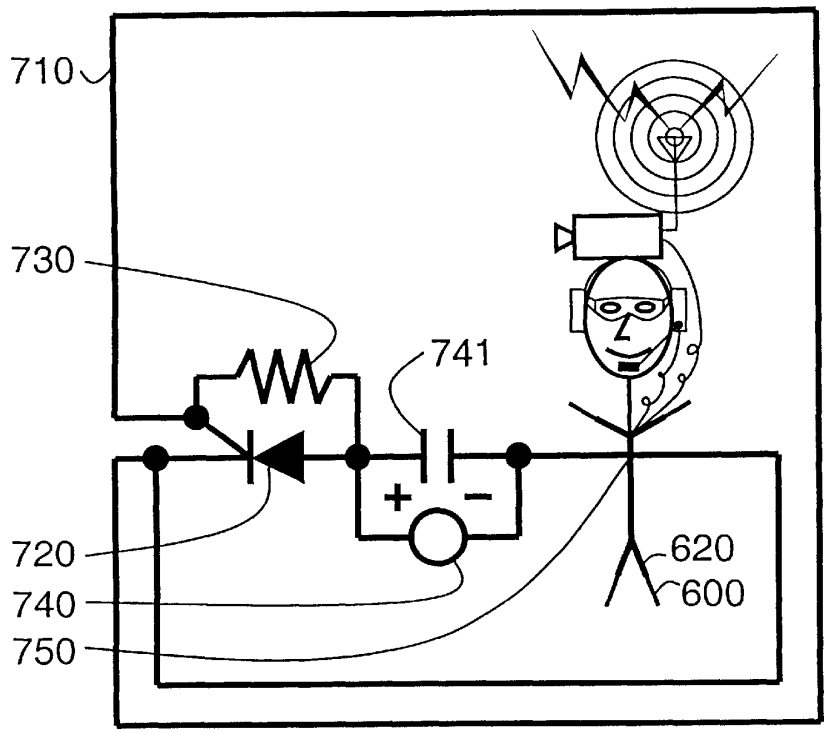


FIG. 7 – PERSONAL SAFETY DEVICE

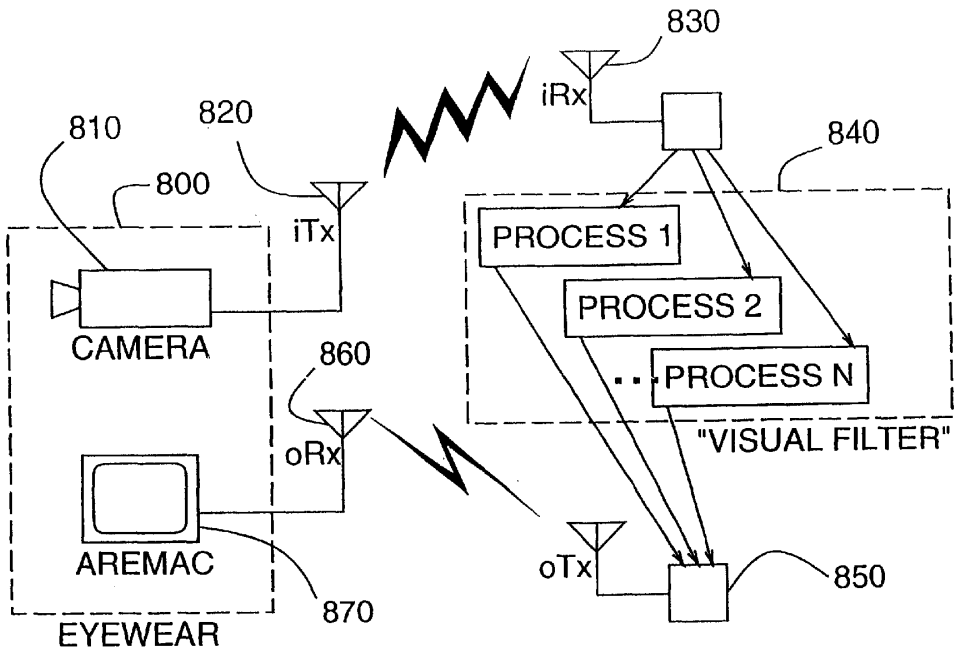


FIG. 8 – SYSTEM ARCHITECTURE

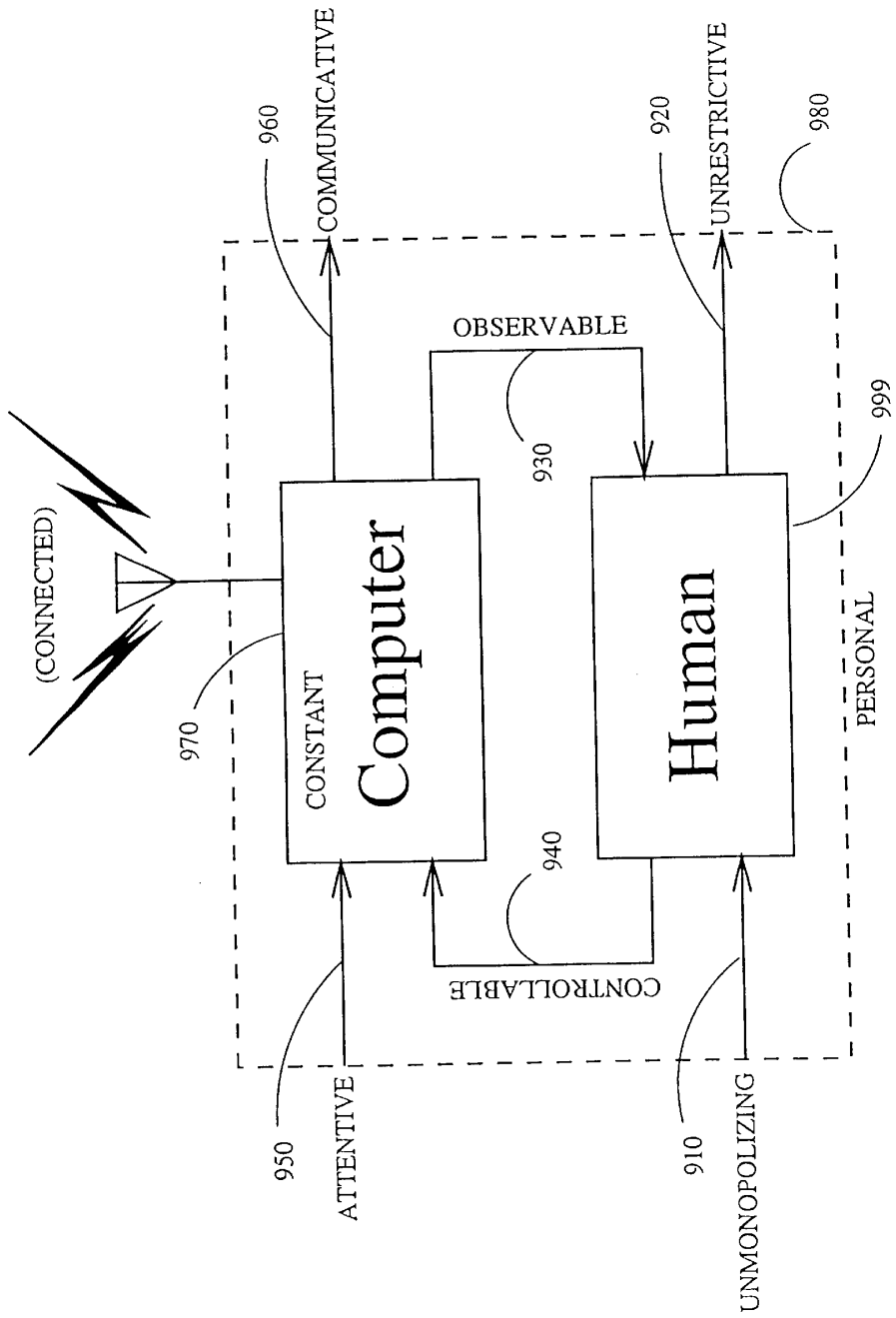


FIG. 9 - PERSONAL IMAGING COMPUTER

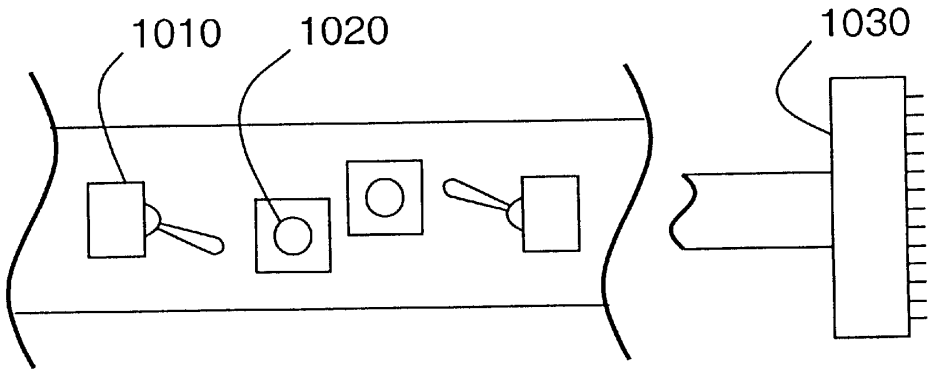


FIG. 10 – COVERT DATA ENTRY DEVICE FOR EYE–TAP CAMERA SYSTEM

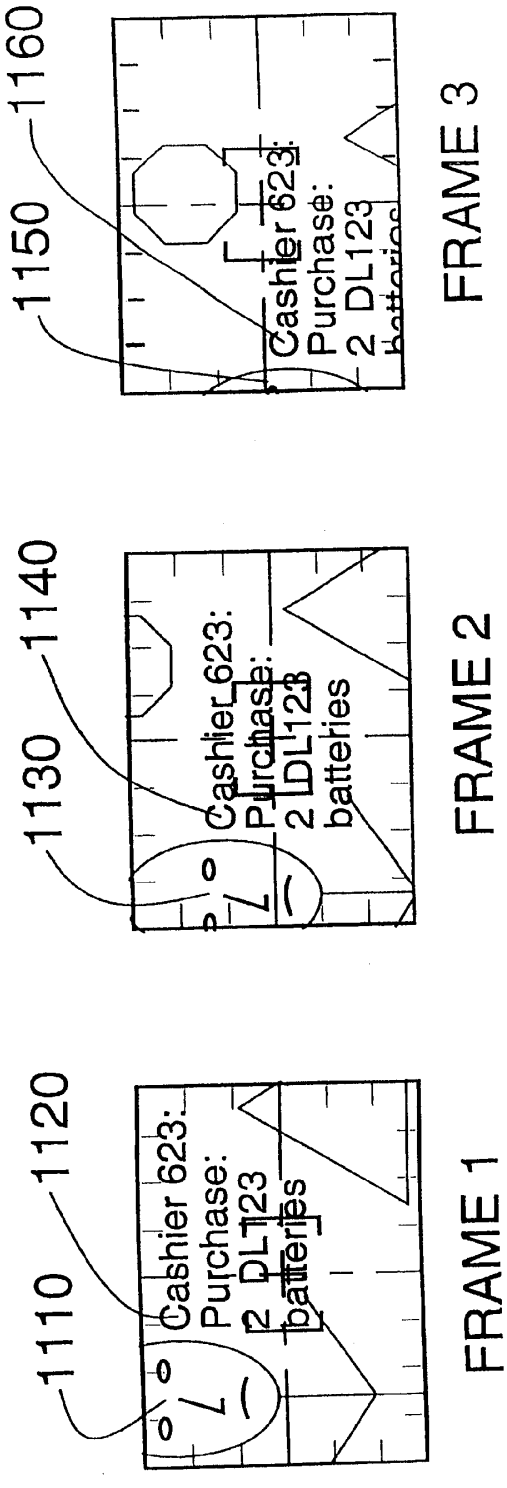


FIG. 11 – MEDIATED REALITY – JOURNALIST'S VIEW

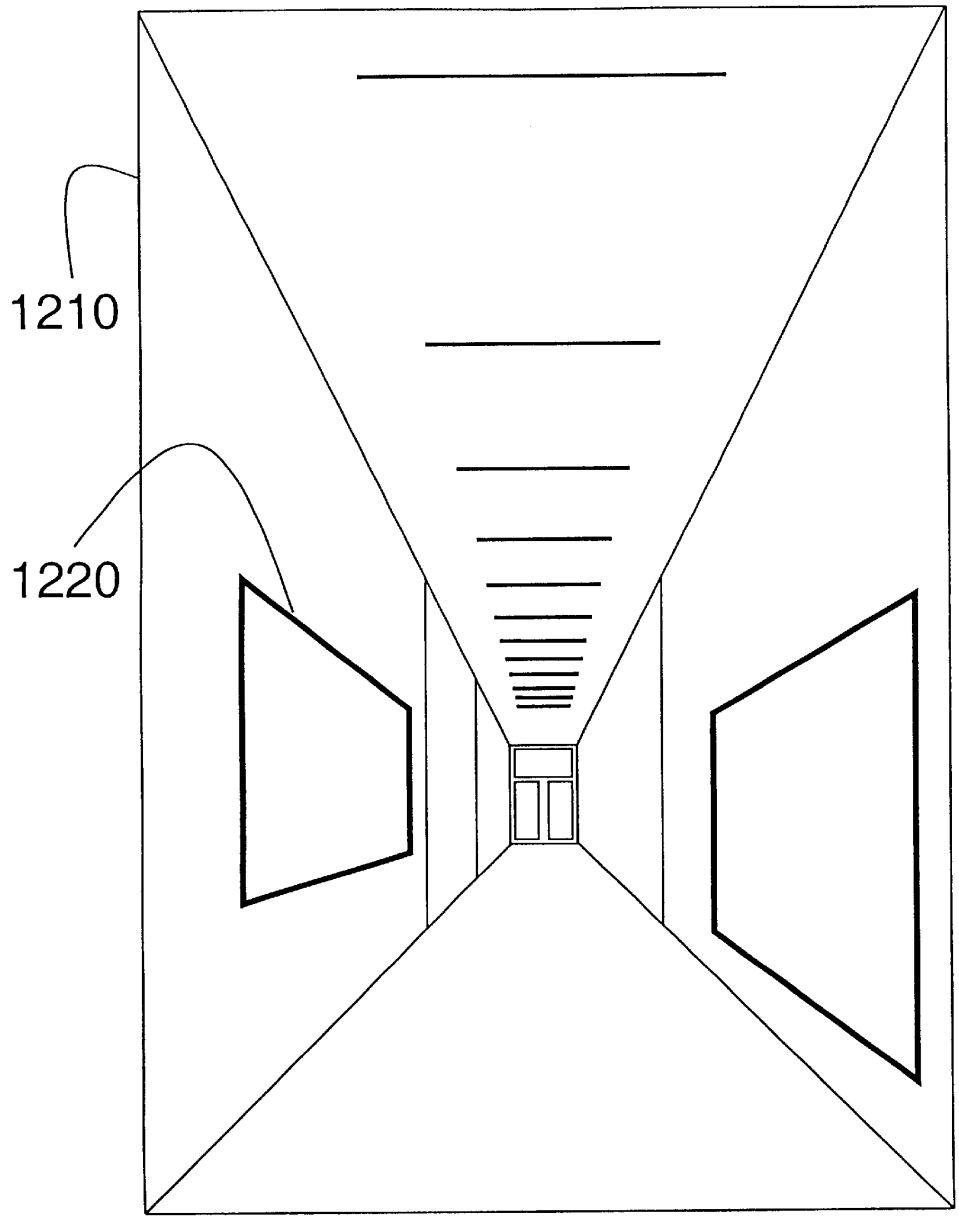


FIG. 12 – COMPUTER–SUPPORTED COLLABORATIVE NEWSGATHERING USING A VIRTUAL NEWSPAPER

EYE-TAP FOR ELECTRONIC NEWSGATHERING, DOCUMENTARY VIDEO, PHOTOJOURNALISM, AND PERSONAL SAFETY

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of U.S. application Ser. No. 09/172,599, filed Oct. 15, 1998, the contents of which are incorporated herin by reference.

FIELD OF THE INVENTION

The present invention pertains generally to a new photographic or video apparatus comprising a portable electronic camera device which captures rays of light collinear with rays passing through a point approximately at the center of the lens of an eye of the user. In this way, the device causes the eye itself to become, in effect, the camera. Preferably the apparatus also includes a viewfinder system, a computer, and a wireless communications link.

BACKGROUND OF THE INVENTION

In photojournalism, electronic news gathering (ENG), and in movie or video production, it is desirable to capture events in a natural manner with minimal disturbance to the subject matter being captured. Current state-of-the-art newsgathering apparatus creates a visual disturbance to others and attracts considerable attention on account of the camera crew, sound crew, the bulky equipment, and the manner in which it is deployed and used. Even when a single camera operator is assigned to a newsgathering task, the simple gesture of bringing or holding the camera up to the eye can disrupt the event being reported. Even if the size of the camera could be reduced to the point of being negligible (e.g. no bigger than the eyecup of a typical camera viewfinder, for example), the very gesture of bringing a device up to the eye is unnatural and attracts considerable attention, especially in establishments such as gambling casinos or department stores where photography is often prohibited, yet where newsworthy events frequently happen. Although there exist a variety of covert cameras which are frequently used in investigative journalism, such as a camera concealed beneath the jewel of a necktie clip, cameras concealed in baseball caps, and cameras concealed in eyeglasses, these cameras tend to produce inferior images, not just because of the technical limitations imposed by their small size, but, more importantly because they lack a means of viewing the image, as well as a means of having others view the image. In typical newsgathering scenarios, one person operates the camera while another carries a monitor to observe the technical quality of the video images. Often there is a news truck equipped with instrumentation so that technical staff can monitor the quality of the video signal, and report back to the camera crew by telephone or the like. Because of the lack of viewfinder means, and the lack of analysis/communications means between the camera operator and remote test equipment/technical staff, investigative video and photojournalism made with concealed cameras of the prior art suffers from poor composition and poor image/sound quality.

Recent experiments, as conducted by and reported by Mann, in a Massachusetts Institute of Technology (M.I.T.) technical report titled Mediated Reality (M.R.), Vision and Modeling Group TR260, (1994), which is available online at http://wearcam.org/mr.htm, show that moderate transformations such as rotation by a few degrees or moderate image displacements, often give rise to a reversed aftereffect that is more rapidly assimilated by the wearer than either very large or very small transformations. It is also shown that effects of moderate transformations can often have a more detrimental effect on performing other tasks through the camera as well as detrimental flashbacks upon removal of the camera, than that which would arise from either extreme or negligible transformations. This work also looked into the effects of using wireless communications with a remote image processing system as a means of mediated reality. These findings suggest that merely mounting a conventional camera such as a small 35 mm rangefinder camera or a small video camcorder to a helmet, so that one can look through the viewfinder and use it it hands-free while performing other tasks, will result in poor performance at doing those tasks while looking through the camera viewfinder, in addition to the obvious shortcoming of not having technical staff or other remote collaborators available.

Part of the reason for poor performance associated with simply attaching a conventional camera to a helmet is the induced noncollinearity (failure to provide a truly orthoscopic view). Even viewfinders which correct for parallax, as described in U.S. Pat. No. 5,692,227 in which a rangefinder is coupled to a parallax error compensating mechanism, only correct for parallax between the viewfinder and the camera lens that is taking the picture, but do not correct for noncollinearity between rays of light passing through the viewfinder and those that would be observed with the naked eye while not looking through the camera.

An object of the invention is to provide a viewfinder means that is suitable for long-term telepresence, computer supported collaborative photojournalism etc., suitable when wearing the camera for an entire day, looking through it all the while.

An important aspect of the invention is the capability of the apparatus to mediate (augment, diminish, or otherwise alter) the visual perception of reality. Traditional camera viewfinders often include the ability to overlay virtual objects, such as camera shutter speed, or the like, on top of reality, as described in U.S. Pat. No. 5,664,244 which describes a viewfinder with additional information display capability.

This electronic news gathering invention is related to known displays that are used in the field of Virtual Reality (VR) in the sense that both are wearable. However, an important difference is that embodiments of the invention allow the wearer to continue to see the real world, while VR displays block out the ability to see the real world.

Displays for helmet mounted aircraft weapons aiming applications have been developed, as described in U.S. Pat. Nos. 3,697,154, 3,833,300, 4,081,209, 4,220,400. Such displays do not directly incorporate a camera. Although they could be used to display the output image from an electronic camera (hand-held or perhaps mounted to the same helmet), the above-mentioned problems would still exist.

U.S. Pat. No. 4,806,011 describes an eyeglass-based display of a clock or the like.

Open-air viewfinders are often used on extremely low cost cameras, as well as on some professional cameras for use at night when the light levels would be too low to tolerate any optical loss in the viewfinder. Examples of open-air viewfinders used on professional cameras, in addition to regular viewfinders, include those used on the Graflex press cameras of the 1940s (which had three different kinds of viewfinding means), as well as those used on some twin-lens reflex cameras. While such viewfinders could be

used in the context of the invention, and would have the advantage of not inducing the problems such as flashback effects described above, they also fail to provide an electronically mediated reality.

Wearable display devices have been described, such as in U.S. Pat. Nos. 5,546,099, 5,708,449, 5,331,333, 4,636,866, but have no light sensing apparatus or wireless communications capability.

U.S. Pat. No. 5,640,221 also proposes an eye-tracking device which may be used in the context of the invention.

DESCRIPTION OF THE INVENTION

The apparatus of the invention can allow visual reality to be mediated in order to make certain that exposure is correct as well as to keep the wearer of the apparatus in the feedback loop of the photo compositional process by constantly providing the wearer with a video stream. Moreover, it is desired that the apparatus will allow the wearer to experience a computationally mediated visual reality, and for that experience to be shared through wireless communications networks so that the wearer may receive additional visual information, as well as be aware of modifications to visual reality that might arise, for example, as part of a communications process in a shared virtual environment. For such compositional and interactional capabilities, a simple air-based viewfinder is inadequate.

The invention facilitates a new form of visual art, in which the artist may capture, with relatively little effort, a visual experience as viewed from his or her own perspective. With some practice, it is possible to develop a very steady body posture and mode of movement that best produces video of the genre pertaining to this invention. Because the apparatus is lightweight and close to the head, there is not the protrusion associated with carrying a hand-held camera. Also because components of the apparatus of the invention are mounted very close to the head, in a manner that balances the weight distribution as well as minimizes the moment of inertia about the rotational axis of the neck, the head can be turned quickly while wearing the apparatus. This allows one to record the experiences of ordinary day-to-day activities from a first-person perspective, and, because of a communications infrastructure, to convey these experiences to a remote entity. Moreover, because both hands are free, much better balance and posture is possible while using the apparatus. Anyone skilled in the arts of body movement control as is learned in the martial arts such as karate, as well as in dance, most notably ballet, will have little difficulty capturing exceptionally high quality video using the apparatus of the invention.

With the prior art, the best camera operators tend to be very large people who have trained for many years in the art of smooth control of the cumbersome video or motion picture film cameras used. In addition to requiring a very large person to optimally operate such cameras, various stabilization devices are often used, which make the apparatus even more cumbersome. The apparatus of the invention may be optimally operated by people of any size. Even young children can become quite proficient in the use of some embodiments of the invention, and could make excellent photojournalists, especially if given the capabilities of a network of adult experts.

A typical embodiment of the invention comprises one or two spatial light modulators or other display means built into a pair of eyeglasses together with one or more light sensor arrays, a body-worn computer and image processing system, and a high-speed wireless communications link. Typically one or more CCD (charge coupled device) image sensor arrays and appropriate optical elements comprise the camera portion of the invention. Typically a beamsplitter or a mirror silvered on both sides is used to combine the image of the viewfinder with the apparent position of the camera. The viewfinder is not just a means of determining the extent of coverage of the camera in a natural manner, but it is also a communications means, so that, for example, a remote expert may provide advice in the form of text superimposed inside the viewfinder. In this manner the viewfinder functions as a teleprompter, as well as a means for judging photographic or video composition. Moreover, one or more remote experts may superimpose graphical elements in the viewfinder, such as a cursor or arrow that points to an object as depicted in the viewfinder. In this way the wearer may collaborate with one or more remote experts on matters such as scene content, or, for example, specific details of a photographic composition. Finally, the collaboration may take the form of one or more computer graphics renderings inserted into the viewfinder, together with the images of real objects. This allows the user to experience a computer-mediated reality in which there is a much more rich form of collaborative potential.

In some embodiments of the invention the viewfinder has a focusing mechanism that is coupled to a focusing mechanism of a camera system. In such embodiments, when the camera is focused on a particular object, the viewfinder also presents that object in a manner such that when the apparatus moves relative to the user's eye, the object appears to neither move with or against the movement of the eye, e.g. rays of light entering the eye are approximately collinear to corresponding rays of light that would be present if the apparatus were not present. This focusing of the camera may be manual or automatic, but in both cases, it is preferable that the viewfinder be either automatic in tracking the camera (whether manual or auto focus), or that it have sufficient depth of focus to allow a lens of an eye of the wearer itself to function as the focal selector, or that it be responsive to the focal state of a lens of an eye of the wearer. A viewfinder meeting one of these criteria will be referred to as an autofocus viewfinder.

A viewfinder-like function may come from various forms of devices that generate a visible image or a visual perception thereof. In some embodiments, a viewfinder which is a small television tube or LCD screen with appropriate optics so that the eye can focus on it as if it were far away, is used. In other embodiments the viewfinder-like function takes the form of an image created directly upon the retina of an eye of the wearer of the apparatus. A viewfinder device, or other kind of device that makes the eye perceive a picture, or creates a picture visible to the eye, or inside the eye, does the opposite of what the camera does, in the sense that it turns electrical signals into pictures or a visible perception like seeing a picture, while the camera turns pictures (light falling on an image sensor) into electrical signals. Because the viewfinder device, or equivalent device that turns electrical signals into pictures or visible perceptions equivalent to seeing or experiencing pictures, does the opposite of what a camera does, I will call the device an aremac. This word "aremac" is simply the word "camera" spelled backwards.

Preferably the viewfinder is a laser-based aremac, or other kind of aremac that has either infinite depth of focus or a sufficient depth of focus that there is a perceived unity between virtual and real objects for real objects at any depth plane. Alternatively, the aremac may be an automatic focus viewfinder, or other device where the limited depth of focus is mitigated by an automatic focusing system.

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Preferably a collinearity criterion is satisfied, e.g. a wearable camera system with aremac is arranged so that the aremac displays video from the camera in such a way that all rays of light from the aremac that enter the eye appear to emanate from essentially the same direction as they would have had the apparatus not been worn.

Preferably the wearer experiences additional information overlaid on top of his or her visual field of view such that the information is relevant to the imagery being viewed, and also such that the virtual objects appear in the same depth plane as the real objects.

The apparatus of the invention gives a photojournalist a means of determining the composition of a picture from a display device that is located such that only the photojournalist can see the display device, and so that the photojournalist can ascertain the composition of a picture and take a picture or video and transmit these to one or more remote locations without the knowledge of others in the immediate environment.

The camera viewfinder can also function as a way of providing a photojournalist with the ability to collaborate with one or more remote entities, in matters pertaining to composition of a picture or video or in matters pertaining to an interview with one or more subjects.

In some embodiments, the viewfinder has a focusing mechanism coupled with the focus of a camera, such that both can be operated remotely with a single control, by a technician or camera operator at a remote location.

Some embodiments of the invention also provide a means by which a technician or camera operator at a remote location can signal to the wearer of the viewfinder which direction in which to turn, for best picture. These signals are typically vibrotactile or facilitated by direct electrical stimulation of the actual muscles needed to effect the actual change (e.g. a message to turn to the right is felt as a tug of the neck muscles that actually turn the head to the right).

In some embodiments a technician or camera operator at a remote location can signal to the wearer of a wearable camera which has no local viewfinder, which direction in which to turn, for best picture, while the remote technician or camera operator remotely monitors the video signal from the wearable camera.

Multiple photojournalists using the invention, at the same location, can also collaborate in such a way that multiple camera viewpoints may be shared among the photojournalists so that they can advise each other on matters such as composition, or so that one or more experts at remote locations can advise one or more of the photojournalists on matters such as composition or camera angle.

Certain embodiments of the invention provide a new genre of journalism in which content may be produced and consumed using the same wearable camera and display system. This content sharing capacity allows for such collaboration among photojournalists and others.

Typically embodiments of the invention allow a photojournalist to wear the apparatus continuously and therefore always end up with the ability to produce a picture from something that was seen a couple of minutes ago, through a retroactive record function into a circular buffer. For example, a "begin recording from 5 minutes ago" button works well if the apparatus is always worn and always ready.

Moreover, as an artistic tool for first-person perspective photojournalism, the apparatus allows the photojournalist to record, from a first-person-perspective, experiences that have been difficult to so record in the past. For example, a photojournalist might be able to record the experience of looking through binoculars while riding horseback, or the experience of waterskiing, rope climbing, or the like. Such experiences captured from a first-person perspective provide a new genre of video by way of a wearable camera system with viewfinder means that goes beyond current state-of-the-art point of view sports videos (such as created by cameras mounted in sports helmets which have no viewfinder means).

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of examples which in no way are meant to limit the scope of the invention, but, rather, these examples will serve to illustrate the invention with reference to the accompanying drawings, in which:

FIG. **1***a* is a diagram of a simple embodiment of the camera and aremac portion of the apparatus of the electronic newsgathering invention in which a portion of the field of view of the journalist wearing the apparatus is diverted into a camera by a diverter (two-sided mirror), and replaced with the view from an aremac viewfinder.

FIG. **1***b* is an embodiment of the camera and aremac in which the diverter is a beamsplitter, rather than a two-sided mirror, and in which the role of the aremac, which is shown by way of its internal components which serve as an example of how an aremac operates, is to provide additional information such as spatially varying exposure level indication, and the like.

FIG. **1***c* depicts how the camera and aremac might be mounted in a typical device, such as an electronic newsgathering telephone, which is shown in its closed position.

FIG. **1***d* shows the electronic newsgathering telephone open 180 degrees for illustrative purposes only, since the phone is preferably manufactured in such a way that it its fully open at 135 degrees when in normal usage.

FIG. **1***e* shows a detailed view of the electronic newsgathering telephone in both front view and top view.

FIG. **2***a* shows an embodiment of the invention which is responsive to an aspect of an eye of a user of the apparatus of the invention.

FIG. **2***b* shows an embodiment of the invention in which a good clear eye-tap image is obtained from rays of light diverted from those passing through the center of projection of a lens of an eye of the user of the apparatus, and at the same time, a less clearly defined but more expressive (and of greater forensic value) image is read out of the eye itself.

FIG. **2***c* shows a housing for the embodiment of the invention depicted in FIG. **2***b*.

FIG. **3***a* shows an embodiment of the invention which is a wearable crosseye-tap camera in which a portion of the rays of light entering one eye is diverted with a beamsplitter into a camera, the output of which is displayed into the other eye with an aremac.

FIG. **3***b* shows an embodiment of the invention which is a hand-held crosseye-tap camera in which a portion of the rays of light entering one eye is diverted with a beamsplitter into a camera, the output of which is displayed into the other eye with an aremac.

FIG. **4***a* shows an embodiment of the invention in which a portion of the rays of light entering one eye is diverted with a beamsplitter into a camera, the output of which is displayed into the other eye with a device that is both an aremac and itself another camera that scans out the eye being displayed to.

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FIG. **4***b* shows the display on the retina, of the embodiment depicted in FIG. **4***a*, illustrating how the displayed data is factored out of the retinal scan of the eye, resulting in a retinal scan that does not depend appreciably on the data displayed thereupon.

FIG. **5***a* shows an embodiment of the invention based on a contact lens.

FIG. **5***b* shows an embodiment of the viewfinder of the invention based on a contact lens.

FIG. **6** depicts an authenticational aspect of the invention in which the source of pictures is authenticated by way of an implantable computer in communication with a wearable computer.

FIG. **7** depicts a Personal Safety Device (PSD) aspect of the invention which prevents theft of the apparatus, and discourages torture or other human rights violations against the wearer, in the same way that the ink-loaded anti-theft tags protect clothing from being stolen by shoplifters.

FIG. **8** depicts the overall system architecture of the apparatus of the invention, in which the camera transmits to a remote location, the image is processed, and the processed image is received by the apparatus and presented to the wearer upon a viewfinder.

FIG. **9** depicts the user-interface based on Humanistic Intelligence (HI).

FIG. **10** depicts a covert data-entry device, such as may be used to set white balance or shutter speed of the apparatus of the invention, in which a plurality of pushbutton switches are mounted to a belt.

FIG. **11** depicts a journalist's view through the viewfinder of the apparatus of the invention, depicting three frames of the video sequence observed in the journalist's viewfinder, in which the journalist's perception of reality is altered by way of a simple object-tracking textual overlay on top of what would normally be seen through the viewfinder.

FIG. **12** shows an application in which the apparatus is used as a means of consuming, not just producing news, and in particular this diagram depicts a virtual newspaper as seen through the special eyeglasses, especially useful for building a community of networked photoborgs living in a shared computer-mediated world.

While the invention shall now be described with reference to the preferred embodiments shown in the drawings, it should be understood that the intention is not to limit the invention only to the particular embodiments shown but rather to cover all alterations, modifications and equivalent arrangements possible within the scope of appended claims.

In all aspects of the present invention, references to "camera" mean any device or collection of devices capable of simultaneously determining a quantity of light arriving from a plurality of directions and or at a plurality of locations, or determining some other attribute of light arriving from a plurality of directions and or at a plurality of locations. Similarly references to "television" shall not be limited to just television monitors or traditional televisions used for the display of video from a camera near or distant, but shall also include computer data display means, computer data monitors, other video display devices, still picture display devices, ASCII text display devices, terminals, and the like.

Similarly, references to "photojournalist" shall mean all manner of journalist, photographer, videographer, filmmaker, or the like.

DETAILED DESCRIPTION OF THE INVENTION WITH REFERENCE TO DRAWINGS

FIG. **1***a* shows an embodiment of the electronic newsgathering system whereby rays of light spanning a visual angle from ray **110** to ray **120** enter the apparatus and are intercepted by a two-sided mirror **115**, typically mounted at an angle of $\pi/4$ (45 degrees) with respect to the optical axis of a scene camera **130**. These rays of light which would otherwise enter an eye of a wearer of the apparatus, instead enter camera **130**. The video output of the camera **130** is displayed upon aremac **140** possibly after having been processed on a body-worn computer system or the like. A reflection of aremac **140** is seen in the other side of mirror **115**, so that a synthetic image of ray **110** appears as virtual ray **160** and the synthetic image of ray **120** appears as virtual ray **170**. Rays of light from the aremac typically form virtual light. Virtual light is light in which rays of light converge, rather than diverge. Since the camera **130** records an image that is backwards, when it is connected to aremac **140**, aremac **140** displays a backwards image. Since the aremac **140** is observed in a mirror, the image is reversed again so that the view seen at eye location **190** is not backwards. In this way a portion of the wearer's visual field of view is replaced by virtual light depicting the exact same subject matter as would be seen in the absence of the apparatus. The virtual light is in perfect spatial register with the real light that would have been seen from the real world, in the absence of the apparatus. A system in which some rays of light (such as **110**) are diverted before reaching eye **190** and replaced with rays of virtual light (such as **160**) which are each collinear with the corresponding ray of real light (e.g. **110**) from which they were derived is said to satisfy the collinearity criterion.

Systems that satisfy the collinearity criterion produce an illusory transparency. In other words, diverter **115** is completely opaque (no light can pass through it), yet the user can see "through" it in the sense that when the user looks into the diverter, there is provided a view of what is beyond the diverter. Of course this illusory transparency is lost once the system is shut off, e.g. when the system is shut off, the diverter functions as a partial blindfold or eye patch that blocks a portion of the user's field of view.

In typical usage of the apparatus, camera **130** is responsive to rays of light that are collinear with lines passing through the center of a lens of an eye of the wearer of the apparatus, so that the eye itself functions, in effect, as the camera (e.g. that the camera viewpoint is as if the eye were the camera).

The apparatus behaves as if the eyeball were removed and replaced with a camera at the exact location of the eyeball. Since the device can so perfectly tap into the eye, providing an almost exact replica of the signal going into the eye (just as tapping a telephone provides a listening experience almost exactly like those involved in the conversation hear), the apparatus will be referred to as an eye-tap camera.

In practice, aremac **140** often comprises a viewfinder with a focus adjustment, and the focus adjustment is often driven by a servo mechanism controlled by an autofocus camera. Thus camera **130** automatically focuses on the subject matter of interest, and controls the focus of viewfinder **140** so that the apparent distance to the object is the same while looking through the apparatus as it would have been if the user were not wearing the apparatus.

In some embodiments the focus is manual. It is desirable that embodiments of the electronic newsgathering invention comprising manual focus cameras have the focus of the camera linked to the focus of the viewfinder so that both may be adjusted together with a single knob. Moreover, a camera with zoom lens may be used together with a viewfinder having a zoom lens. The zoom mechanisms are linked in

such a way that the viewfinder image magnification is reduced as the camera magnification is increased. Through this appropriate linkage, any increase in magnification by the camera is negated exactly by decreasing the apparent size of the viewfinder image.

The focus may, alternatively, be controlled by a remote expert or technician, so that the journalist can concentrate on higher-level issues such as videographic composition or doing an interview.

The calibration of the autofocus zoom camera and the zoom viewfinder may be done by temporarily removing the mirror **115** and adjusting the focus and zoom of the viewfinder to maximize video feedback. This must be done for each zoom setting, so that the zoom of the viewfinder will properly track the zoom of the camera. By using video feedback as a calibration tool, a computer system may monitor the video output of the camera while adjusting the aremac and generating a lookup table for the viewfinder settings corresponding to each camera setting. In this way, calibration of the camera and aremac may be automated during manufacture of the apparatus of the invention. Some similar embodiments of the invention use two cameras and two viewfinders. In some embodiments, the vergence of the viewfinders is linked to the focus mechanism of the viewfinders and the focus setting of cameras, so that there is a single automatic or manual focus adjustment for viewfinder vergence, camera vergence, viewfinder focus, and camera focus.

FIG. **1***b* shows an embodiment of the electronic newsgathering system based on a camera system that uses a beamsplitter rather than a two-sided mirror for a diverter. In this case, only a portion of a ray of light **110** passing through beamsplitter **116** is diverted from eye **160** into camera **130**. The rest of the ray **110** goes through the diverter along with ray **160** of virtual light. In this way the eye experiences a mixture of real and virtual light.

Unlike the apparatus depicted in FIG. **1***a* in which the system must be operating in order that it not obstruct a portion of the user's vision, the apparatus of FIG. **1***b* does not function as an eye patch or partial blindfold when it is not running an illusory transparency. In other words, since diverter **116** is a beamsplitter, it is not necessary that virtual light be synthesized in order for the wearer have a complete and unobstructed vision. Therefore diverter **116** can be of greater extent than diverter **115** was. In particular diverter **116** can cover a larger portion of the visual field of view than that seen in the aremac. In FIG. **1***a*, diverter **115** was carefully made so that that portion which it blocked was replaced by virtual light. Diverter **116**, however, need not be so constructed, and may, in fact, cover a larger field of the user's vision than the portion of it which reflects light from the aremac into an eye of the user. In this manner, the perceived edge of the image area of the viewfinder or viewfinder effect is not abruptly ended by the diverter, but, rather, is defined only by the light reflected off the diverter **116**. Moreover, since the device is transparent, any material presented by the display capability of the system may be used to aim the camera and determine how much extent the camera has. Thus one can aim the camera while reading an email message, or surfing the world wide web, since so doing causes there to be a display screen which will ordinarily have a rectangular raster associated with it. The shape of the rectangular raster thus determines the coverage of the camera even when the raster is not responsive to an output from the camera.

In this beamsplitter embodiment of the invention, the aremac is preferably comprised of a spatial light modulator **141** together with optics **142** and a point source **143** of light, such that there is no need for any focus adjustment. In this embodiment with the point source of light, the aremac is to a pinhole camera as an ordinary camera viewfinder is to an ordinary camera. Such an aremac has infinite depth of focus, so that the user can see everything clearly in focus from the blood vessels inside an eye of the user, to infinity. Thus, if a complete and full light colored image (such as when aiming the apparatus at an evenly illuminated white wall) is displayed upon spatial light modulator **141**, the wearer will typically see aspects of his or her own iris superimposed upon the image, along with specks of dust upon the eye lens surface, as well as the wipe marks of the eyelids (in the same way as one sees wipe marks on the windshield of a car, when the wipers sweep back and forth on a rainy day).

Such a view is often desirable for its expressive quality, and the manner in which it lets the user see into his or her own eye, and the way in which it creates a cybernetic feeling of being at one with the machine. However, in the event that such infinite depth of focus is not desirable (e.g. insofar as it might be confusing to novice users), processor **135** is often used to modify the image from camera **130** and extract just the salient details that are needed, so that a full and complete image is not presented to the user. For example, the image to spatial light modulator **141** may be simply a spatially varying graphic, such as zebra stripes, or plus ("+") signs appearing only in areas of the image that are overexposed. With such minimal content, the appearance of the blood vessels in the eye, etc., is not discernible. Other embodiments display zones of exposure throughout the image as ascii art, where processor **135** is typically a wearable computer running the linux operating system or a computer built into the apparatus of the invention, and spatial light modulator **141** might, for example, be the output of the computer formed from function calls using the aalib ascii art library.

Alternatives to ascii art also include simply adding noise to the image, or passing the image through a high pass filter to make it look more like a line drawing. More advanced processing may also be done to optimize the psychophysical tendency to find television more compelling than real life.

People tend to look at a television screen regardless of what is playing on the screen. Even if the television is tuned to a blank station, and just playing "snow" (random noise), people will often linger with gaze fixated upon the screen. Accordingly, by presenting material in a dynamic varying form, whether through ascii art video, high-pass filtering, line-art, or other related means, there can easily be created a system whereby the user, without conscious thought or effort, has a compulsive urge to place the subject matter of greatest interest within the mediation zone (the zone over which the visual perception of reality is altered, which also corresponds to the field of view of the camera).

Point source **143** is typically a red laser diode, or a combined point source from two laser diodes (red and green) where the laser diodes are combined with a beamsplitter prior to being passed through a pinhole spatial filter and beam spreader. Additionally, a raw (unencapsulated) blue LED may be used in addition to the two laser diodes, to create three colors. When multiple (red and green, or red and green and blue) sources are used, they may be sequenced in sync with the material displayed on spatial light modulator **143**, so that a color image results.

Point source **143**, when polarized, is preferably oriented at a favorable angle of polarization with spatial light modulator **141**. Spatial light modulator **141** is preferably mounted so the preferred polarization orientation will be such that the

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major axis of the point source is aligned along the major axis of spatial light modulator **141**.

Polarizer **131** in front of camera **130** prevents video feedback.

FIG. **1***c* shows an embodiment of the electronic newsgathering system mounted in a folding telephone having a main body **180** which includes antenna **185**. Foldable out from main body **180** is mouthpiece **182**. Mouthpiece **182** normally occupies the whole width of known telephone, but in the invention, mouthpiece **182** is very narrow, to allow room for an eyepiece. Unlike known cellular telephones, the invention includes an eyepiece **184**. The mouthpiece unfolds in the way known folding cellular telephones unfold, at fold point **195**. Eyepiece **184**, however has an additional pivot point **196**, in addition to fold point **195**.

FIG. **1***d* shows the newsgathering telephone opened out 180 degrees for illustrative purposes. In actual use, the phone stops opening at 135 degrees, where it is considered to be fully open. The main body **180** includes an earphone **181** as known telephones do. Mouthpiece **182** is shown opened, so that microphone **183** is visible.

Eyepiece **184** swings upward through an angle of approximately 70 degrees at pivot point **196**, when it is opened 135 degrees at pivot point **195**. Preferably both the earpiece and eyepiece fold out together, and the eyepiece automatically swings around pivot point **196** through the approximately 70 degree angle. Both the mouthpiece **182** and the eyepiece **184** may be spring-loaded so that the phone flips out into its normal operating position in a fraction of a second.

Eyepiece **184** holds aremac **140** and camera **130**, and houses diverter **116**, in an arrangement similar to that illustrated in FIG. **1***b*. Preferably diverter **116** is a beamsplitter, rather than a two-sided mirror like that shown in FIG. **1***a*. In order to prevent diverter **116** and other apparatus from being pushed into the user's eye, should the user, for example, be hit in the face by a ball, or the like (e.g. while covering sporting events), eyepiece **184** is much larger than it needs to be. In this way, the possibility of eye damage is greatly reduced. Eyepiece **184** is preferably made of transparent material so that the user can see through most of it, except for certain components such as portions of camera **130** and aremac **140** that might block some vision in the right eye. However, this blocking is minimal, and the user can see through both eyes in a relatively unobstructed manner while using the apparatus of the invention.

The optical axis of camera **130** (and that of diverter **140**) is typically oriented approximately 30 degrees clockwise with respect to the axis across eyepiece **184**, so that when eyepiece **184** flips out and up approximately 70 degrees, the optical axis of camera **130** (and that of diverter **140**) will be approximately 10 degrees clockwise of horizontal. Since eyepiece **184** is tipped slightly during use, the optical axis will thus be approximately horizontal during use.

FIG. **1***e* shows a closeup detail, front view and top view, of the newsgathering telephone. When eye **199** is correctly placed, the center of projection of camera **130**, which is an equal distance from optical axes intersection point **191**, along the optical axis of camera **130**, as eyetap point **190** is from optical axes intersection point **191**, along the optical axis of eye **199**, which lines up with the approximate center of projection of the lens of eye **199**.

Correct alignment of the apparatus with respect to the user results in increased performance, so aremac **140** may be fitted with nose bridge support **145**, to help in registering the apparatus against the user's face, in the proper manner. Nose bridge support **145** may be adjustable by the user, or custom-made/adjusted for a specific user.

FIG. **2***a* depicts an embodiment of the invention in which a portion of the field of view that would otherwise pass through the center of projection of a lens of an eye of the wearer of the apparatus is diverted by way of beamsplitter **116** into a real camera **130**. Beamsplitter **116** diverts light between rays **110** and **120**, while light beyond these (e.g. beyond ray **210** to the left, or beyond ray **220** to the right) is not affected by the apparatus and passes straight through to eye **200**.

Ordinarily cameras are responsive to rays of light that meet at a center of projection of the camera, and these ordinary cameras will be referred to as real cameras. Similarly ordinary light sources produce diverging rays of light, and will be called real lights.

Real lights produce diverging rays of light and real cameras are responsive to converging rays of light.

A special kind of camera that is responsive to diverging rays of light may be constructed, and is called a virtual camera. A simple example of a virtual camera is an ordinary camera with the lens deliberately set out-of-focus, where the distance between the lens and the sensor array is less than it would normally be for proper focus. In particular, for a particular distance between lens and sensor array, instead of focusing a point to a point, it focuses a point to the entire sensor array, and thus the camera becomes responsive to rays passing through a single point, such that each element of the sensor array is responsive to rays of light having a certain angle of azimuth and elevation as they pass through this single point. Other kinds of virtual cameras may also be built using a sensor array, and alternative optical arrangements.

Virtual camera **250** receives diverging rays of light from eye **200**, providing information about an eye of the wearer of the apparatus, and may, for example, provide information such as degree of flex of the lens of the eye of the wearer of the apparatus, or a view into the eye. A view into the eye results from rays of light passing through the lens of an eye **200** of the user.

Virtual camera **250** and real camera **230** are fed to processor and combiner **260** to produce output pictures or output video. This output video has forensic value if it can be shown that the video must have been taken from a particular eye of a particular individual. Eye information is also useful in controlling the real camera, and the image acquisition process. In some embodiments, virtual camera **250** is or includes a normal real camera with optics to provide convergence of light rays and magnification for a close up view of the eye to determine direction of gaze, etc.

The acquisition, storage, or transmission of images may also be governed by attributes of eye **200**. For example, when the pupil of eye **200** is dilated more than it would normally be for a given light level, pictures can be taken more rapidly, or picture capture can be initiated when none would normally be initiated, or a circular buffer can be stopped, dumped to storage, or transmitted. Since camera **130** can be used as an array of lightmeters, an inference can be made about how much pupil dilation would be expected for a given light level and scene contrast. Also, the system may "learn" what is normal in terms of pupil dilation for various light levels. It is well known that physiological effects of fear can cause eye pupils to open up, such that a wearable camera system responsive to such opening may be useful as a personal safety device for reducing crime.

FIG. **2***b* depicts an embodiment of the invention in which the virtual camera is a retinal camera. Retinal scanners are well known in the art of security and access control.

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Accordingly, a retinal camera can be used to provide, through processor and combiner **260**, an image which is cogent and compelling evidence that the wearer of the apparatus of the invention was present at the scene of the picture or video captured. For example, a court could be convinced that a picture of a car accident must have been taken by the right eye of a person accused of committing a robbery in another part of the city. If it can be shown that the two events were simultaneous, such evidence may, for example, be used to show that the wearer of the camera must not have been present at the scene of the crime and therefore must not have committed the crime for which he was accused. Therefore, the apparatus can function as a personal safety device insofar as it may be used to occasionally capture pictures of known subject matter.

Moreover, the virtual camera comprising sensor array **251** and optics **252** also includes a directional filter **253**, such that there can be sufficient gain applied to the system, so as to see into the eye **200**, and therefore to see what the eye **200** sees, as a view from within eye **200**. In particular, because the directional filter attenuates unwanted rays of light, a sensor array of greater sensitivity can be used, such that the overall system can be made more responsive to desired rays of light before the response will be contaminated by undesired rays of light. The image will thus include aspects of the eye that make the image unique to that eye. If eye **200** has transfer function G, then the image from the virtual camera will be affected approximately as G^2, having captured light passing through the eye twice (once in, once out). Thus the output from real camera **130** may be used to compensate for G, and calculate a true eyeview image by processing the output of both cameras with processor **260**. A true eyeview image has certain desirable expressive and artistic characteristics that define a new genre of videography, which is of great value in certain kinds of documentary video shooting.

FIG. **2***c* depicts a housing for a typical embodiment of the invention. A first opening **280** in the housing admits light. Camera **130** is protected by a transparent window **231**. A second opening **290** comprises a transparent window. This embodiment of the electronic newsgathering system is preferably sealed and waterproof, such that it may be used to capture experiences like waterskiing from a first-person perspective. Opening **290** may also include an eyecup that seals around the eye so that the apparatus can be used underwater.

The housing depicted in **2***c* is suitably shaped for a right eye **200**. Real camera **130** would rest upon the nose bridge, or the right portion of the nose bridge. There may also be two identical units, one for each eye, so that recordings can be made in stereo. In this case the left eye side would be an approxiate mirror image of the right eye side, or both units may be built into a single housing in which cameras **130** for both right and left sides rest on the nose bridge.

FIG. **3***a* depicts an embodiment of the electronic newsgathering apparatus using a camera in which a portion of the rays of light from ray **110** to ray **120** that would otherwise enter right eye **200** is instead diverted by diverter **116** to a camera comprised of sensor array **331** and optics **332**. In this way right eye **200** has an unobstructed view, but is also made to function, effectively, as the camera for the electronic newsgathering system. The output of sensor array **331** is passed through processor **335** to aremac **340** where it is directed by mirror **315** and/or beamsplitter **316** into the left eye **300** of a user of the apparatus. In this way, the apparatus causes the user to experience two right eyes.

The term "seeing crosseyed" is ordinarily used to mean a condition when one is suffering from strabismus, or one who is deliberately directing the eyes in an unnatural fashion such as one does when trying to see a stereo image pair. Since the apparatus of FIG. **3***a* causes one eye to become crossed over to see out through the other eye (e.g. is crossed over to be responsive to the other eye's eye-tap), such an apparatus will be called a crosseye-tap camera.

Typically a mirror **315** is used rather than a beamsplitter **316**, so that at least a portion of the field of view of the left eye **300** is blocked from seeing anything other than a reconstructed version of rays **110** to **120**. The reconstructed rays span the same field of view as the original rays **110** to **120**. In this way, both the left eye **300** and right eye **200** effectively see out through the right eye **200**. This allows the operator of the newsgathering system to use both eyes to see through the one eye (right eye) that is the eye that is, in effect, the camera. Ordinarily videographers shoot with a camcorder over the right eye, and use the left eye to supply context (e.g. to anticipate what will enter the frame), causing there to be a difference between the two views. However, with the apparatus of the invention, the views are united, and the operator becomes, in effect, a monocular cybernetic organism in which all processing capability of the human brain and its visual system is directed to the right eye. The left eye therefore experiences somewhat of a television image of what the right eye is seeing, and the right eye functions as the camera as well as functioning as the contextual eye to anticipate what will enter or leave the frame.

This embodiment of the apparatus of the invention, when manufactured in a wearable form (e.g. covertly concealed in eyeglasses) may be used for meta documentary, such as when shooting a documentary about shooting a documentary. In meta documentary, the wearer of the glasses carries an ordinary camcorder and records the experience of looking through the viewfinder of the camcorder. In this way the wearer, in effect, has two right eyes, one which is natural and is the camera that shoots through the viewfinder of the camcorder, and the other that is a viewfinder for the viewfinder of the camcorder. Thus the wearer can capture a true and accurate depiction of what it is like to walk around with a camcorder, so that those viewing the documentary are, in effect, taken inside the eyecup of the camcorder viewfinder so they can vicariously experience the making of a documentary. The camcorder need not actually record, but may in fact be nothing more than a prop.

Known cameras fit over one eye, so they can be rotated sideways when the user wishes to shoot in portrait mode rather than landscape mode. However, the apparatus of the invention depicted in FIG. **3***a* fits over both eyes, and cannot therefore be easily rotated as a whole unit, without having it uncover one or both eyes. Accordingly, the apparatus is preferably constructed so that aremac **340**, or at least the active portion thereof, may be rotated together with sensor array **331**, so that both can be simultaneously changed from landscape to portrait orientation or the like. Preferably both are mounted in a single housing **310** which rotates within the housing **311** which holds the rest of the apparatus depicted in FIG. **3***a*. Rotatable housing **310** allows any orientation between and including portrait and landscape to be selected. For example, it may be desired to shoot on the diagonal.

Thus the display is arranged so that when the electronic newsgathering apparatus of FIG. **3***a* is held up to a face of the user, the display is observable a second eye of the user, and the display is arranged so as not to be seen by a first eye when the apparatus is held up to both eyes of the user.

Housing **310** is mounted inside a second housing **311**. The second second housing **311** may be wearable, and the first

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housing is rotatable around an axis of rotation parallel to a line going through both eyes of a wearer of the second housing.

FIG. **3***b* depicts an alternate embodiment of the crosseye-tap camera of the electronic newsgathering invention. This embodiment is handheld rather than wearable, and thus includes a handle **370**. Handle **370** also includes controls, such as a control to **376** to select from among portrait or landscape modes of operation, and a capture button **375** to grab and transmit a picture to a remote site.

Since a handheld camera cannot be readily used for meta documentary (which requires a right eyeview since most camcorders are right eyed), the device may be either left-eyed or right-eyed. In the drawing, a left-eyeview system is depicted, where the roles of the eyes is reversed from that depicted in FIG. **3***a*, so that in this embodiment the effect is to have two left eyes while looking through the viewfinder. The left eye is, in effect, the camera, and the right eye sees out through the left eye by way of the aremac. Additionally, a reticle generator **360** is added, so that a small viewing rectangle may be superimposed over the left eye, in addition to the television image of the left eyeview that is presented to the right eye. Reticle generator **360** may be of a simplified design such that it can present the image of a reticle that moves in accordance with the vergence of the eyes or the focus of the camera, such that the rectangular outline or grid of the reticle in the left eye aligns with the video picture displayed to the right eye.

FIG. **4***a* depicts an embodiment of the eye-tap camera, which is similar to the crosseye-tap camera depicted in FIG. **3***a* (and like parts have been given like reference numerals), except that the aremac **340** has been replaced with a scanner **440**. Since there is no mirror between left eye **300** and scanner **440**, a left-right image reversal circuit **336** processes the video signal so the image will be flipped L-R.

FIG. **4***b* depicts the left retinal view of the scanner of this embodiment of the electronic news gathering invention, referencing FIG. **4***b* along with FIG. **4***a*. A raster is generated on the retina of left eye **300**, where text, video, or graphics, or any combination of these, is presented to the user of the apparatus. In practice, processor **335** is typically a wearable computer running the Linux operating system with the XFreeS6 variant of X-windows, so that the material on left eye **300** is typically X-windows which display a combination of textual and graphic information together with video from the right eyeview camera. Alternatively, SVGAlib is often used. For simplicity, however, suppose that the material to be displayed is a single letter of the alphabet. The first letter of the alphabet for which one can determine its orientation is the letter "F", so consider the letter "F" displayed on the left retina in raster **445**. Suppose the background **446** is black, while the foreground **447** is white. While scanning the information onto the retina, scanner **440** also scans information from the retina by compensating for the different illumination between **446** and **447**. Most notably, the scanning process is active, and the amount of drive is simply varied to scan information onto the retina, while at the same time, measuring the result. Thus the image combiner and information processor **460** (which may be included as part of the same wearable computer system as processor **335**) can produce an output image that is responsive to aspects of the left eye of the wearer of the apparatus, including identifying attributes of the left eye **300**.

FIG. **5***a* depicts an embodiment of the electronic news-gathering system based on a contact-lens camera system where light rays **110** to **120** are diverted to scene camera **130** as before, but additionally there is a second camera **530** which is aimed, by way of the diverter, at the eye, such that it captures an image from the eye location as a reflection of the scene in a mirrored contact lens **540**. For example, ray **120** is reflected off the mirrored contact lens as ray **520**, entering camera **530**. The contact lens acts as a curved mirror to provide a reflected image. Distortion is corrected by camera optics in camera **530**, or by processor and combiner **560**.

The contact lens camera provides an image of the subject matter in view of the eye, wherein the image is responsive to the gaze of the eye. For example, the contact lens provides a limited field of view, with emphasis to subject matter twice as off-axis as where the eye is looking. When the eye looks to the right, the contact lens moves with it, so subject matter to the right is imaged, and rays, such as ray **110** coming from the left do not hit the mirrored contact lens and are thus reflected weakly. The weak reflection of ray **110** is denoted as dashed line **510**. Accordingly, processor **560** can calculate the gaze pattern by way of comparison of the two images, such that comparison of the two images results in an eye-tracker. Other embodiments include different kinds of special contact lenses that assist in the user-interface between the apparatus of the invention and the operator.

FIG. **5***b* denotes a display based on a contact lens. A special contact lens is made wherein there is a central portion **542** which has special optical properties, allowing the wearer to see or experience a display, and there is an outer portion **543** which allows the wearer to see normally, by seeing around the special portion **542**. Owing to the natural opening and closing of the eye's own iris, the display will become more dominant when the iris closes in bright light. Thus a dim display will still be visible in bright light. Conversely, when the eye's own iris opens in dim light, the display will have a lesser degradation on the wearer's natural non-display view of the world. Likewise dilation of pupils which is a natural reflex action in dangerous situations will have the effect of bypassing a good part of the display.

Rays of light **545** passing through the center of the contact lens will be affected by special portion **542**, resulting in altered rays **546**. Rays of light **567** not passing through this central region but still entering the lens of eye **500** will not be affected, so they will enter as if the special contact lens were absent from the eye **500**.

In some embodiments of the invention, the central portion **542** of the contact lens consists of nothing more than a small magnifying lens of focal length approximately 2 centimeters, and the contact lens is used together with special eyeglasses having a spatial light modulator (SLM) imbedded within the glass, directly in front of the eye. In such embodiments, the magnifying lens allows the wearer to read text and examine image material presented by the SLM inside the glass of the eyeglass lens. Covert versions can easily be built having the appearance of ordinary eyeglasses, wherein there is an eyetap camera in the opposite eye, which feeds the contact lens display.

In other embodiments, the central portion **542** is a diffraction grating which causes there to appear a reticle, graticule, or similar aiming aid. The diffraction grating is driven by a small laser concealed in other wearable items such as eyeglasses or a hat.

Another embodiment of the contact lens display makes use of markings within the contact lens itself. These are typically four "L" shaped corner marks. Alternatively, two bracket marks can be used, to denote the left and right edges

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of the picture boundary. When such markings are driven (illuminated) by a point source outside the contact lens (e.g. in a hat or in eyeglasses), a strong lens is also placed over the markings so that they will be seen as sharply defined markings in an out-of-focus circle of confusion caused by the eye's inability to focus on such a strong lens. In this case, the focal length of the lens is not particularly critical, so long as it creates an out-of-focus condition. Accordingly, it should have focal length shorter than about 3 to 5 centimeters. For example, a lens of focal length equal to 2 or 3 millimeters will ensure that a point source a centimeters away or further will be out of focus. The lens may also have negative focal length in order to make the point source appear out-of-focus.

Alternatively, one or more laser diodes may be imbedded in the contact lens and driven inductively by a small coil located therein. The coil may either be out of focus because of contact with the eye and would not interfere with normal vision or it may be located beyond the iris opening of the eye. Since electrical power is conveyed to the lens anyway, it may be desirable to make use of the availability of this power by also including a spatial light modulator, also responsive to this electrical power source. A circuit in the contact lens may also multiplex power to different elements of the spatial light modulator in accordance with different attributes of a signal conveyed along with the electrical power source. In this way a crude but useful viewfinder with variable graphics display may be implemented.

The effect of such a contact lens is to provide markings superimposed upon the real world. Such markings give the wearer a sense of photographic composition and scale. Even when a photojournalist is not shooting pictures or video, the contact lens of the invention may be useful in "sizing up" the scene, and in helping the journalist see the world with a "photographic eye". In particular, by constantly viewing the world through markings, a graticule, reticule, or the like, the wearer experiences a heightened sense of awareness of photographic composition. A clock, or other very simple but useful indicator may also be incorporated into the contact lens, by fitting the central portion with liquid crystal elements, each responsive to different signals received by the coil.

FIG. **6** depicts an image authentication aspect of the electronic newsgathering system. Inside the wearer's body **600** there is implanted a computer **610** which is powered remotely (preferably through inductive coupling) by way of a wearable newsgathering system **620**. There is between the wearable unit **620** and the implantable computer **610** a cryptographic protocol wherein images acquired are watermarked as having been captured by the wearer **600**. Moreover, in addition to the forensic value of the images or video so captured, there may also be provided a security system in which theft of apparatus **620** is discouraged by the fact that apparatus **620** requires implantable computer **610** to be in close proximity in order to operate. Whether this theft is because of the value of apparatus **620** itself, or the value of the data contained therein, the apparatus is still protected. For example, if user **600** removes clothing containing apparatus **620** in order to take a shower or the like, apparatus **620** will have little or no value to thieves. Moreover, apparatus **620** will be preferably designed so that there is a self destruction feature that will render data contained therein useless to one who attempts to force apparatus **620** open.

Implantable computer **610** may also be similarly protected from those who might try to murder wearer **600** and cut open his or her body to obtain implantable computer **610**. Computer **610** may in fact be such that it senses vital signs and self destructs in their absence. Similar attempts to penetrate **610** may cause it to self destruct. Computer **610** may also contain a cryptographic protocol to protect it from being detected by unauthorized individuals who might, for example, attempt to use it to track the wereabouts of wearer **600**.

FIG. **7** depicts a personal safety device in which cabling **710** encircles the wearer **600** of the apparatus. Cabling **710** is typically made of heavy security cable, which is similar to aircraft cable but designed so that it cannot be easily cut with bolt cutters, hacksaws, or the like. In this way, clothing incorporating cabling **710** cannot be easily removed by individuals who might attack the wearer **600**. Cabling **710** is typically locked together by means that only the wearer can open. A remote escrow can also be used to protect the wearer from torture or other forms of forced disclosure of the unlocking means.

Should adversaries attempt to undress the wearer by drastic measures such as liquid nitrogen or acetylene cutting torches, once the circuit comprising cabling **710** is broken, thyristor **720** switches on by way of resistor **730** between its anode and gate. When thyristor (typically an SCR) **720** is turned on, current from high voltage power supply **740**, and parallel capacitor **741** completely destroys apparatus **620**.

Insofar as apparatus **620** might be or include a life-support system, or for other reasons that cutting through cabling **710** would result in death of the wearer, it is preferable that cabling **710** be sufficiently durable as to withstand most attempts to remove apparatus **620**, and that cabling **710** be in two stages, a first stage of cutting through which activates a distress signal indicating an attempt to kill wearer **600**. Chemicals, for example, a marker chemical such as that sold under the trade name Dye Witness™, are preferably automatically released, under extremely high pressure, by apparatus **620**, at a first stage of attempted disrobing by assailants. In this way, the perpetrators of the attempted murder or similar crime will be identifiable, and will also be discouraged from cutting further through cabling **710** after knowing that they have already been so marked for identification. Moreover, the crime scene will be marked. Furthermore, very loud ear-piercing alarms may be activated, to scare off attackers or to interfere with their ability to continue with their criminal activity.

FIG. **8** depicts the system architecture in which camera **810** of eyewear **800** transmits through antenna **820** to remote site **830**. At remote site **830**, a collection of remote experts **840**, some of which may be human experts (technicians, legal experts, scholars, etc.) and some of which may be computer agents or other kinds of computer programs. The experts at site **840** modify the images received from camera **810** and then send those images to transmitter **850** which is picked up by the eyewear receiver **870** and displayed on the head mounted display (HMD) aremac **870**. Camera **810** and television (HMD) **870** are both typically housed in eyeglasses, and collectively, in the context of this entire system, allow the remote experts **840** to augment, diminish, or otherwise alter the visual perception of reality of the wearer of eyewear **800**, and therefore establish not only a means by which images are transmitted from the wearer's camera **810** to one or more remote sites, but also allow the remote sites to communicate directly with the wearer by way of modifying the image stream. Typically the wearer might be a photojournalist or videographer, and simple examples of this modification of the image stream might include recognization of the identity of individuals in pictures sent by the journalist, and insertion of virtual name tags in the form of virtual text or graphics overlays upon the journalist's viewfinder aremac **870**.

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FIG. **9** depicts a system including a personal imaging computer in which some of the functionality embodied in the panel of remote experts **840** is instead embodied in a wearable system. In actual practice, the expertise may come from computer programs running on systems worn on the body of the journalist, from systems remotely accessed by the journalist, or from remote human intelligence. FIG. **9** is characterized by a computer **970** that operates constantly, but is configured so that it does not restrict the journalist **999** from doing other tasks. For example, computer **970** may include a camera which constantly takes in information **950**, from the environment, and is thus constantly attentive to the environment even when it is not being explicitly used. Computer **970** might, for example, constantly compare incoming camera signals against a database of faces of people who the journalist might wish to interview, so that the journalist can recognize people he or she has never met before. This information from the camera may be observable by the journalist by way of a viewfinder which completes path **930** of information from computer **970** to journalist **999**. With such a configuration, computer **970** may be interposed between the camera and aremac (viewfinder) of FIG. **1**.

The unencumbering (unrestrictive) nature of the apparatus of the invention is expressed by signal flow **920** from the human, outward. Moreover, computer **970** is unmonopolizing of the journalist's attention, and is configured so that the journalist does not need to pay the level of attention to the computer that is typical of normal desktop or laptop computers. Preferably the journalist uses a reality-interface metaphor to the computer, so that information, for example, can appear where the journalist is already looking (such as at the person he or she is interviewing), rather than requiring undivided attention of the journalist as might be the case with a conventional graphical user interface found on most desktop computers. This signal flow **910** denotes input from the environment to the human (journalist). There is also signal flow **930** from the computer to the journalist and signal flow from the journalist to the computer **940**. Since the computer **970** is constant in operation, at any time, it can respond to signal control **940**, unlike a traditional laptop computer which must ordinarily first be turned on and booted before becoming responsive to input. Thus the system assists in being always ready to cover any newsworthy event that might happen without notice. Furthermore, since the computer **970** is always running, it is always taking in information **950** in the environment. For example, the system is always taking pictures and video whether or not there is a need for pictures or video. In this way, a retroactive record function may, for example, be implemented. Moreover, a remote (or local) expert might recognize someone of importance even if the journalist is not paying attention to his or her viewfinder.

Signal path **950** into the computer, and a signal path **960** out of the computer also include a high-speed communications link with other computers on the network, so that the computer is preferably online (CONNECTED) constantly.

The entire system is worn on the body of the journalist **999**, within clothing **980**, so that it is a personal effect of the journalist and is therefore also perceived by others as a personal effect of the journalist, rather than something that the journalist carries in a satchel or case. In this way, it is less likely that others will ask the journalist to leave the apparatus behind, since it would be unreasonable of someone to ask the journalist to leave his or her clothes behind. While a shopkeeper, for example, may ask a journalist to leave a bag or briefcase at the front counter of a department store, it is less likely that a shopkeeper would ask the journalist to undress and leave his or her clothing at the front counter.

FIG. **10** illustrates the covert typing and data-entry device which may be used to achieve signal flow **940** (that the computer is CONTROLLABLE) of FIG. **9**. Spring-loaded rocker switches **1010** function as both momentary and latching switches, while pushbutton switches **1020** function as momentary-only switches. Belt mounted switches **1010** and **1020** are connected to the computer by connector **1030**. The belt may be concealed under a heavy sweater or jacket, and permits control of the body-worn computer system, such as may be desired to covertly type a query to a remote expert while conducting an investigative interview. In this way, rather than having to call for remote advice by telephone, little or no sound is made in this process, and it is not as easily for others to eavesdrop on this virtual conversation, as might be facilitated by the UNIX "talk" command or the like.

FIG. **11** depicts a computer-mediated reality as seen from the perspective of the journalist. This figure depicts three frames of a video sequence taken from the journalist's viewfinder. The journalist, doing a story on the honesty of cashiers in explaining refund policies, looks at a cashier **1110** in a department store. The viewfinder of the system of FIG. **9** provides the journalist with additional information in the form of an overlay **1120**. As the journalist turns his head to the right, the cashier **1130** moves to the left in the viewfinder, as we normally expect when looking through a viewfinder. However, computer **970** of FIG. **9** provides extra information **1140** to the journalist, which moves with the cashier, so that computer **970** sustains the illusion of a rigid planar patch. In this way, the real and virtual objects remain connected. Even when the cashier **1150** begins to fall off the left side of the viewfinder as when the journalist turns his head so far to the right as to no longer be able to see the cashier's face, the extra information **1160** is still, in part, visible, and the illusion of attachment is sustained. This is an example of a reality-user interface that does not require that the journalist pay full attention to the computer task.

FIG. **12** depicts an application in which the end-user uses the system of FIG. **9** to read a newspaper, or in which content producers can collaborate in a shared virtual space.

Referencing FIG. **9** and FIG. **12**, as the user walks down corridor **1210**, a virtual newspaper is displayed on wall **1220** by computer **970**. The newspaper is presented to the reader in a way that it appears to be a rigid planar patch attached to the wall **1220** of corridor **1210**. In this way a journalist can write a story upon the walls of the corridor, and others who wear the appropriate apparatus can read the story. This may allow, for example, the journalist to write a story about this very corridor, and place it in the corridor for reading, so that those reading the story may, for example, re-live an experience as a virtual past. Alternatively, it allows journalists to work together in a virtual space to leave messages for each other. For example, a person who was physically assaulted and unlawfully detained for having taken a picture in a Shell™ gas station variety store on Spadina Avenue in Toronto, could leave a virtual message to other users of the apparatus, warning them of illegal and potentially dangerous past activity of a particular Shell gas station employee.

There have been many situations in which owners of shops and other establishments have committed crimes, such as the murder of Latasha Harlins who was falsely accused of shoplifting and fatally shot in the back by a shopkeeper. Thus it is preferable that these shop owners not have a monopoly on video surveillance.

In addition to shops and other organizations using their own video surveillance networks for the purposes of stalking and attacking people entering their organization, there is the problem that these perpetrators may attempt to committ undocumented crimes by avoiding their own surveillance network, or erasing data therein.

Thus the utility and value of an intelligence collective of citizens, photojournalists, and the like, living in a shared computer mediated reality environment, is quite evident, especially when members of the collective may post virtual warning messages, danger signs, and the like, that owners of establishments would not ordinarily wish be seen or known. When citizens do not own the physical space, they may not put real markings and real signs up. Hence the value of a system such as that depicted in FIG. **12** in which citizens, journalists, etc., may post virtual notices within business establishments and dangerous places is quite evident.

BENEFITS OF THE INVENTION

The present invention allows the journalist to experience the camera over a long period of time. For example, after wearing the apparatus all day for several weeks, it begins to function as a true extension of the mind and body. In this way, photographic composition is much more optimal, because the act of taking pictures or shooting video no longer requires conscious thought or effort. Moreover, the intentionality of the picture-taking process is not evident to others, because picture-taking is not preceded by a gesture such as holding a viewfinder object up to the eye. The wearable viewfinder is an important element of the wearable camera invention allowing the journalist to experience everyday life through a screen, and therefore be always ready to capture anything that might happen, or even anything that might have happened previously by virtue of the retroactive record capability of the invention. Moreover, additional information beyond just exposure and shutter speed may be displayed in the camera viewfinder. For example, the camera allows the journalist to augment, diminish, or otherwise alter his or her perception of visual reality. This mediated-reality experience may be shared. The journalist may allow others to alter his or her perception of reality. In this way the invention is useful as a new communications medium, in the context of collaborative photojournalism, collaborative videography, and telepresence for intelligence augmentation for purposes of conducting an interview.

The apparatus of the invention captures a natural first-person perspective, and allows the user to take better pictures or video, especially in embodiments in which both eyes are effectively co-located. Some embodiments also provide for improved security and personal safety, as well as for forensic aspects of the pictures or video captured.

OTHER EMBODIMENTS

From the foregoing description, it will thus be evident that the present invention provides a design for a wearable camera with viewfinder means. As various changes can be made in the above embodiments and operating methods without departing from the spirit or scope of the following claims, it is intended that all matter contained in the above description or shown in the accompanying drawings should be interpreted as illustrative and not in a limiting sense.

Variations or modifications to the design and construction of this invention, within the scope of the appended claims, may occur to those skilled in the art upon reviewing the disclosure herein. Such variations or modifications, if within the spirit of this invention, are intended to be encompassed within the scope of any claims to patent protection issuing upon this invention.

I claim:

1. A portable electronic camera device including an electronic camera and an electronic display, said electronic display responsive to an output from said electronic camera, said electronic display being, in use, viewable by an eye of a user of said portable electronic camera device, and reflective optics arranged for reflecting light such that at least a portion of a first set of converging rays of light which would, absent said reflective optics, converge at said eye is reflected to a second set of converging rays directed at the center of projection of said camera, wherein said reflective optics is further for reflecting light from said electronic display such that said reflected light from said electronic display forms a third set of converging rays approximating said first set of converging rays, in order to provide substantial exact registration of what would have been seen by said eye, in the absence of said portable electronic camera device, with what, in the presence of said portable electronic camera device, is seen at said eye.

2. The camera device as described in claim **1**, where at least a portion of said camera device is wearable.

3. The camera device as described in claim **2**, where said electronic display is visible to said eye, and subtends a visual field of view that is equal to the visual field of view of said electronic camera.

4. The camera device as described in claim **2**, where said electronic display is an aremac, and where a given ray of light from said aremac is an output ray, said output ray being from an element of said aremac primarily responsive to a corresponding element of said camera that is primarily responsive to a particular input ray of light, said output ray and said input ray being approximately collinear.

5. The camera device as described in claim **2**, wherein said third set of converging rays converge at a point which, in use, is at said eye and wherein said electronic camera is a real camera responsive to real rays of light going towards said point and collinear with lines passing through said point, and further including a virtual camera, said virtual camera responsive to virtual rays of light going away from said point and collinear with lines passing through said point.

6. The camera device as described in claim **5**, where said virtual camera is responsive to at least one aspect of an eye of a wearer of said camera device.

7. The camera device as described in claim **6**, where said at least one aspect includes the direction of gaze of said eye.

8. The camera device as described in claim **6**, further comprising a wearable processor responsive to an output of said real camera and responsive to an output of said virtual camera and where said at least one aspect includes the amount of pupil dilation of said eye, where said wearable processor determines from said electronic camera an amount of light present in subject matter in view of said eye, and where said virtual camera is responsive to pupil dilation, such that pupil dilation in excess of that which would normally accompany said amount of light present, causes images to be captured, stored, or transmitted at greater frequency, or flagged as images having greater importance than would be the case with pupil dilation not in excess of that which would normally accompany said amount of light present.

9. The camera device as described in claim **5**, where said virtual camera is responsive to at least one identifying attribute of an eye of a wear of said camera device.

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10. The camera device as described in claim 5, where said virtual camera is a virtual retinal camera.

11. The camera device as described in claim 1, where said eye is a first eye, and where said electronic display is arranged so as to be observable by a second eye of a wearer of said camera device.

12. The camera device as described in claim 11, where said electronic display subtends the same angle of field of view as the angle of field of view of said electronic camera.

13. The camera device as described in claim 11, where said electronic display is arranged so as not to be seen by said first eye.

14. The camera device as described in claim 13, where at least an active portion of said electronic display and at least a sensor array of said electronic camera are both mounted in a rotatable housing, so that they can both be rotated together in unison.

15. The camera device as described in claim 14, where said rotatable housing is a first housing, where said first housing is mounted inside a second housing, said second housing being wearable, and said first housing being rotatable around an axis of rotation parallel to a line going through both eyes of a wearer of said second housing.

16. The camera device as described in claim 13, where said electronic display is part of a device comprising a scanner displaying display information to said second eye and also deriving derived information from said second eye, said derived information being conveyed to said wearable processor, along with picture information from light diverted from said first eye, and further including a processor responsive to attributes of said second eye and a scene in view of said first eye.

17. The camera device as described in claim 2, housed within a unit that also functions as a telephone, and said telephone providing means of wirelessly sending pictures acquired by said electronic camera to a remote location.

18. The camera device as described in claim 17, said telephone including two folding and unfolding arms, one of which is a mouthpiece, and another of which is an eyepiece, and further including a main body to be held over an ear of said user, and where said mouthpiece flips out over said user's mouth, as with a conventional folding cellular telephone, and where said third arm flips out over an eye of said user of said telephone, said eyepiece containing said electronic camera and said aremac.

19. The camera device as described in claim 2, further including a bidirectional data communications link to at least one remote site, said bidirectional data communications link providing means for images to be simultaneously sent from said electronic camera to said at least one remote site and also further including means for images to be received from said at least one remote site and displayed to said user by way of said aremac.

20. The system as described in claim 19, further including image processing means for images received at said remote site, to produce modified images at said remote site, and means of sending said modified images from said remote site to said electronic display.

21. The camera device as described in claim 1, where said camera device may be held up to a face of said user where said eye is a first eye, and where said electronic display is arranged so as to be observable by a second eye of said user when said camera device is held up to both eyes of said user, and where said electronic display is arranged so as not to be seen by said first eye when said device is held up to both eyes of said user.

22. The camera device as described in claim 1, where said electronic camera is a scene camera, and further including a contact lens camera, said contact lens camera comprising:

a second camera;

optics comprising a mirrored or reflective contact lens, said optics providing said second camera with a reflected view of subject matter in view of an eye of a wearer of said mirrored or reflective contact lens.

23. The camera device as described in claim 1, further including a contact-lens to be worn on said eye, said contact lens comprising:

a central portion, said central portion having at least one of:

a lens of focal length less than 3 centimeters;

a diffraction grating embedded within said contact-lens;

a lens of focal length less than 5 centimeters, said lens containing markings;

an inductive pickup coil around the periphery of said contact-lens and a light source responsive to said inductive pickup coil,

a peripheral portion, said peripheral portion not appreciably affecting rays of light passing through it.

24. The camera device as described in claim 1, further including a contact-lens to be worn on said eye, said contact lens comprising:

an inductive pickup coil around the periphery of said contact-lens;

a light source responsive to said inductive pickup coil;

a spatial light modulator, said spatial light modulator embedded in said contact-lens between an eye of a wearer of said contact-lens and said light source, said spatial light modulator responsive to said inductive pickup coil.

25. A personal safety device, including the camera device described in claim 1, further including an implantable computer, implanted within said user's body, said implantable computer deriving its power source from said camera device, where said camera device is not implanted within said user's body, said implantable computer having a bidirectional data communications link with said camera device, said camera device including means for providing at least one of the following functions:

becoming inoperable without being in close proximity to said implantable computer;

self-destruction if separated from said implantable computer in an unauthorized manner;

erasure of at least some of the data contained therein if separated from said implantable computer in an unathorized manner.

26. The camera device as described in claim 1, further including a strong conductive cable incorporated in clothing, and further including control circuits responsive to electricity flowing through said strong conductive cable, such that severing said strong conductive cable will result in at least one of the following:

self-destruction of at least some portions of said camera device;

erasure of at least some of the data contained within said camera device;

release of chemicals which can be used to aid in the capture of perpetrators of a crime.

27. The camera device as described in claim 1, housed within a unit that also functions as a telephone, and said telephone providing means of wirelessly sending pictures acquired by said electronic camera to a remote location.

28. The camera device as described in claim 1 further including a wireless communications link to at least one remote site.

29. The camera device as described in claim 28, where said wireless communications link is a video communications link.

30. The camera device as described in claim 29, said video communications link providing means for sending images from said electronic camera to at least one remote site.

31. The camera device as described in claim 1 further including a wireless communications link to at least one remote computer.

32. A personal imaging system including the camera device of claim 1 further comprising image capture means, where an image produced by said image capture means is responsive to subject matter in front of a user of said personal imaging system, and where said image is also responsive to an attribute of an eye of said user, said personal imaging system being worn by said user such that it may be aimed at said subject matter without use of a hand of said user to hold said personal imaging system.

33. A personal imaging system, as described in claim 32, where said image is responsive to an attribute which is sufficient to uniquely identify said user.

34. A personal imaging system including the camera device of claim 1 and further comprising a light-tight housing containing a sensor array and having a first opening to admit light from subject matter and a second opening for an eye opposite said first opening, such that light passing through said first opening emerges through said second opening and passes into said eye, and then said light emerges from said eye and enters said second opening and then forms an image responsive to said eye and said subject matter.

35. A personal imaging system including the camera device of claim 1 and comprising at least one camera display, and optics arranged for producing two simultaneous pictures comprising a first picture of subject matter in front of a user of said personal imaging system, and a second picture of an aspect of an eye of said user.

36. A hand-held device said hand-held device including the camera device of claim 1 and including an opening for an eye, and means for capture of at least one picture responsive to rays of light coming toward a point approximately located at the center of a lens of said eye, such that during capture of said at least one picture by said means for capture, said eye is afforded with a natural undistorted view of the same rays of light to which said picture is responsive, and in which said eye is also afforded with means of determining the spatial extent of said picture.

37. A hand-held device as described in claim 36, where said hand-held device further includes the functionality of a telephone, operable while holding said opening to said eye.

38. A personal camera system including the camera device of claim 1 and further comprising:

a first camera and optics arranged for imaging light collinear with light entering an eye of a user;

a second camera and optics arranged for receiving light reflected from one of:

(a) an internal feature of said eye; and

(b) a contact lens worn by said eye.

39. The camera system of claim 38 further comprising said contact lens and wherein said second camera and optics is arranged for receiving light reflected from said contact lens when worn by said eye of said user and wherein said contact lens includes a reflective feature whereby a position of said contact lens, and therefore said eye, may be determined by a position of said feature.

40. The camera system of claim 38 including a source of light for illuminating said eye.

41. The camera system of claim 38 further comprising said contact lens and a display wherein said second camera and optics is arranged for receiving light reflected from said contact lens when worn by said eye and wherein said contact lens includes a first portion with a different magnification than a second, remaining, portion of said contact lens, said first portion for imaging onto a retina of said eye.

42. The portable electronic camera device of claim 1, further comprising a processor or computer, said electronic display being responsive to an output of said processor or computer, said processor or computer being responsive to said electronic camera.

43. The portable electronic camera device as described in claim 1, further including a processor or computer, where said electronic display may be made responsive to an output of said processor or computer, and where said processor or computer is responsive to said electronic camera.

* * * * *

Appendix TT

‘WearCam’ (The Wearable Camera):

Personal Imaging Systems for long–term use in wearable tetherless computer–mediated reality and personal Photo/Videographic Memory Prosthesis[ffl]

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Abstract

The purpose of this paper is to disclose the operational principles of ‘WearCam’, the basis for wearable tetherless computer–mediated reality, both in its idealized form, as well as in some practical embodiments of the invention, including one of its latest embodiments. The specific inner workings of WearCam, in particular, details of its optical arrangement, have not previously been disclosed, other than by allowing a small number of individuals to look inside the glasses. General considerations, background, and relevant findings, in the area of long–term use of wearable, tetherless computer–mediated reality, are also presented. Some general insight (arising from having designed and built more than 100 different kinds of personal imaging systems over the last 20 years) is also provided. Unlike the artificiality of many controlled laboratory experiments, much of the insight gained from these experiences relates to the natural complexity of real–life situations.

Keywords: WearComp, WearCam, Personal Imaging, Virtual Reality, Augmented Reality, Mediated Reality, Head Mounted Display, Eyeglass Mounted Display, Head Mounted Camera, Eyeglass Mounted Camera, Camera Viewfinder.

1 Personal Imaging

WearComp systems are convenient to use while walking around, or doing other things, because they bring many of the computing tasks one normally does with a laptop computer or Personal Data Assistant (PDA) into the prosthetic territory of the individual in a very natural and intuitive way[7]. For example, a WearComp allows the user to send and receive email or take notes while walking at a brisk pace along a crowded street, or to consult reference material while working on another task in addition to the computing itself.

However, in addition to just enabling the wearer to perform traditional computing tasks at the same time as the wearer is doing other tasks, there are some important new affordances that WearComp can provide. These new affordances include augmented reality[13][3][4], mediated reality[9][1], and a host of other capabilities that rely on an “always ready” paradigm. Examples of other affordances that rely on this “always ready” paradigm include personal documentary video, as well as shared visual experiences and computer–supported collaboration (telepresence).

Personal imaging systems (WearComp with a properly integrated wearable cameara) form a basis for much of these new affordances[7]. In augmented reality, the use of a wearable camera as part of the system may, for example, assist in head–tracking through the use of object recognition or egomotion estimation. Sutherland, who pioneered augmented reality, relied on a tethered head–tracking device[13]. Feiner, who pioneered many of the modern forms of augmented–reality, also concentrated on tethered systems[3][4]. In contrast to these, a camera–based system provides a tetherless form of head–tracking.

Good head–tracking is important in order to keep the real and virtual objects in good register. Moreover, while augmented reality systems with traditional tethered forms of head–tracking are quite suitable for fixed–location work, mobile forms of head–tracking that will work in any environment are of great benefit to some of the visual affordances of wearable computing. Although other forms of tetherless head–tracking have been proposed in the context of augmented reality and wearable computing[2], they are more suited to applications, such as identifying a user’s location by GPS (Global Positioning System) and magnetometer/inclinometer orientation tracking, and presenting the name of the building the wearer is likely standing in front of to the display[2]. In these applications, registration between the real and virtual worlds is not particularly important. Camera–based head–tracking, however, has the capability of providing extremely good (often even sub–pixel) resolution[9]. Moreover, camera–based tracking can be configured so that it operates in the image coordinates, so that 3D objects can be modeled in the context of 2D pro-

[ffl] Thanks to Kodak, Digital Equipment Corporation (DEC), Kopin, ViA, and Xybernaut for assistance in this project.

[1] See also http://wearcam.org/mediated-reality/index.html

Motorola v. Stellar
Motorola Exhibit 1063
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jective coordinates[9], reducing the computational load to something that can be managed in concealable body–worn hardware. Furthermore, using a camera as a head–tracker also makes it available for camera–based object recognition, which may be of value in and of itself in an augmented reality or mediated reality WearComp system.

In mediated reality, a camera is an essential part of the system, as it forms the basis by which visual reality is interpreted, so that the interpretation of visual reality can be modified, and then presented to the wearer of the system[9].

Another important affordance of personal imaging is that it provides a means of communication. Personal imaging systems not only allow the wearer to augment, diminish, or otherwise alter his or her visual perception of reality, but they allow the wearer to allow others to do so, over a wireless communications link. In this way, a personal imaging system becomes a means of communication[8].

Lastly, incorporating a personal imaging system into ordinary day–to–day life enables it to, through a process of long–term adaptation, function as a true extension of the mind and body.

1.1 Always ready

There are various reasons why it might be desired to wear a personal imaging system over a sustained period of time:

1. There is the capability of generating a personal visual diary of sorts.
2. There is the very simple capability of being always ready to take a picture. By constantly recording into a circular buffer, a retroactive record function, such as a button that instructs the device to "begin recording from five minutes ago" may be useful in personal safety (crime reduction) as well as in ordinary everyday usage, such as capturing a baby's first steps on video. With other prior methods in photography and video, we spend so much time preparing the camera and searching for film, batteries, etc., or at the very least, just getting the camera out of its carrying case, that we often miss important moments like a baby's first steps, or a spontaneous facial expression during the opening of a gift.
3. As mentioned previously, there is the capability that the apparatus, after worn for a long period of time, begins to behave as a true extension of the wearer's mind and body. As a result, it has been found that the composition of video shot with the device is often impeccable without even the need for conscious thought or effort on the part of the user. Moreover, a very natural first–person perspective genre of video results. For example, while wearing an embodiment of the proposed WearCam apparatus, it is possible to capture the experience of looking through the eyepiece of a telescope or microscope, and convey to others this experience, including the approach toward the eyepiece. This characteristic ability of personal imaging was used in the making of the award–winning documentary video ShootingBack[6], which was a meta–documentary: a documentary about making a documentary about video surveillance. In ShootingBack, the experience of using an ordinary hand–held camera was recorded using an eyeglass–mounted camera/personal imaging system. Most notably, an accurate recording of the experience of bringing the viewfinder of an ordinary hand–held camera up to the eye, and then of looking through the viewfinder, was recorded, along with the reaction of individuals to having a camera pointed at them, as seen from a "fly in the eye" perspective. Moreover, the act of making recordings such as ShootingBack, is often done without appreciable conscious thought or effort beyond that needed to perform the task being documented. Traditional forms of video recording do not afford this same kind of true first–person perspective capability.
4. WearComp, which forms the central basis of the apparatus, may be used to enhance images. This capability may be of value to the visually impaired. As previously described, the computer may also perform other tasks such as object recognition. Because the device is worn constantly, it may also function as a memory aid, e.g. to help in way–finding through spontaneous automated recall and display of previously captured images or video.

2 Functional specification of WearCam

The idealized reality–mediator (idealized WearCam) is characterized by three components: a lightspace analysis system; a lightspace modification system; and a lightspace synthesis system.

2.1 The identity requirement

The idealized reality–mediator must be capable of the identity map (when the lightspace modification system passes the lightspace through without modification).

A television system is said to be *orthoscopic* when the recording and viewing arrangement is such that rays of light enter the eye at the same angle as they would have if the viewer were at the camera's location. The concept of being *orthoscopic* is generalized to the lightspace passing through the reality–mediator; the ideal reality–mediator is capable of being (and thus facilitates):

1. orthospatial
   (a) orthoscopic (homographic overlays)
   (b) orthofocal (true 3-D overlays)
2. orthotonal
   (a) orthoquantigraphic (quantigraphic overlays)
   (b) orthospectral (non-metameric overlays)
3. orthotemporal (non-lagging overlays)

An idealized reality mediator is such that it is capable of producing an illusion of transparency, over some or all of the visual field of view, that meets all of the above criteria. Of

course its utility typically arises from slight, and sometimes large deviations from these criteria. For example, violations of the orthotemporal characteristic are useful for embodiments implementing a photographic/videographic memory recall ('WearCam flashbacks')[8].

3 Embodiments of the WearCam invention

The above criteria are typically only implemented in a discrete sense (discrete sampling of lightspace, for example, a discrete frame rate, which itself imposes limitations on sense of transparency, just as in virtual reality[1]). Typically, the apparatus turns lightspace into a numerical description for processing, after which the processed numerical description is converted back to lightspace.

For the idealized reality–mediator, one could imagine the front of the glass as being an idealized holographic video camera and the back of the glass as being an idealized holographic video display, so that when this ideal camera is connected to the ideal display, the glass appears to be transparent to the wearer, and the wearer has the same experience as would be obtained wearing ordinary eyeglasses or ordinary sunglasses. While this somewhat circuitous means of constructing a device to behave as a transparent piece of glass may, at first, seem strange, it is the fact that a computational process may be inserted between the ideal camera and the ideal display that makes this concept interesting. This arrangement makes it possible for the computer to completely mediate (e.g. augment, diminish, or otherwise alter) the wearer's perception of visual reality. Moreover, if some or all of the computing resides at one or more remote sites, or if the body–worn computer system is wirelessly connected to one or more remote sites, the apparatus may allow others to mediate the wearer's perception of visual reality. In this way, the device functions as a new form of visual communication[8].

It is the author's view that such an apparatus is of most benefit when it is worn over a long period of time, so that, as a computational framework, it leads to a constancy of user–interface. In order for there to be widespread acceptance of this apparatus, it should have the appearance of ordinary eyewear. Thus the components of the system should be concealed within ordinary eyewear, or concealable by the clothing and hair of a typical user. Thus the apparatus may take the form of ordinary eyeglasses or ordinary sunglasses. Dark or mirrored sunglasses may also help conceal intricate and sophisticated imaging and display systems.

However, since it may, at times, appear unusual for a person to wear dark or heavily mirrored sunglasses indoors or late at night, it may, at times, be preferable that the system provide others with a view of the wearer's eyes so that others may establish eye contact with the wearer. On the other hand, when the visual perception of reality is so severely mediated, that there is little correlation between the wearer's eye position and the eye position that others expect, it may be preferable to have the glasses remain dark, even indoors, following the convention that blind people often do, of wearing dark glasses at all times. In this case, it has been found that incorrect eye contact (e.g. the blind person's eyes which often bear no relation to expected direction of gaze) is sometimes more confusing or more unsettling to others than no eye contact at all (dark glasses). Ideally, therefore, the darkness of the glasses should be adjustable by the wearer, so that eye contact may be established when mediation of visual reality is moderate, while at the same time providing the wearer with a means of indicating to others, an internal state of alternate reality, by making the glasses turn dark[2]. Of course, an ideal system might also allow the wearer to provide some alternate image that resembles what others might expect the wearer's eyes to look like.

Finally, the apparatus should be unencumbering both in terms of its weight and moment of inertia, as well as visually. By visually unencumbering, what is meant is that it does not interfere with the process of seeing and responding to real–world events. Thus it should be possible to participate in tasks that require a high degree of hand–eye coordination. Ideally the apparatus would also be durable, and weatherproof.

It is the author's belief that these goals may be succinctly captured by the following three extreme tests, where it is understood that these tests far exceed what would be needed for most ordinary everyday use:

1. **The Casino Test:** Casino operators are perhaps the most camera–shy and the most savvy in detecting cameras. Therefore, if the apparatus can pass undetected in the casino environment, under the scrutiny of pit bosses and croupiers, it can probably be used in other establishments such as grocery stores, where photography is also usually prohibited. Use in grocery stores is, for example, of value when one wishes to wirelessly transmit pictures to and from the store to collaborate with a remote spouse on the purchase of fruits and vegetables. It has been a goal of the WearCam project to facilitate telepresence in ordinary day–to–day life such as while shopping, standing in line at the bank, or waiting for a bus. (All three of these examples, shops, banks, and bus terminals, are places where photography is typically prohibited.)
2. **The Sports Test:** A sporting event, such as volleyball, requires good hand–eye coordination, rapid reflexes, but is not too unreasonably demanding of visual acuity, owing to the large size of the ball, nor would it be particularly destructive to the apparatus or wearer were the ball to hit the wearer in the face. Accordingly, being able to play a competitive game of volleyball through the apparatus should be a reasonable test of its visual transparency and quality.
3. **The Rain (Swim) Test:** Finally, it is desired that the apparatus be waterproof, or at least weatherproof. An extreme scenario might be that if one were to fall off of a small sailing vessel or the like, into the water,

[2] Early prototypes were based on various technologies related to Kerr Cells, as might be found in gaming or 3D viewing glasses such as those marked under the trade name "Crystal Eyes"

that the apparatus and wearer would both survive. A suitably sealed unit would thus protect itself and the wearer from any electrical hazards. Moreover, a suitably sealed unit could facilitate the recording of such experiences as waterskiing or sailing in a small vessel where one often pushes the limits of the vessel such that it frequently capsizes.

Of these three, the first two have already been passed by the author. The third remains as a challenge that could be easily solved by proper sealing of the unit, at least to the extent that it might be worn in rainy weather.

The goals set forth in this paper all present a tremendous technical challenge, and may not all be completely realizable, but the purpose of this paper is to describe some of the approaches toward realizing some of these goals.

4 Personal imaging in the context of traditional photography

A traditional camera with viewfinder, held up to the eye, provides a form of personal imaging. Visual perception of reality is typically altered (mediated) in some way. This alteration of reality may take the form of optical distortion in the viewfinder, some amount of offset between the camera's center of projection and the actual center of projection of the eye (to the extent that one cannot readily remove one's eye and locate the camera in the eye socket, exactly where the eye's normal center of projection resides). In the case of cameras with electronic viewfinders, mediation of reality may take the form of colorblindness (a form of *diminished reality*), or at least altered perception ofcolor. Moreover, traditional cameras often *overlay* text, graphics, and other material on top of the visual perception of reality. In the context of traditional photography, a camera absorbs and, in some sense, quantifies, incoming rays of light and its viewfinder, in some sense, reconstructs these rays of light.

Apart from large view cameras and waist–level cameras, upon which the image is observed on a ground glass, most viewfinders present an erect image. See, for example, U.S. Pat. 5095326 entitled "Keppler–type erect image viewfinder and erecting prism". In contrast to this fact, it is well–known that one can become accustomed, through long–term psychophysical adaptation, as reported by Stratton[11][12], to eyeglasses that present an upside–down image. After wearing upside–down glasses constantly, for eight days (keeping himself blindfolded when removing the glasses for bathing or sleeping) Stratton found that he could see normally through the glasses. More recent experiments[3], as conducted by the author, suggest that slight transformations such as rotation by a few degrees or small image displacements give rise to a reversed aftereffect that is more rapidly assimilated by the wearer, and that such effects often have a more detrimental effect on performing other tasks through the camera as well as detrimental flashbacks upon removal of the camera after long–term wearing. These findings suggest that merely mounting a conventional camera such as a small 35mm rangefindercamera or a small video camcorder onto a helmet, so that one can look through the viewfinder and use it hands–free while performing other tasks, will result in poor performance at doing those tasks while looking through the camera viewfinder.

It was also found that the flashback effects, observed after removal of the camera, were worse when the tasks done through the camera had involved a great deal of hand–eye coordination, such as when, for example, making a video recording of the experience of eating or playing volleyball by doing the task while concentrating primarily on the eye that was looking through the viewfinder of the wearable camera. Indeed, since conventional cameras were never intended to be worn and used constantly, over an extended time period, to record events from a first–person–perspective while looking through the viewfinder, it is not surprising that performance is poor in this usage.

Part of the reason for poor performance associated with simply attaching a conventional camera to a helmet is the induced parallax and the failure to provide an orthoscopic view. Even viewfinders which correct for parallax (as described in U.S. Pat. 5692227 in which a rangefinder is coupled to a parallax error compensating mechanism) only correct for parallax between the viewfinder and the cameralens that is taking the picture, but do not correct for parallax between the viewfinder and the image that would be observed with the naked eye while not looking through the camera.

One goal of personal imaging is to provide a camera viewfinder[4] that is suitable for long–term usage, such as when one may be wearing the camera for 16 hours per day, looking through it all the while. Therefore, since traditional viewfinders are only looked through on a shorter term basis, there will be some important differences between the proposed wearable camera system and traditional cameras. For example, when the proposed wearable camera system incorporates a zoom lens for the camera, it is desirable that the viewfinder also has a zoom lens, so that when zooming into a scene, the image in the viewfinder will subtend a lesser visual angle (appear to get smaller) to negate the usual effect in which zooming in normally produces increased magnification. In this manner the proposed wearable camera system will provide the wearer with absolutely no magnification from the viewfinder's point of view, regardless of the

[3] A distinction should be made here between controlled laboratory experiments and experiments in the real–world. The former are more repeatable, but because of the artificiality of many controlled laboratory experiments the results often do not generalize to the natural complexity of situations outside the lab. The latter, of which the author's work, as well as that of Stratton, are examples, often have more relevance to the real–world. The author's experiments, for example, were conducted over a 20 year period, in several different countries, and thus include a large variety of ordinary day–to–day experiences. Although these reflect personal experiences (as opposed to a controlled experiment with hundreds of different subjects), the insight gained over more than 20 years (on and off) of wearing such apparatus, is something that one can seldom obtain over a large number of experimental subjects. For a brief overview see http://wearcam.org/mediated-reality/index.html

[4] The terms "viewfinder", "computer screen", and "television" are used interchangeably. In most embodiments of personal imaging systems, wearable computers were custom–built to accept NTSC video input and provide NTSC video output. Having identical inputs and outputs facilitated a modular approach to building large image processing systems. In most cases this was found to be preferable to using VGA output since VGA cameras are more cumbersome (and did not exist at the time of many of the experiments).

zoom adjustment. At first this may seem counter–intuitive, in the sense that we normally expect zooming in to produce increased magnification. However, after using the proposed apparatus for an extended period of time, one quickly grows accustomed to the unique characteristics of its viewfinder, and the much more seamless integration of the viewfinder with everyday life. This seamlessness is such that after time, the wearer will begin to operate the proposed wearable camera without appreciable conscious thought or effort.

An important aspect of the personal imaging system is its unique viewfinder (display). Displays for helmet mounted aircraft weapons aiming applications have been developed, as described in U.S. Pat. 3697154, U.S. Pat. 3833300, U.S. Pat. 4081209, U.S. Pat. 4220400. Eyeglass mounted displays, such as those either made commercially, or planned for manufacture, by Virtual Vision, Virtual Image Displays Inc., and MicroOptical Corp., have also been proposed. Such display systems do not incorporate a camera. Although they could be used to display the output image from an electronic camera (hand–held or perhaps mounted to the same helmet), the above–mentioned problems will still exist. U.S. Pat. 4806011 describes an eyeglass–based display of a clock or the like. While the clock could, in principle, be replaced with a small television, and a camera could be attached to the glasses and the output of the television connected to it, the above–mentioned problems would also still exist.

Open–air viewfinders are often used on extremely low cost cameras, as well as on some professional cameras for use at night when the light levels would be too low to tolerate any optical loss in the viewfinder. Examples of open–air viewfinders used on professional cameras, in addition to regular viewfinders, include those used on the Grafflex press cameras of the 1940s (which had three different kinds of viewfinding means, just one of which was the open–air viewfinder), as well as those used on some twin–lens reflex cameras. While such viewfinders could be used in the context of the proposed personal imaging system, and would have the advantage of not inducing the problems such as flashback effects described above, they also fail to provide means for a computationally mediated visual reality. In addition to its use in such applications as telepresence, shared visual spaces, etc., as described above, it is also a goal of personal imaging to allow visual reality to be mediated simply for the purpose of making certain that exposure is correct as well as to keep the wearer of the apparatus in the feedback loop of the photo compositional process by constantly providing the wearer with a video stream. For such compositional and interactional capabilities, a simple air–based viewfinder is inadequate.

4.1 Avoiding moderately mediated reality

One approach to solving the undesirable flashback effects associated with wearing a personal imaging system for an extended period has been to deliberately design a large error in the correspondence between the camera and the viewfinder, since it was found that the flashback effects were much worse in the neighbourhood of the identity. Typical embodiments of WearCam include having the image appear upside–down, backwards, or rotated 90 degrees while looking through the viewfinder. After several weeks of wearing the apparatus, a long–term adaptation process resulted. Moreover, it was found that after longer periods (often two years or more) of more intermittent usage, it was possible to attain a high degree of proficiency in switching back and forth between shooting through a personal imaging system and performing tasks with the apparatus removed.

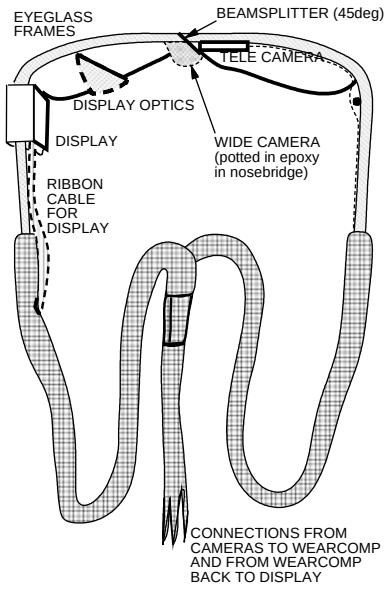


Figure 1: Early covert personal imaging system with foveated camera comprising a wide–camera potted in epoxy, concealed in the nosebridge of the glasses, and a tele–camera aimed at right angles to the optical axis of the wide–camera. A beam splitter provided a unified center of projection. The wide–camera was in landscape orientation and used by the wearable computer for head–tracking, while the tele–camera was in portrait orientation, and presented on the viewfinder visible to the left eye.

An early covert version of the personal imaging system, based on this principle, and suitable for everyday use, is depicted in Fig 1. The cameras absorb and quantify incoming light rays, using the quantagraphic version of the VideoOrbits algorithm. (VideoOrbits is described in[10] and http://wearcam.org/research.html) Quantagraphic information[9] (the quantity of light arriving from each direction, up to a single unknown scalar constant) is calculated in an underwearable computer system[9] (a computer system distributed upon a heavy tank–top concealed underneath ordinary clothing). In order to make this system covert, it was desired to only process visual information for one eye (in this case, the left eye). This gave rise to a so–called *partially mediated reality*, where the left eye was mediated by the computational processes, while the right eye experienced a normal unobstructed view of the world. During typical usage, the author would mentally block out the view from the right eye, just as a person looking through a telescope or microscope might do. This is quite easy to do, given the tendency of the electronic image on the computer screen (viewfinder) to be both compelling and distinct from the unmediated view (especially given the 90 degree rota-

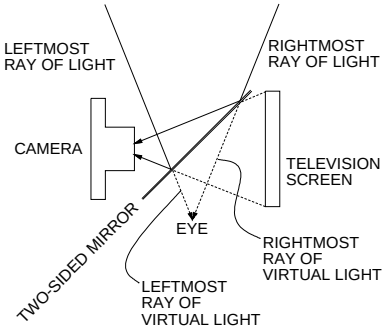


Figure 2: **The orthoscopic reality–mediator:** A double–sided mirror diverts incoming rays of light to a camera, while at the same time providing the eye with a view of a television screen, connected to the wearable computer system. The television screen appears backwards to the eye, but since the computer captures a backwards stream of images (the camera's view of the world is also through a mirror), display of that video stream will create an illusion of transparency. Typically, such an apparatus may operate with orthoquantigraphic capability through the use of quantigraphic image processing [5].

tion).

5 Exact identity mapping: The orthoscopic reality mediator

In order to better facilitate rapid switching back and forth between the mediated and unmediated worlds, particularly in the context of a partially mediated reality, it was desired to mediate part of the visual field without alteration in the identity configuration (e.g. when the computer was issued the identity map, equivalent to a direct connection from camera to viewfinder). This was accomplished with a two–sided mirror. In many embodiments a pellicle was used, while sometimes a glass silvered on one or both sides was used, as illustrated in Fig 2.

In this way a portion of the wearer's visual field of view may be replaced by the exact same subject matter, in perfect spatial register with the real world. The image could, in principle also be registered in tonal range, using the *quantagraphic imaging* framework for estimating the unknown nonlinear response of the camera, and also estimating the response of the display, and compensating for both[9]. So far focus has been ignored, and infinite depth–of–field has been assumed. In practice, a viewfinder with a focus adjustment is used for the computer screen, and the focus adjustment is driven by a servo mechanism controlled by an autofocus camera. Thus the camera automatically focuses on the subject matter of interest, and controls the focus of the viewfinder so that the apparent distance to the object is the same while looking through the apparatus as with the apparatus removed.

It is desirable that embodiments of the personal imaging system with manual focus cameras also have the focus of the camera linked to the focus of the viewfinder so that both may be adjusted together with a single knob. Moreover, a camera with zoom lens may be used together with a viewfinder having zoom lens. The zoom mechanisms are linked in such a way that the viewfinder image magnification is reduced as the camera magnification is increased. Through this appropriate linkage, any increase in magnification by the camera is negated exactly by decreasing the apparent size of the viewfinder image. As mentioned previously this may seem counterintuitive, given traditional cameras, but it was found to assist greatly in elimination of undesirable long–term effects caused by wearing a camera not implementing the virtual light principle.

The calibration of the autofocus zoom camera and the zoom viewfinder was done by temporarily removing the double sided mirror and adjusting the focus and zoom of the viewfinder to maximize video feedback. This must be done for each zoom and focus setting, so that the zoom and focus of the viewfinder will properly track the zoom and focus of the camera. By using video feedback as a calibration tool, a computer system may monitor the video output of the camera while adjusting the viewfinder and generating a lookup table for the viewfinder settings corresponding to each camera setting. In this way, calibration could be automated during manufacture of the personal imaging system. Some similar embodiments of the personal imaging system used two cameras and two viewfinders. In some embodiments, the vergence of the viewfinders was linked to the focus mechanism of the viewfinders and the focus setting of cameras, so that there was a single automatic or manual focus adjustment for viewfinder vergence, camera vergence, viewfinder focus, and camera focus. However some of these embodiments became too cumbersome for unobtrusive implementation, rendering them unacceptable for ordinary day–to–day usage. Therefore most of what follows will describe other variations of single–eyed (partially–mediated) systems.

5.1 Partial mediation within the mediation zone

Partial–mediated reality typically involves a mediation zone (field of view of the viewfinder) over which visual reality can be completely reconfigured. However, a more moderate form of mediated–reality is now described. In what follows, the mediation is not only partial in the sense that it affects only part of the field of view (e.g. one eye or part of one eye) but moreover, mediation is partial *within* the mediation zone. The original reason for introducing this concept was to make the apparatus less obtrusive, so that others could see the wearer's eye(s) where obstructed by the mediation zone.

The apparatus of Fig 2 does not permit others to make full eye–contact with the wearer. Therefore, a similar apparatus was built using a beamsplitter instead of the double–sided mirror. In this case, a partial reflection of the television is visible to the eye of the wearer by way of the beamsplitter. The leftmost ray of light of the partial view of the television is aligned with the direct view of the leftmost ray of light from the original scene, and likewise for the rightmost ray, or any ray within the field of view of the viewfinder. Thus the wearer sees a superposition of whatever real object is located in front of the apparatus and a television picture of the same real object at the same location. The degree of transparency of the beamsplitter affects the degree of mediation. For example, a half–silvered beamsplitter gives rise to a 50% mediation within the mediation zone.

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In order to prevent video feedback, in which light from the television screen would shine into the camera, a polarizer was positioned in front of the camera. The polarization axis of the polarizer was aligned at right angles to the polarization axis of the polarizer inside the television, in situations where the television already had a built–in polarizer as is typical of small battery powered LCD televisions, LCD camcorder viewfinders, and LCD computer monitors. In embodiments of this form of partially mediated reality where the television did not have a built in polarizer, a polarizer was added in front of the television. Thus video feedback was prevented by virtue of the two crossed polarizers in the path between the television and the camera.If the television displays the exact same rays of light that come from the real world, the view presented to the eye is essentially the same as it might otherwise be. However, in order that the viewfinder provide a distinct view of the world, it was found to be desirable that the virtual light from the television be made different in color from the real light from the scene. For example, simply using a black and white television, or a black and green television, gave rise to a unique appearance of the region of the visual field of the viewfinder by virtue of a difference in color between the television image and the real world upon which it is exactly superimposed. Even with such chromatic mediation of the television view of the world, it was still found to be far more difficult to discern whether or not video was correctly exposed, than when the double–sided mirror was used instead of the beamsplitter. Therefore, when using these partially see–through implementations of the apparatus, it was found to be necessary to use a pseudocolor image or unique patterns to indicate areas of over exposure or under exposure. Correct exposure and good composition are important, even if the video is only used for object recognition (e.g. if there is no desire to generate a picture as the final result). Thus even in tasks such as object recognition, a good viewfinder system is of great benefit.

In this see–through embodiment, calibration was done by temporarily removing the polarizer and adjusting for maximum video feedback.

The apparatus may be concealed in eyeglass frames in which the beamsplitter is either embedded in one or both lenses of the eyeglasses, or behind one or both lenses. In the case in which a monocular version of the apparatus is being used, the apparatus is built into one lens, and a dummy version of the beamsplitter portion of the apparatus may be positioned in the other lens for visual symmetry.

It was found that such an arrangement tended to call less attention to itself than when only one beamsplitter was used.

These beamsplitters may be integrated into the lenses in such a manner to have the appearance of the lenses in ordinary bifocal eyeglasses. Moreover, magnification may be unobtrusively introduced by virtue of the bifocal characteristics of such eyeglasses. Typically the entire eyeglass lens is tinted to match the density of the beamsplitter portion of the lens, so there is no visual discontinuity introduced by the beamsplitter. It is not uncommon for modern eyeglasses to have a light–sensitive tint, so that a slight glazed appearance does not call attention to itself.

5.2 The foveated personal imaging system

A more recent embodiment of the personal imaging system incorporates two televisions, as depicted in Fig 3. Incoming light is intercepted from the direct visual path and directed instead, by a double–sided mirror to a beamsplitter. A portion of this light passes through the beamsplitter and is absorbed and quantified by a wide–camera. A portion of this incoming light is also reflected by the beamsplitter and directed to the tele–camera. The image from the wide–camera is displayed on a large screen television, of size 0.7 inches (approx. 18mm) on the diagonal, forming a wide–field–of–view image of virtual light from the wide–camera. The image from the tele–camera is displayed on a small screen television, typically of screen size 1/4 inch (approx. 6mm) on the diagonal, forming a virtual image of the tele–camera as virtual light. A smaller television screen is used to display the image from the tele–camera in order to negate the increased magnification that the tele–camera would otherwise provide. In this manner, there is no magnification, and both images appear as if the rays of light were passing through the apparatus, so that the virtual light rays align with the real light rays were they not intercepted by the double–sided mirror. The large television is viewed as a reflection in mirror, while the small television is viewed as a reflection in the beamsplitter. Note also that the distance between the two televisions, as measured along the optical axis of the wide–camera is set to be equal to the distance between the double–sided mirror and the beamsplitter as measured along the optical axis of the tele–camera. In this way, the apparent distance to both televisions will be the same, so that the wearer experiences a view of the two televisions superimposed upon one–another in the same depth plane.

In most embodiments, the televisions were equipped with lenses to form an apparent image in the same depth plane as a central real object in the scene. Alternatively, the televisions may be equipped with lens assemblies of differing magnification to adjust their magnifications so that the television displaying the image from the tele–camera subtends a smaller visual angle than the television displaying the image from wide–camera,and so that these visual angles match the visual angles of the incoming rays of light. In this way, two television screensof equal size may be used, to simplify manufacture of the apparatus.

6 Further Observations and Conclusions

It is the author's view that camera viewfinders presenting a spatial mediation of visual reality in the neighbourhood of the identity (e.g. a moderate distortion) have greater detrimental long–term effects than either viewfinders that severely mediate visual reality or viewfinders that provide no distortion at all. Thus today's generation of cameras are not well suited to long–term use, as might be desired of a system for continuous mediated reality or continuous personal documentary.

Just as moderate time–lag is detrimental to videoconferencing (e.g. it is preferable to either have immediate response, or very slow response such as a slowly updated still image), spatial reality mediators should also either severely alter reality, or be able to portray reality with almost no distortion. Therefore a new kind of camera and viewfinder system is needed for use in personal imaging. Various such designs have been described in this paper, beginning with an idealized conceptual form, followed by a number of practical embodiments. These practical embodiments are well–suited to telepresence applications in the context of ordinary day–to–day living.

In addition to telepresence (e.g. computer–supported collaboration) personal imaging forms the basis for a new kind of photography and videography characterized by an "always ready" framework where the viewfinder image constantly hovers in front of the eyes during all facets of life. In this case, even when not shooting, the human and machine together evolve into an organism that constantly seeks "best picture" even at the subconscious level. For this reason, it is of the utmost importance that the apparatus not induce any undesirable long–term effects.

Even in situations where it is not desired to completely modify the visual perception of reality, but merely to add to it (e.g. overlays, augmented reality, etc.) including a viewfinder for the camera helps to make sure that it operates in the feedback loop of a learned and often subconscious tendency to maintain a good quality image on the screen. Thus for example, if the only task of the system is for object recognition (such as recognizing people at a business meeting), constant presentation of the video images upon the screen give rise to an evolution of human and machine toward a system that will cause the object (or person) of interest to be centered in the camera's field of view, and a point of vantage chosen in which there is minimal clutter behind the object (e.g. person). This has been found to happen often without conscious thought or effort. Therefore this "life–through–the–screen" approach, that is so typical of embodiments of mediated reality, has benefit even in applications where there is not a desire to modify reality; it is helpful, even then, to have a system that allows the camera viewfinder to function as a true extension of the mind and body.

It is toward these goals that this paper, and the WearCam effort in general, is directed. It is my desire that the various successful implementations of WearCamthat have been presented here will find great use in a large variety of applications and will take wearable computing beyond just duplicationg the kinds of tasks that are already done with laptop computers and PDAs.

There are numerous other embodiments of WearCam, some of which meet the criteria in the functional specification, although limited space here does not permit their inclusion. For additional information contact the author.

The technology disclosed in this article is covered by several pending patents. Those interested in licensing this technology for product manufacture should contact the author at the address in the title page.

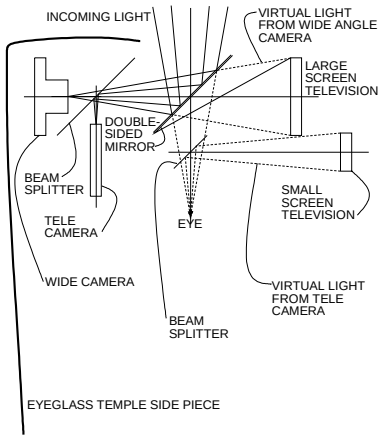


Figure 3: Foveated personal imaging system. A large–screen television (0.7 inch diagonal) displays virtual light from a wide–camera, while a small–screen television (0.25 inch diagonal) displays virtual light from a tele–camera. The wide–camera typically performs only head–tracking, as in the foveated system depicted earlier, but having a viewfinder for the head–tracker was still found to be of benefit in long–term adaptation.

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Appendix VV

08-15-02 60403553 08114 02/PROV

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INVENTOR(S)		
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Sid	REICH	1135 Inter Lake Ave. Ocean NJ 07712

☐ *Additional inventors are being named on the _____ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

Digital Video and Audio EYEGLASS Recording DEVICE. That STORES Buffered digital Signals To Memory FLASH Cards.

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

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Address	894 Somerset Dr				
Address					
City	Toms River	State	NJ	ZIP	08753
Country		Telephone	732-270 0823	Fax	732-506-9228

ENCLOSED APPLICATION PARTS ***(check all that apply)***

☐ Specification *Number of Pages* _____
☑ Drawing(s) *Number of Sheets* 1
☐ Application Data Sheet. See 37 CFR 1.76
☐ CD(s), Number _____
☐ Other (specify) _____

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant claims small entity status. See 37 CFR 1.27.
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Respectfully submitted,

SIGNATURE Bruce Fortier

TYPED or PRINTED NAME BRUCE FORTIER

TELEPHONE 732-270-0823

Date 8/14/02

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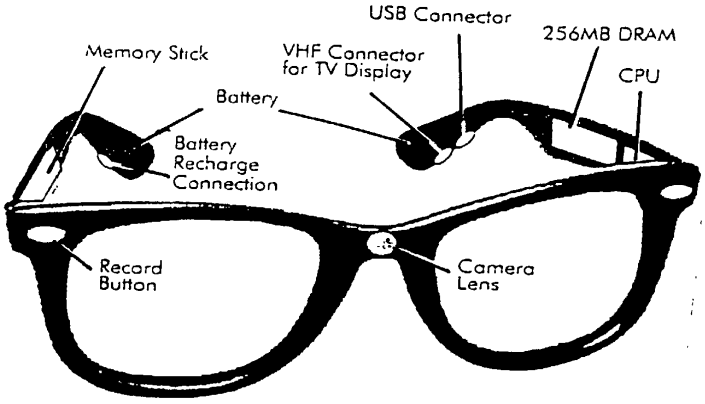
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[redacted]

DRAWING



NOTE: Memory stick can be replaced with communications adapter for Blackberry Proto or wireless connection for direct recording to PDA or Laptop.

A DIGITAL VIDEO & AUDIO EYEGLASS RECORDING CAMERA.

THE PRACTICAL USES ARE TO RECORD SOMETHING YOU'VE JUST SEEN HAPPEN WHILE YOU'RE WEARING THE EYEGLASSES. YOU THEN PRESS A RECORD BUTTON TO ACTIVATE A PLAY BACK BUFFERING MODE THAT DIGITALLY RECORDS THE IMAGE YOUR JUST SEEN 30 SECONDS AGO.
THE MEMORY FLASH CARDS STORE THE 15 OR 30 SECOND CLIPS.

INVENTORS: FORTIER & REICH
08-14-02

Appendix WW

9-10-02

60409236, pages A-PROV

jc921 U.S. PTO 09/09/02

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jc879 U.S. PTO 60/409236 09/09/02

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INVENTOR(S)

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SIDNEY	REICH	1135 INTERLAKEN AVE OCEAN NJ 07712
BRUCE	FORTIER	894 Somerset Dr. Toms River NJ 08753

☐ *Additional inventors are being named on the _____ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

DEJA VIEW VIDEO SYSTEM

CORRESPONDENCE ADDRESS

Direct all correspondence to:

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OR *Type Customer Number here*

☑ Firm or Individual Name	DEJA VIEW INC.				
Address	894 Somerset Dr.				
Address					
City	Toms River	State	NJ	ZIP	08753
Country	USA	Telephone	732-270-0823	Fax	732-929-3624

ENCLOSED APPLICATION PARTS *(check all that apply)*

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☑ Drawing(s) *Number of Sheets* 1 ☐ Other (specify)

☐ Application Data Sheet. See 37 CFR 1.76

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Respectfully submitted,

SIGNATURE Bruce Fortier

TYPED or PRINTED NAME BRUCE FORTIER

TELEPHONE 732-270-0823

Date 09.04.02

REGISTRATION NO. *(If appropriate)*

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[redacted]

SPECIFICATION
DEJA VIEW VIDEO SYSTEM

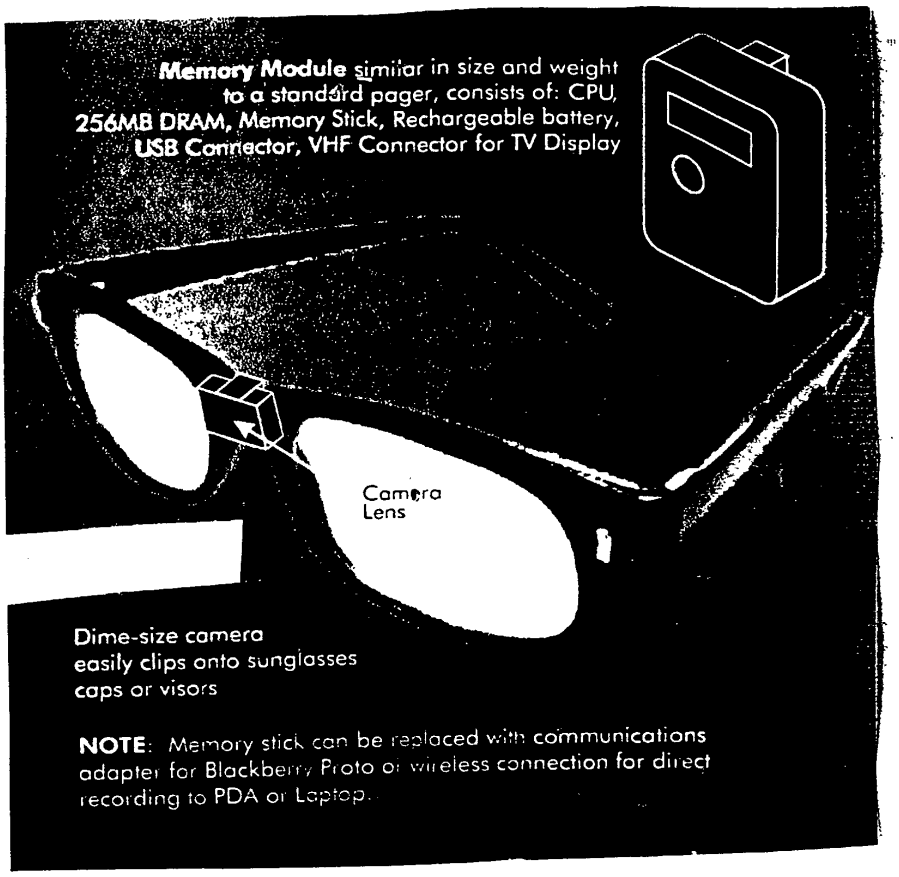
DIGITAL VIDEO AND AUDIO EYEGLASS CAMERA CLIP-ON.

THE PRACTICAL USE IS TO RECORD CLIPS OF SCENES YOU'VE JUST SEEN HAPPEN IN THE 30 SECONDS PRIOR TO RECORDING WITH THIS UNIQUE CAMERA.

THE PROPRIETARY MEMORY TECHNIQUE BUFFERS WHAT A USER IS SEEING. THAT MEANS YOU RECORD 30 SECONDS BEFORE YOU HIT THE RECORD BUTTON.

THE EYEGLASS CLIPON TRANSMITS SIGINALS TO THE MEMORY MODULE THAT CONSISTS OF 256MB DRAM, MEMORY STICK, RECHARGEABLE BATTERY, USB CONNECTOR, VHF CONNECTOR.

INVENTORS-09/04/02 REICH & FORTIER / DEJA VIEW Inc.



DRAWING - DEJA VIEW VIDEO SYSTEM

INVENTORS - REICH & FORTIER 9/4/02

DEJA VIEW INC.

[redacted]

Appendix XX

04-11-03 04:31 61674 .04100034/PROV

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INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Bruce	Fortier	Toms River, N.J.
Sid	Reich	Ocean, N.J.

☐ *Additional inventors are being named on the _____ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

Recording Device That Stores Buffered Digital Signals To Memory Flashcards

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

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☑ Drawing(s) *Number of Sheets*	9	☐ Other (specify)	
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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☑ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

Respectfully submitted,

SIGNATURE _____

TYPED or PRINTED NAME Timothy X. Gibson

TELEPHONE 732-634-7634

Date 04/10/2003

REGISTRATION NO. *(if appropriate)* 40,618

Docket Number: 460/2

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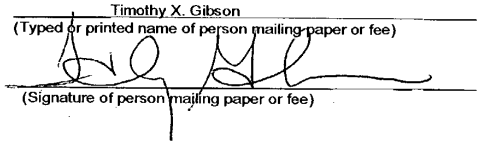
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RECORDING DEVICE THAT STORES BUFFERED DIGITAL SIGNALS TO MEMORY FLASHCARDS

The subject invention relates to a specialized camera that is adaptable to be attached to headgear such as but not limited to a pair of glasses and transmits the video to a device worn on the hip where the video is recorded. The device permits capture, in a buffer, a particular period of time such as the last 0-30 seconds or more seen by the camera and is able to record that video to a removable media.

Overview

Camera technologies have been divergent in their capabilities and costs and more designed for the cell phone handsets rather than mounted to headgear such as glasses. Digital cameras provide a more cost effective solution but have proven difficult to integrate into a small unit on headgear due to data rates and encoding. Analog cameras provide a solution but at a larger cost.

The present invention captures multiple 0- 30 second or more of video that was just seen by the viewer. In preferred embodiments an LCD screen is incorporated in the hippack and continuous recording capabilities for hours to a compact flash card is provided. In some embodiments it will be required to insert a digital to analog converter. In a preferred embodiment a digital camera is employed and a non-tethered connection is preferred but tethered acceptable between camera and hippack

The present invention is easy to use. In a most preferred embodiment the camera is located in the vicinity of the eyes with the data recording occurring on a device located on the hip attached to a belt or strap. The invention is able to capture the last at least 30 seconds of what was just viewed by the camera to a removable media when requested by user. Further, the invention includes audio. The invention may be employed in conjunction with a USB slave connection available on the hippack to allow the device to write a PC where they can transfer the file(s) from the hippack to the PC. LCD and continuous recording is most preferred.

In one embodiment of the invention the invention comprises the following components:

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The Design:

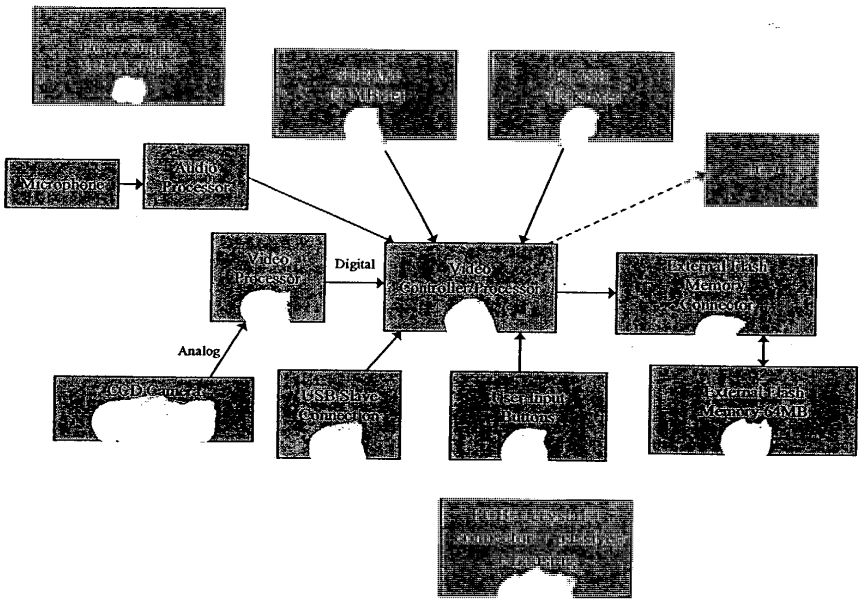


FIG. 1

Exemplary Specifications

- Camera mounted on glasses (or other means to be near user's eyes), connected via a cable to a remote unit located on the hip of the user.
    - Ability to capture at least last 30 seconds of what user just viewed and heard when user presses the appropriate button on the remote unit and the unit can record multiple at least 30 second captures based upon the size of the compact flash.
        - Video quality minimum of 10 frames per second with a preferred rate of 13.3 frames per second.
        - Video quality meets CIF standards with frames at 320x240 pixels.
        - Audio mono with quality dependent on the microphone chosen
        - Video compression maximized. DIVX compression of 2MB per minute is preferred.

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- An indicator light to inform the user when there is insufficient storage left on the compact flash card to store another 0- 30 second or more image.
- The recording function of the camera disabled while the camera is capturing and compressing the previous at least 30 seconds.
- Remote unit writes the 0- 30 second or more of video and audio to a removable media (such as but not limited to compact flash card) located within the remote unit. This unit approximately the size of a Palm III device.
    - The video stored on the removable media in a format that can be viewed and heard via media player such as Windows Media Player or Real One Media Player.
    - A USB connection available to allow the moving of video from the camera to a PC.
- All power for the camera and the remote unit supplied by a rechargeable battery, using a standard 110 recharging connection, located in the remote unit with enough power to sustain 8 hours of operations with a maximum of 250 video captures.

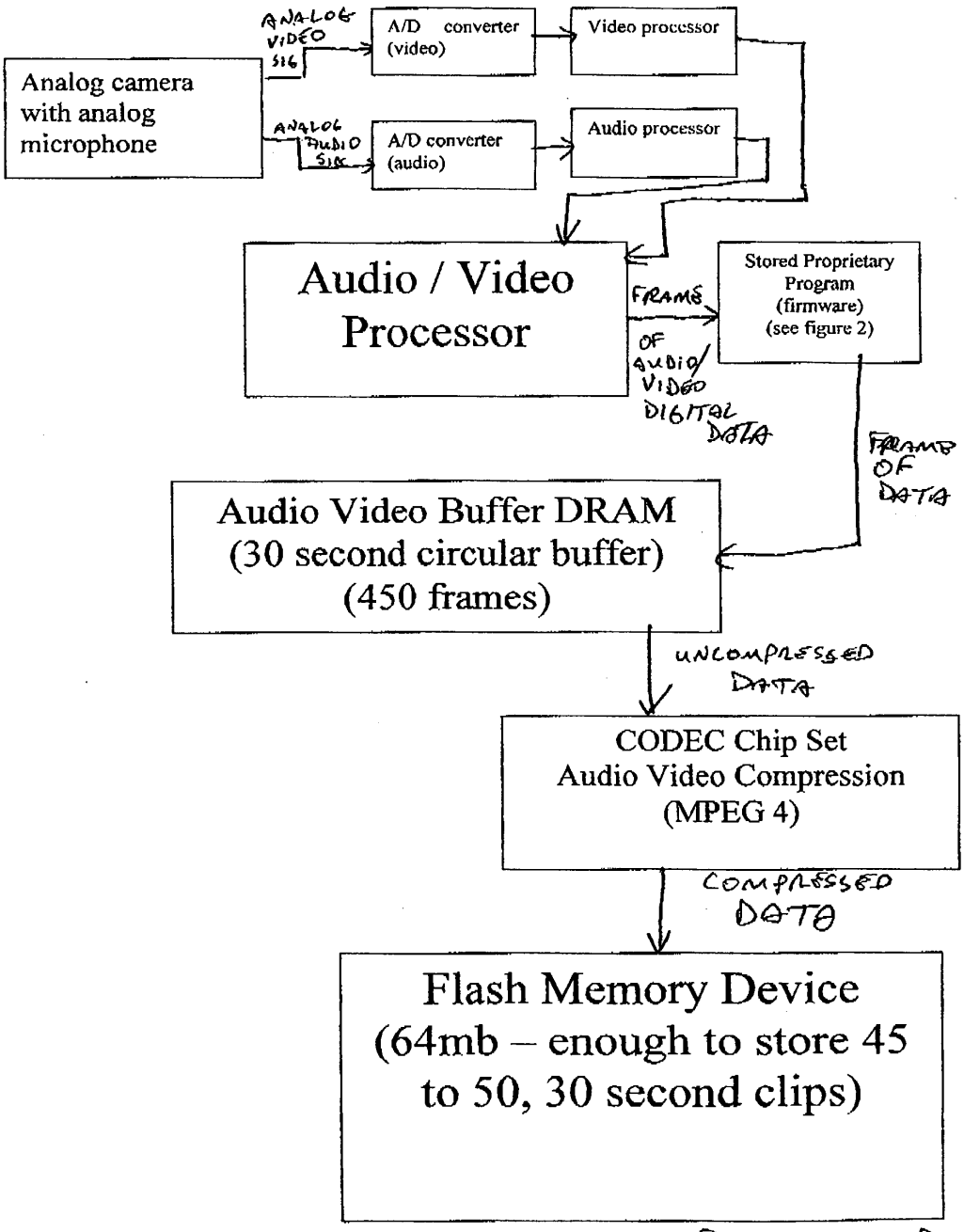
Now referring to FIG. 2 the basic functional diagram and information flow of the invention is set forth. Now referring to FIG. 3, the software flow chart is set forth describing a preferred embodiment of the manner in which the 0- 30 second or more video image is captured to memory.

When activated, the proprietary software enables the camera to continuously monitor what the camera wearer is seeing. N order to permanently record audio and video, the user presses a record button and triggers the software to save the previous 30 seconds of monitored video and audio to flash memory. The invention is capable of storing at least 128 clips of video and audio.

Claim:

1. A device comprising a camera adaptable to be attached to headgear, a receiver for receiving data from said camera and a recorder for recording said data, said device adapted to capture in a buffer a particular period of time such as the last 0-30 seconds or more seen by the camera and further adapted to record that video to a media.

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Page 086



Deja View Camwear Functional Diagram
FIG. 2

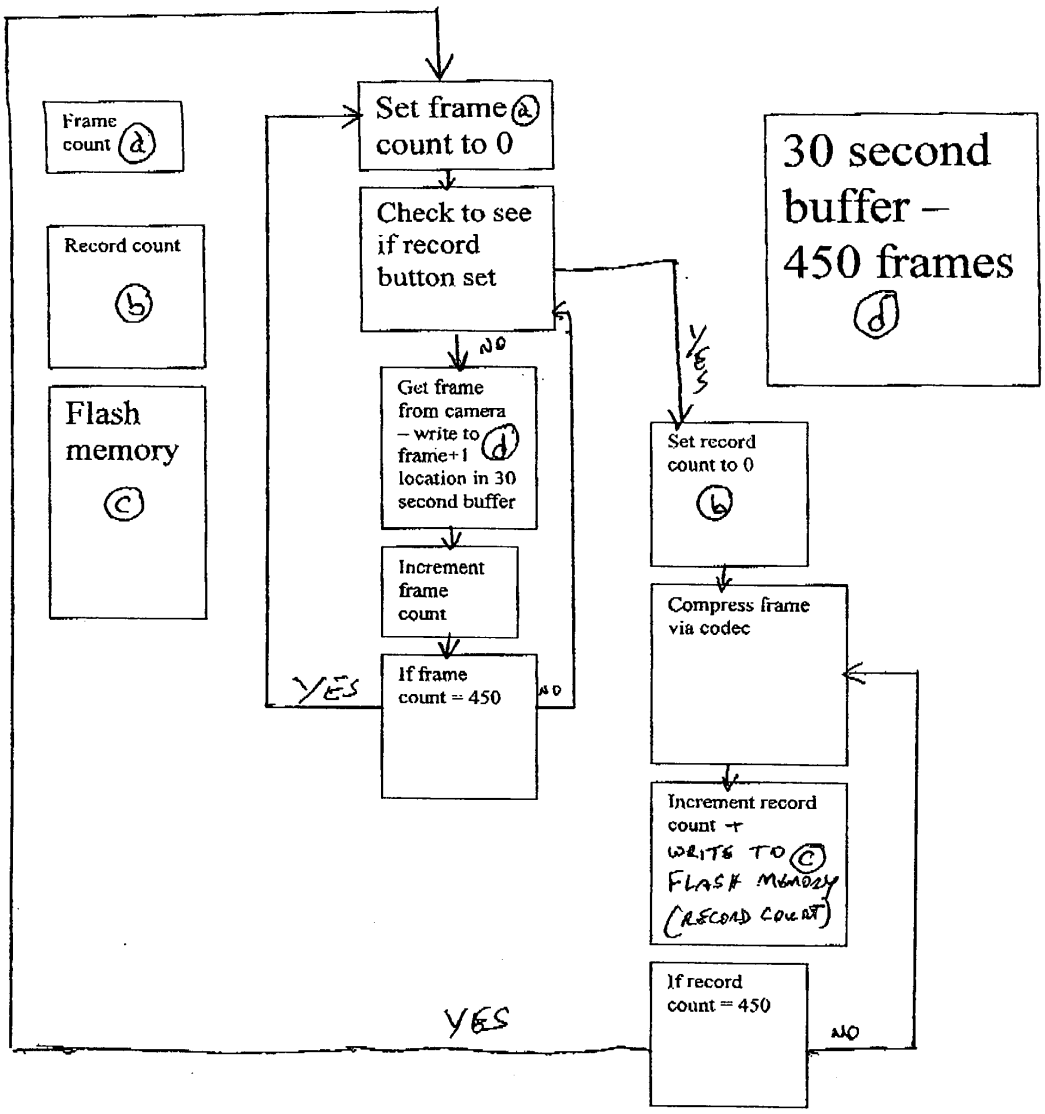
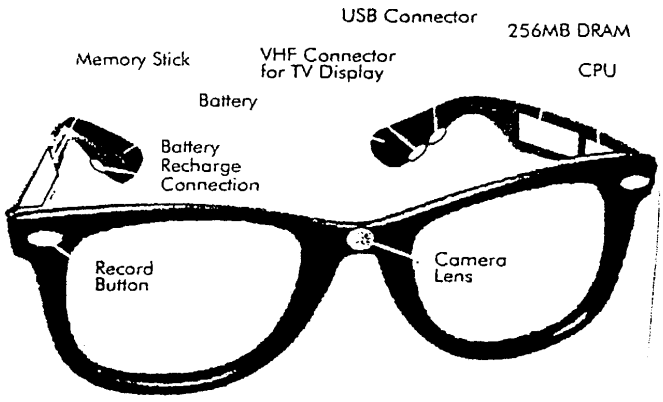


Figure 3

Deja View Camwear Software Flow Chart

DRAWING



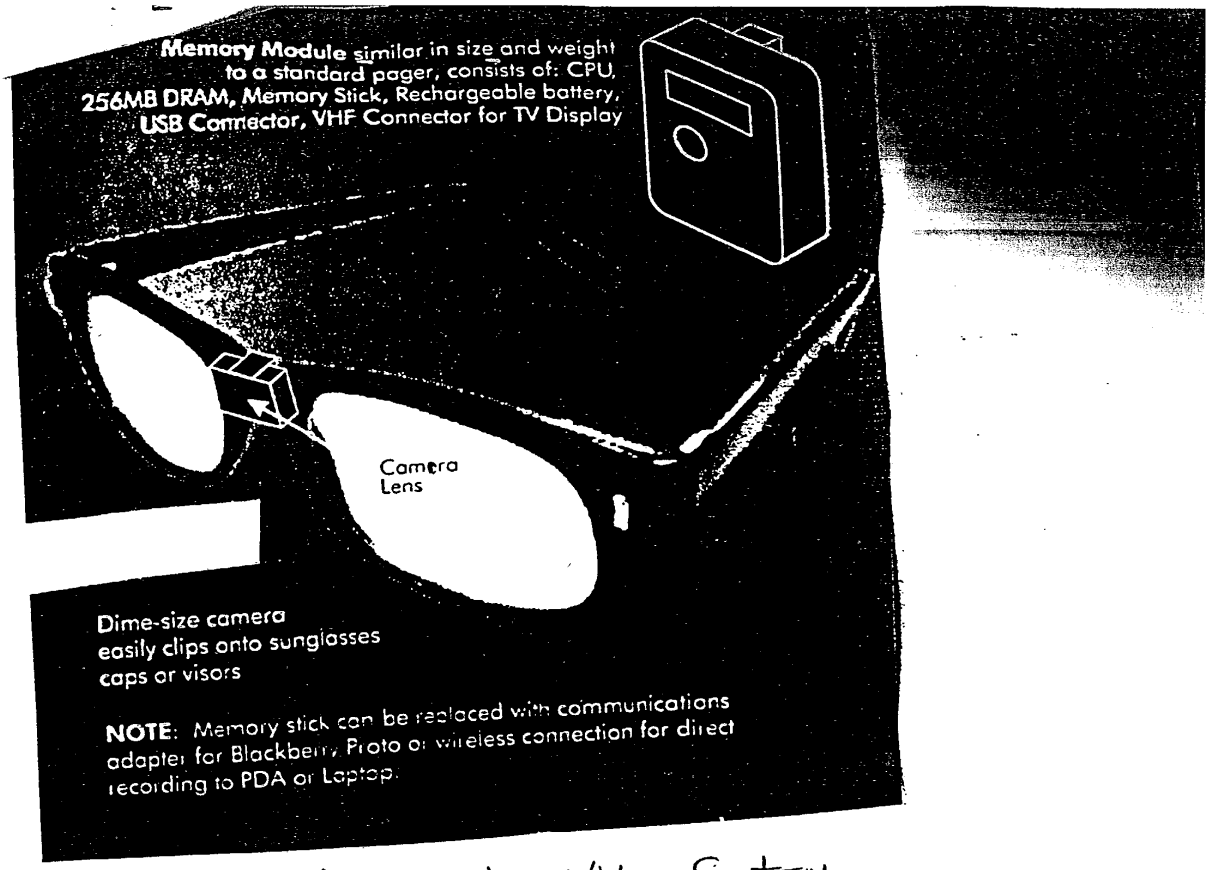
NOTE: Memory stick can be replaced with communications adapter for Blackberry Proto or wireless connection for direct recording to PDA or Laptop.

A DIGITAL VIDEO & AUDIO EYEGLASS RECORDING CAMERA.

THE PRACTICAL USES ARE TO RECORD SOMETHING YOU'VE JUST SEEN HAPPEN WHILE YOU'RE WEARING THE EYEGLASSES. YOU THEN PRESS A RECORD BUTTON TO ACTIVATE A PLAY BACK BUFFERING MODE THAT DIGITALLY RECORDS THE IMAGE YOUR JUST SEEN 30 SECONDS AGO.
THE MEMORY FLASH CARDS STORE THE 15 OR 30 SECOND CLIPS.

INVENTORS: FORTIER & REICH
08-14-02

[redacted]



DRAWING - DEJA VIEW Video System

INVENTORS - REICH & FORTIER 9/4/02

DEJA VIEW INC.

6046167A .041003

DEJA·VIEW

PRODUCT OVERVIEW

DEJA·VIEW is designed to merge two practical uses of digital image recording: digital web-cam and hard-disk (TiVo, replay tv) method of being able to "control" tv.

- Digital Web Cam devices use flash-card technology to store short (15-30) video clips with audio. Typically, these hand-held devices are inexpensive, under $100, and can store 5 to 10 of these clips.

- Users of the TiVo-type, hard-disk method for controlling the video playback can rewind the image and play it back and continue time-delayed. This feature of 'buffering' a digital video signal is the second underlying technique.

DEJA·VIEW uses flash-card technology similar to the Digital Web Cam to store a number of video clips. The difference is it will store clips of scenes ***before*** the decision to record is made.

DEJA·VIEW will use a proprietary memory technique to buffer what a user is seeing. That means you record the 15-30 seconds before you ever hit record. This means you can record the bird you saw fly by. Or the spectacular view that you just passed by. Or a smile in conversation. Or...

DEJA·VIEW will initially be packaged in a set of eyeglass frames or sunglasses. Other packaging methods are being considered.

DEJA·VIEW is designed to retail for $199.

For more information call 1-866-DEJAVIEW

www.MyDejaView.com

Memory Module similar in size and weight to a standard pager, consists of: CPU, 256MB DRAM, Memory Stick, Rechargeable battery, USB Connector, VHF Connector for TV Display

Camera Lens

Dime-size camera easily clips onto sunglasses caps or visors

NOTE: Memory stick can be replaced with communications adapter for Blackberry Proto or wireless connection for direct recording to PDA or Laptop.

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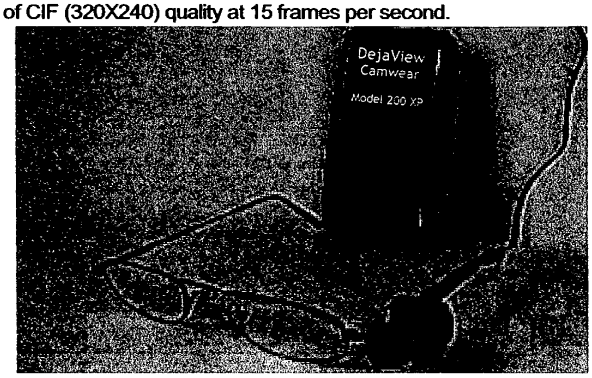
DejaView CAMWEAR model 200 XP

Features:

- Records up to 4 hours of video with audio
- Easy to use – ready to go right out of the box
- Our cameras are all *wearable* – meaning that they are hands free!!
- Download to your PC or MAC via USB cable or via flash memory reader and use our software to view the files. The software also allows you to create CD's, VCD's and DVD's (dependent upon your computer hardware).
- Can be used with DejaVIEW DirectConnect for connecting to your TV or VCR.

Specifications:

- Camera is FCC compliant.
- An indicator light to inform the user when there is less than 15 minutes of storage left on the compact flash card .
- Remote unit will write the video and audio to a removable media (1 gigabyte flash memory) located within the remote unit. This unit is approximately the size of an average-sized PDA.
- All power for the camera and the remote unit is supplied by a rechargeable battery located in the remote unit with enough power to sustain 8 hours of operations with a maximum of 4 hours of record time. Comes with a 110v charger similar to those used with cellular phones.
- USB slave connection available on the hip pack to allow user to download movie clips to a PC or MAC, where they can be viewed using our supplied software or Windows Media Player™ , RealPlayer™, and other industry standard players.
- Video will be of CIF (320X240) quality at 15 frames per second.



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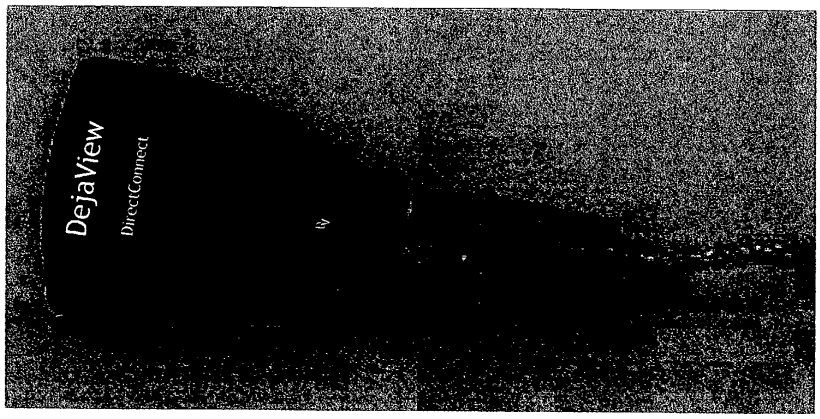
DejaView DirectConnect

Features:

- Reads flash memory and sends video or video with audio or still pictures directly to your TV or VCR.
- Ease of use – ready to go right out of the box !!
- Also serves as generic flash memory reader / writer for connection to your PC or Mac.
- Use with the DejaView model 100, model 200, model 50, or your digital camera.

Specifications:

- Works with CompactFlash type I™ and CompactFlash type II™, MicroDrive™, SmartMedia™, MultiMediaCard™, SecureDigital™, Memory Stick™, and most other similar media.
- Output is both USB (to your computer) or NTSC (VCR or TV).



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DejaView CAMWEAR model 50 for use with your PDA

Features:

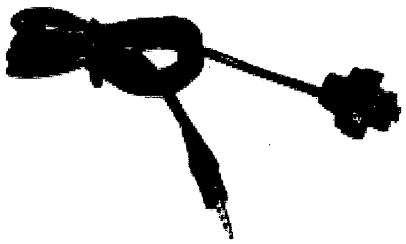
- Captures a 30 second video clip with audio of what happened ***before*** *you hit the record button*
- Optional DejaVIEW DirectConnect for connecting to your TV or VCR (for use with PDA's with removable flash memory).
- Ease of use – ready to go right out of the box -and it's hands free!!
- Download to your PC or MAC via USB cable or via flash memory reader (for removable memory equipped PDA's) and use our software to view the files. The software also allows you to create CD's, VCD's and DVD's (dependent upon your computer hardware).

Specifications:

- Camera is FCC compliant.
- PDA will indicate on its LCD screen the number of clips that can be stored. If the PDA is equipped with sound the software will produce an audible alarm when only 1 more clip can be stored.
- Software will write the 30 seconds of video and audio to a flash card located within the PDA.
- All power for the camera is supplied by the PDA via the USB cable.
- Video will be of CIF (320X240) quality at 13.3 frames per second
- Number of clips is dependent on flash memory size in the PDA and run time of battery between recharges in PDA.

System Requirements:

- USB on PDA
- Windows CE, Palm OS



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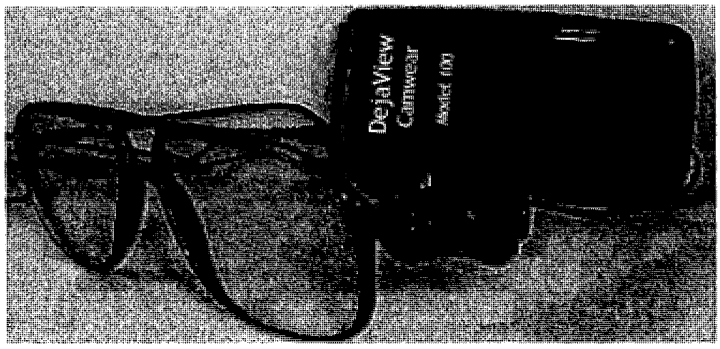
DejaView CAMWEAR model 100

Features:

- Captures a 30 second video clip with audio of what happened ***before*** *you hit the record button*
- Easy to use – ready to go right out of the box
- Our cameras are all *wearable* – meaning that they are hands free!!
- Download to your PC or MAC via USB cable or via flash memory reader and use our software to view the files. The software also allows you to create CD's, VCD's and DVD's (dependent upon your computer hardware).
- Can be used with DejaVIEW DirectConnect for connecting to your TV or VCR.

Specifications:

- Camera is FCC compliant.
- An indicator light to inform the user when there is insufficient storage left on the compact flash card to store another 30 second image.
- Remote unit will write the 30 seconds of video and audio to a removable media (64mb compact flash card – upgradeable to 1 gigabyte) located within the remote unit. This unit is approximately the size of an average-sized PDA.
- All power for the camera and the remote unit is supplied by a rechargeable battery located in the remote unit with enough power to sustain 8 hours of operations with a maximum of 250 video captures. Comes with a 110v charger similar to those used with cellular phones.
- USB slave connection available on the hip pack to allow user to download movie clips to a PC or MAC, where they can be viewed using our supplied software or Windows Media Player™ , RealPlayer™, and other industry standard players.
- Video will be of CIF (320X240) quality at 15 frames per second
- Camera will record a minimum of 48 clips with standard 64 mb flash memory.



[redacted]

60461674.041003

United States Patent & Trademark Office

Office of Initial Patent Examination

Application papers not suitable for publication

j1040 U.S. PTO
60/461674
04/10/03

SN_____ Mail Date_____

☐ Non-English Specification

☒ Specification contains drawing(s) on page(s)_____ or table(s)_____

☐ Landscape orientation of text ☐ Specification ☐ Claims ☐ Abstract

☐ Handwritten ☐ Specification ☐ Claims ☐ Abstract

☐ More than one column ☐ Specification ☐ Claims ☐ Abstract

☐ Improper line spacing ☐ Specification ☐ Claims ☐ Abstract

☐ Claims not on separate page(s)

☐ Abstract not on separate page(s)

☐ Improper paper size -- Must be either A4 (21 cm x 29.7 cm) or 8-1/2"x 11"

☐ Specification page(s)_____ ☐ Abstract

☐ Drawing page(s)_____ ☐ Claim(s)

☐ Improper margins

☐ Specification page(s)_____ ☐ Abstract

☐ Drawing page(s)_____ ☐ Claim(s)

☐ Not reproducible

Reason

☐ Paper too thin

☐ Glossy pages

☐ Non-white background

Section

☐ Specification page(s)_____

☐ Drawing page(s)_____

☐ Abstract

☐ Claim(s)

☐ Drawing objection(s)

☐ Missing lead lines, drawing(s)_____

☐ Line quality is too light, drawing(s)_____

☐ More than 1 drawing and not numbered correctly

☐ Non-English text, drawing(s)_____

☐ Excessive text, drawing(s)_____

☐ Photographs capable of illustration, drawing(s)_____

Appendix YY

05-30-03 60474269.APPROV

PTO/SB/16 (10-01)
Approved for use through10/31/2002. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

JC554 U.S. PTO 05/29/03

PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No.	EL867123215US

JC554 U.S. PTO 60/474269 05/29/03

INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Sid	Reich	Ocean, N.J.

☐ *Additional inventors are being named on the _____ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

Recording Device That Stores Buffered Digital Signals To Memory Flashcards

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☑ Customer Number 27538 → Place Customer Number Bar Code Label here 27538 PATENT TRADEMARK OFFICE

OR

☐ Firm or Individual Name

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Address					
City		State		ZIP	
Country		Telephone		Fax	

ENCLOSED APPLICATION PARTS *(check all that apply)*

☑ Specification *Number of Pages* 8 ☐ CD(s), Number

☑ Drawing(s) *Number of Sheets* 2 ☐ Other (specify)

☐ Application Data Sheet. See 37 CFR 1.76

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

		FILING FEE AMOUNT ($)
☑	Applicant claims small entity status. See 37 CFR 1.27.	
☑	A check or money order is enclosed to cover the filing fees	
☑	The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 11-0223	$80.00
☐	Payment by credit card. Form PTO-2038 is attached.	

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☑ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

Respectfully submitted,

SIGNATURE _____

TYPED or PRINTED NAME Timothy X. Gibson

TELEPHONE 732-634-7634

Date 05/29/2003

REGISTRATION NO. *(if appropriate)* 40,618

Docket Number: 460/3

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C. 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Box Provisional Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

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RECORDING DEVICE THAT STORES BUFFERED DIGITAL SIGNALS TO MEMORY FLASHCARDS

The subject invention relates to a specialized camera that is adaptable to be attached to headgear such as but not limited to a pair of glasses and transmits the video to a device worn on the hip where the video is recorded. The device permits capture, in a buffer, a particular period of time such as the last 0-30 seconds or more seen by the camera and is able to record that video to a removable media. In one embodiment the device automatically switches from a monitoring mode, wherein the last 30 seconds or so "seen" by the camera can be and is captured to memory, to a direct real time record mode if no further action is taken by the user, e.g., the "stop" button is pressed.

Overview

Camera technologies have been divergent in their capabilities and costs and more designed for the cell phone handsets rather than mounted to headgear such as glasses. Digital cameras provide a more cost effective solution but have proven difficult to integrate into a small unit on headgear due to data rates and encoding. Analog cameras provide a solution but at a larger cost.

The present invention captures multiple 0- 30 second or more of video that was just seen by the viewer. In preferred embodiments an LCD screen is incorporated in the hippack and continuous recording capabilities for hours to a compact flash card is provided. In some embodiments it will be required to insert a digital to analog converter. In a preferred embodiment a digital camera is employed and a non-tethered connection is preferred but tethered acceptable between camera and hippack

The present invention is easy to use. In a most preferred embodiment the camera is located in the vicinity of the eyes with the data recording occurring on a device located on the hip attached to a belt or strap. The invention is able to capture the last at least 30 seconds of what was just viewed by the camera to a removable media when requested by user. In a most preferred embodiment the device automatically switches from a monitoring mode, wherein the last 30 seconds or so "seen" by the camera can be and is captured to memory, to a direct real time record mode if no further action is taken by the user, e.g., the "stop" button is pressed. Further, the invention includes audio. The invention may be employed in conjunction with a USB slave connection available on the hippack to allow the device to write a PC where they can transfer the file(s) from the hippack to the PC. LCD and continuous recording is most preferred.

In one embodiment of the invention the invention comprises the following components:

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The Design:

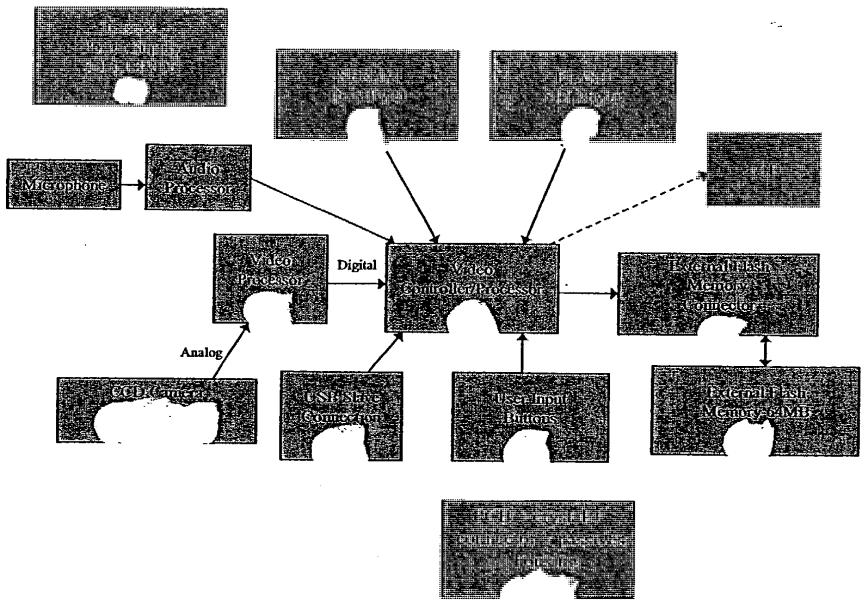


FIG. 1

Exemplary Specifications

- Camera mounted on glasses (or other means to be near user's eyes), connected via a cable to a remote unit located on the hip of the user.
    - Ability to capture at least last 30 seconds of what user just viewed and heard when user presses the appropriate button on the remote unit and the unit can record multiple at least 30 second captures based upon the size of the compact flash.
        - Video quality minimum of 10 frames per second with a preferred rate of 13.3 frames per second.
        - Video quality meets CIF standards with frames at 320x240 pixels.
        - Audio mono with quality dependent on the microphone chosen
        - Video compression maximized. DIVX compression of 2MB per minute is preferred.

[redacted]

- An indicator light to inform the user when there is insufficient storage left on the compact flash card to store another 0- 30 second or more image.

- The Sigma device, which looks identical to the Model 100 or Model 200XP (except for the addition of an extra mode switch), automatically switches from the monitoring mode of the Model 100, wherein the last 30 seconds or so "seen" by the camera can be and is captured to memory, to the direct real time record mode of the Model 200XP if no further action is taken by the user, e.g., the "stop" button is pressed.

- The recording function of the camera disabled while the camera is capturing and compressing the previous at least 30 seconds.

- Remote unit writes the 0-30-second or more of video and audio to a removable media (such as but not limited to compact flash card) located within the remote unit. This unit approximately the size of a Palm III device.

    - The video stored on the removable media in a format that can be viewed and heard via media player such as Windows Media Player or Real One Media Player.

    - A USB connection available to allow the moving of video from the camera to a PC.

- All power for the camera and the remote unit supplied by a rechargeable battery, using a standard 110 recharging connection, located in the remote unit with enough power to sustain 8 hours of operations with a maximum of 250 video captures.

Now referring to FIG. 2 the basic functional diagram and information flow of the invention is set forth. This functional diagram is essentially the same for the Model 100, Model 200XP and Sigma. Now referring to FIG. 3, the software flow chart is set forth describing a preferred embodiment of the manner in which the 0- 30 second or more video image is captured to memory and the feature of the Sigma model, in which the device automatically switches from the monitoring mode of the Model 100, wherein the last 30 seconds or so "seen" by the camera can be and is captured to memory, to the direct real time record mode of the Model 200XP if no further action is taken by the user, e.g., the "stop" button is pressed.

When activated, the proprietary software enables the camera to continuously monitor what the camera wearer is seeing. In order to permanently record audio and video, the user presses a record button and triggers the software to save the previous 30 seconds of monitored video and audio to flash memory. If no stop command is given the camera can continue recording in real time. The invention is capable of storing at least 128 clips of video and audio.

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Claims:

1. A device comprising a camera adaptable to be attached to headgear, a receiver for receiving data from said camera and a recorder for recording said data, said device adapted to capture in a buffer a particular period of time such as the last 0-30 seconds or more seen by the camera and further adapted to record that video to a media.

2. The invention according to claim 1 further comprising means to automatically switch the device from a monitoring mode, wherein the last 30 seconds or so "seen" by the camera can be captured to memory, to a direct real time record mode.

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DejaView CAMWEAR SIGMA

Features:

- Captures a 30 second video clip with audio of what happened ***before*** *you hit the record button.* The camera can then continue recording in real time.
- Can record up to 4 hours of video in camcorder replacement mode (straight recording without 30 second after the fact feature)
- Ease of use – ready to go right out of the box - and it's hands free!!
- Download to your TV or VCR via RCA jacks or to PC or MAC via USB cable or via flash memory reader and use our software to view the files. The software also allows you to create CD's, VCD's and DVD's (dependent upon your computer hardware).

Specifications:

- 320 x 240 resolution
- 30 frames per second
- Camera is FCC compliant.
- An indicator light to inform the user when there is insufficient storage left on the compact flash card to store another 30 second image or in camcorder replacement mode, when there is only 10 minutes video left on flash memory.
- Remote unit will write video and audio to a removable media (currently 1 gig compact flash card) located within the remote unit. All power for the camera and the remote unit is supplied by a rechargeable battery, using a standard 110 recharging connection, located in the remote unit with enough power to sustain 8 hours of operations with a maximum of 250 video captures or 4 hours of video recording in camcorder replacement mode.

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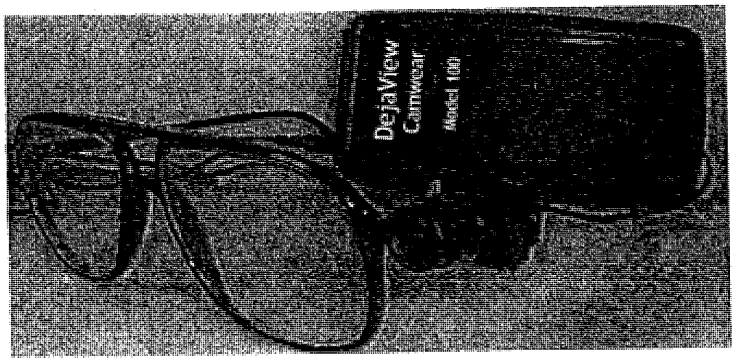
DejaView CAMWEAR model 100

Features:

- Captures a 30 second video clip with audio of what happened ***before*** *you hit the record button*
- Easy to use – ready to go right out of the box
- Our cameras are all *wearable* – meaning that they are hands free!!
- Download to your PC or MAC via USB cable or via flash memory reader and use our software to view the files. The software also allows you to create CD's, VCD's and DVD's (dependent upon your computer hardware).
- Can be used with DejaVIEW DirectConnect for connecting to your TV or VCR.

Specifications:

- Camera is FCC compliant.
- An indicator light to inform the user when there is insufficient storage left on the compact flash card to store another 30 second image.
- Remote unit will write the 30 seconds of video and audio to a removable media (64mb compact flash card – upgradeable to 1 gigabyte) located within the remote unit. This unit is approximately the size of an average-sized PDA.
- All power for the camera and the remote unit is supplied by a rechargeable battery located in the remote unit with enough power to sustain 8 hours of operations with a maximum of 250 video captures. Comes with a 110v charger similar to those used with cellular phones.
- USB slave connection available on the hip pack to allow user to download movie clips to a PC or MAC, where they can be viewed using our supplied software or Windows Media Player™ , RealPlayer™, and other industry standard players.
- Video will be of CIF (320X240) quality at 15 frames per second
- Camera will record a minimum of 48 clips with standard 64 mb flash memory.



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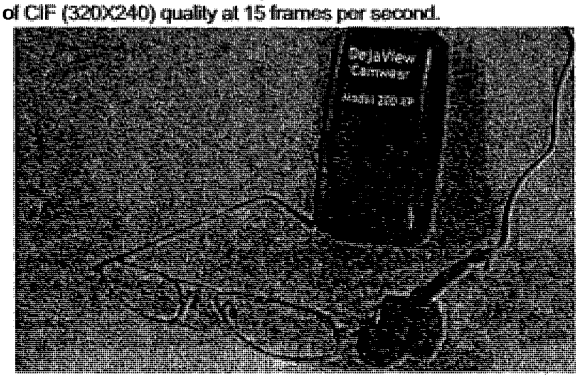
DejaView CAMWEAR model 200 XP

Features:

- Records up to 4 hours of video with audio
- Easy to use – ready to go right out of the box
- Our cameras are all *wearable* – meaning that they are hands free!!
- Download to your PC or MAC via USB cable or via flash memory reader and use our software to view the files. The software also allows you to create CD's, VCD's and DVD's (dependent upon your computer hardware).
- Can be used with DejaVIEW DirectConnect for connecting to your TV or VCR.

Specifications:

- Camera is FCC compliant.
- An indicator light to inform the user when there is less than 15 minutes of storage left on the compact flash card .
- Remote unit will write the video and audio to a removable media (1 gigabyte flash memory) located within the remote unit. This unit is approximately the size of an average-sized PDA.
- All power for the camera and the remote unit is supplied by a rechargeable battery located in the remote unit with enough power to sustain 8 hours of operations with a maximum of 4 hours of record time. Comes with a 110v charger similar to those used with cellular phones.
- USB slave connection available on the hip pack to allow user to download movie clips to a PC or MAC, where they can be viewed using our supplied software or Windows Media Player™ , RealPlayer™, and other industry standard players.
- Video will be of CIF (320X240) quality at 15 frames per second.

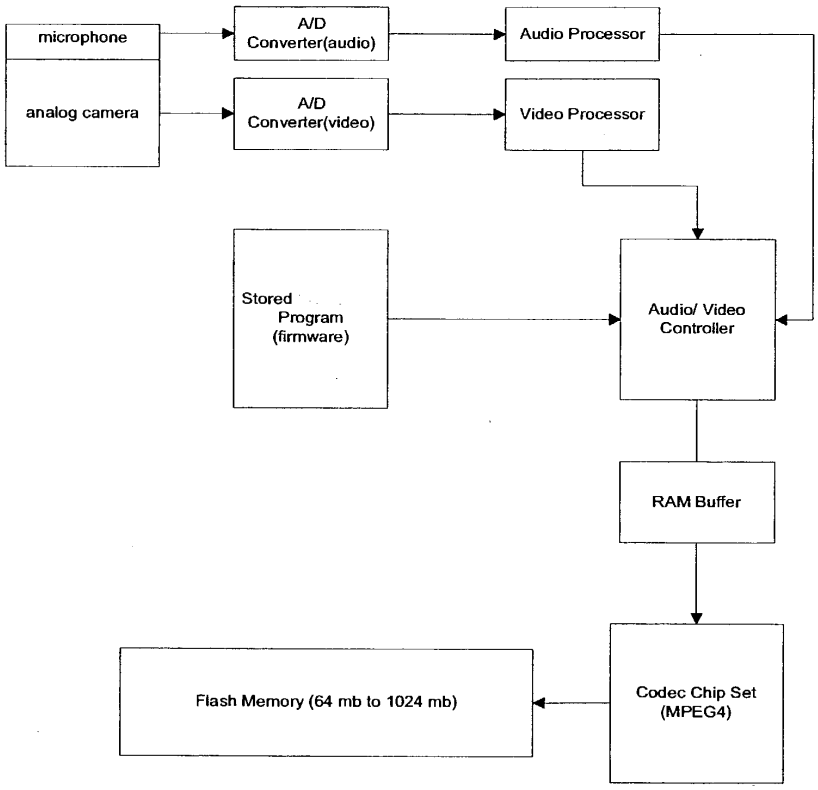


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Ver: A0

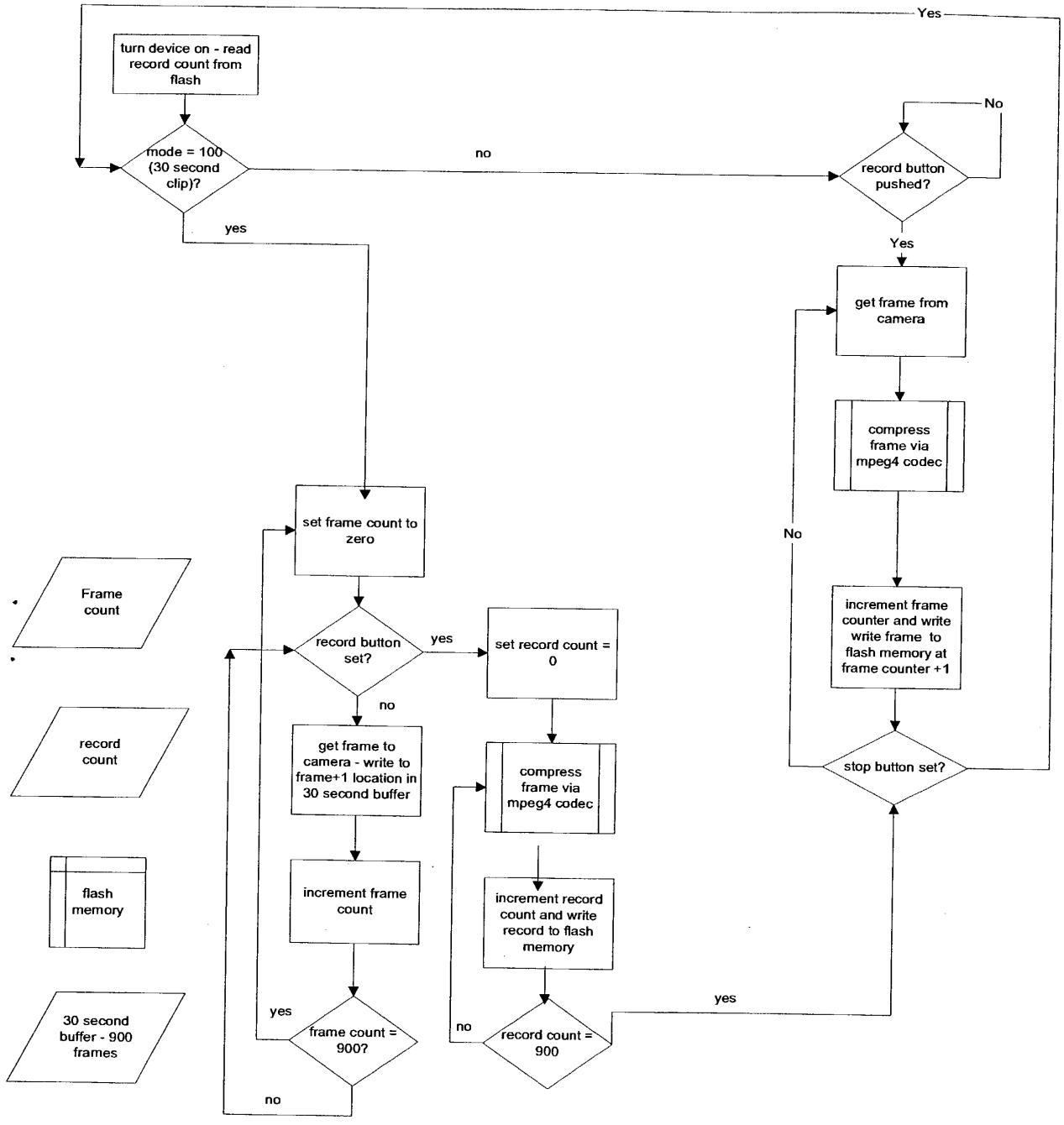
SPECIFICATION

ITEM	DESCRIPTION
Model	CM30
TV System	NTSC
Power Source	DC 6V
Power Consumption	Approx. 0.3W(Max.)
Image	CMOS Sensor
Effective Picture Element	510(H)X492(V)
Scanning System	2:1 Interlace
Sync.Frequency	H:15750 Hz, V:60Hz
Sync.System	Internal
Resolution	320 TV Lines
S/N Ratio	More than 46dB (AGC Off)
IR Night Vision	No
Minimum Illuminance(300K)	<2 Lux
AGC	On
AES	1/60s ~ 6.4us
Gamma Correction	0.45
Video Output	Composite Video Signal: 1.0Vp-p, 75 ohms
Lens	f=4.8mm, F2.6
Microphone	Built in
Audio Output	1.4V rms (Output Impedance 18K ohms)
Operating Temperature	-10°C~+50°C(14°F~122°F)
Operating Humidity	30%~90%
Dimension	0.7"X0.7"X1.0"(18X18X25.5mm)
Weight	1.16 oz (33g)



Deja View Camwear
Functional Diagram

FIG. 2



Deja View Camwear SIGMA Firmware Flow Chart

FIG. 3

Appendix ZZ

Deja View Camwear Model 100

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ABSTRACT
Deja View Camwear Model 100 is the first in a family of wearable camcorders designed to free the user from being shackled to his viewfinder. The Model 100 is designed to ensure that the user never misses that important tidbit. While the initial use is for active lifestyles, we are exploring its use in Security, Military, Training, Automotive and sundry other vertical markets.

Categories and Subject Descriptors
B.4.2 [**Input/Output and Data Communications**]: Input/Output Devices
H.3.0 [**Information Storage and Retrieval**]: General

General Terms: Design, Human Factors

Keywords
Camcorder, After-the-fact, wearable, hip pack, clip-on, microphone, lens, SD, flash, memory, ARM, MPEG-4, 1/4" PEL.

1. INTRODUCTION
Deja View, Inc. was founded in September 2002 to offer a wearable camcorder to the consumer electronics market that would solve the age-old dilemma of most amateur photographers who utter the words: "I missed that shot". After nearly two years of research, product design and development, the first Camwear mini-camcorders were scheduled for shipping to retailers in the Fall of 2004.

2. Product Idea
The camera is the brainchild of Sid Reich, Deja View's founder, whose background is in math and in statistics, and has a background which includes writing operating systems. Mr. Reich saw the potential for an always-on camera to prevent users from missing precious footage. He admired Replay TV, or Tivo, which lets users pause and rewind live television. He was further inspired when, while golfing with friends, a squirrel jumped into their parked golf cart. Reich watched from a distance as the squirrel ripped open a bag of bagels, pulled one out and ran to a tree to enjoy it. He said at the time that he wished he could have shown his friends a video instead of just telling them about the squirrel episode.

3. Product Technology
The first Deja View product, called Camwear Model 100, combines the memory of digital cameras, video stream managerment of DVR's and optics of digital camcorders. The device uses a chip developed by Divio (now ESS), a semiconductor company in Sunnyvale California and the NAND Flash SD™ Memory Cards from Toshiba America Electronic Components, Inc. (TEAC). The "engine" for the device is a RISC processor from NeoMagic which is coupled to proprietary firmware.

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CARPE'04, October 15, 2004, New York, New York, USA.
ACM 1-58113-932-2/04/0010.

4. Product Description
The Camwear Model 100 is the world's first wearable mini-camcorder that solves the dreaded problem faced by many amateur photographers/cinematographers each day: "I Missed that Shot!!!"

It does that by allowing the user to press the "record" button AFTER an even has occurred to capture and save up to the 30 seconds of the action that otherwise would be gone forever. The tiny camera/microphone with clip is less than an inch long and smaller than a nickel for easy attachment to eyeglasses or the bill of a hat. It is tethered by a thin wire to a PDA-sized remote unit, or "hip pack" that clips to a belt or waistband, or fits in a pant or coat pocket or handbag.

To operate the Camwear Model 100, users turn on the power and just watch the action as it occurs in front of them. The camcorder's always-on scanning feature feeds a continuous video stream into the control unit. Although users may not have been ready for the action that had just taken place, they can still capture up to 30 seconds of the previous action by hitting the "record" button after-the-fact! Normally, to obtain action footage with a standard handheld video camcorder, the user must anticipate what might happen by keeping the device aimed and ready – before, during and after the event occurs. The Camwear Model 100 eliminated the need to "view the world through a viewfinder." It is completely hands-free.

Key features of the Camwear 100 include:

- Video quality at CIF (320x240) at 30 frames per second
- From 64MB to 1GB memory storage
- Memory-low warning light
- ArcSoft ShowBiz 2 software for editing audio/video clips on a PC and authoring DVD's, VCD's and single frame prints.
- Download clips to PC via USB 1.1 or 2.0 (cable included)
- 110v charger and rechargeable lithium ion battery with a minimum 4 hour operating capacity.
- Direct output to TV, VCRs or DVD burner via RCA jacks
- File viewing with ArcSoft ShowBiz 2 software or Windows Media Player

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5. Product Audience

The Camwear 100 with its "after-the-fact" technology is ideally suited to a variety of applications, including recreation and leisure, travel and tourism, business, education, government, military, law enforcement, medical research and many others where it is important to keep visual documentation of activity. Aimed primarily at the consumer, the product's typical usage would be by parents attempting to capture the precious moments of their son or daughter at such milestone events as school promotions and graduations, Little League or other sports action, weddings, etc.

6. Pricing

The Camwear Model 100 is priced at $399.99 MSRP

7. Distribution

The Camwear 100 will be available through the Deja View website at www.mydejaview.com , and through a network of consumer electronics chain stores, camera stores and major online resellers.







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Appendix AAA

Augmenting and Sharing Memory with eyeBlog

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ABSTRACT
eyeBlog is an automatic personal video recording and publishing system. It consists of ECSGlasses [1], which are a pair of glasses augmented with a wireless eye contact and glyph sensing camera, and a web application that visualizes the video from the ECSGlasses camera as chronologically delineated blog entries. The blog format allows for easy annotation, grading, cataloging and searching of video segments by the wearer or anyone else with internet access. eyeBlog reduces the editing effort of video bloggers by recording video only when something of interest is registered by the camera. Interest is determined by a combination of independent methods. For example, recording can automatically be triggered upon detection of eye contact towards the wearer of the glasses, allowing all face-to-face interactions to be recorded. Recording can also be triggered by the detection of image patterns such as glyphs in the frame of the camera. This allows the wearer to record their interactions with any object that has an associated unique marker. Finally, by pressing a button the user can manually initiate recording.

Categories & Subject Descriptors
H.5.m. Information Interfaces and Presentation, H.5.4. Hypertext/Hypermedia. H.3.1. Content Analysis and Indexing.

General Terms
Human Factors. Management.

Author Keywords
Attentive User Interface. Humanistic Intelligence. Ubiquitous Computing. Blogging. Eye Tracking. Wearable.

INTRODUCTION
We are entering an age of information overload. The pervasiveness of portable personal recording devices that produce large amounts of data or large numbers of files emphasizes this problem. We find ourselves on the brink of an era where the unlimited storage capacity first envisioned by Bush [2] will allow everyone to record and store their entire lives in personal libraries. The increasing amount of data accumulated by the average user is becoming more difficult to manage, and will continue to do so as storage space increases and recording devices approach ubiquity. Although Engelbart [3] had once envisioned computational devices that would augment human intellect, integrating these devices into our every day existence has proven to be challenging. The affordances of virtually unlimited storage are both empowering and constraining. As the notion of manually deleting older files to make room for new ones becomes obsolete, we will have to deal with the reality that finding a particular file, or relevant data within large files becomes more difficult. To combat this we must devise ways to either reduce the amount of recorded information to that which is relevant, or annotate files with information about their content. To this end we present eyeBlog; an automatic, attentive video blogging tool.

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CARPE'04, October 15, 2004, New York, New York, USA.
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Previous Work
The Humanistic Intelligence (HI) model proposed by Mann [4], describes a framework in which the human and computer interact in close synergy with one another. According to him, HI arises from the very existence of the computer, user and their close interaction with one another. The HI framework describes devices that are in close proximity to, and often worn by the user on a daily basis [5]. As such, meeting the requirements of the HI framework (see Fig. 1) enables the human and computer to achieve the augmentation of intellect envisioned by Engelbart. According to the HI model, the system must:

- Be unmonopolizing;
- Support unrestrictive interaction to the human and the outside world;
- Support observation of system properties;
- Be controllable: The device is responsive to the human's control at any one time;
- Communicate: The computer can communicate with others;
- Pay attention: The computer is attentive to the user and the environment.

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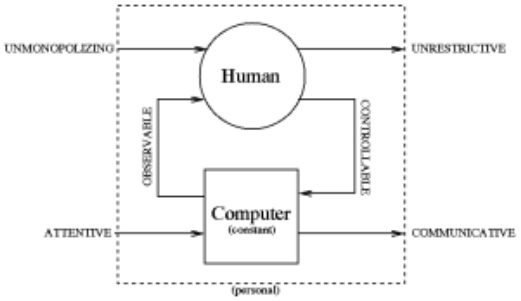


Figure 1. HI framework for augmentation [6]

EyeTap [6] is an illustration of a device that satisfies these properties. EyeTap are a pair of glasses that allow the user to continuously capture and record information. To record, the device employs a circular buffer system such that the last 10 minutes of video is retained. This enables the user to review the last 10 minutes of their life, allowing them to manually save the most memorable moments throughout the day. Although effective, manual initiation of recordings demands attention, and therefore goes against the attentive properties of HI. Manually editing and categorizing the recorded segments from an entire day is both tedious and time consuming. In this respect, the attentive property of the device is the most notable of the fundamental HI framework. That is, the device must be intelligently aware of the context in which it is operating. With this knowledge, we can automate the processes of determining which moments are relevant as well as the recording of metadata. The Attentive User Interface (AUI) paradigm by Vertegaal et al. [7] integrates well with the HI model. AUIs register the attention of the user through sensing proximity, body orientation and eye contact of users. The Attentive Cellphone prototype [8] is an early example of a system that exploits an AUI. Unlike Eye-aRe glasses [9] that used Infra Red emitters and receivers to detect when two pairs of glasses are mutually aligned, the Attentive Cellphone registered actual eye contact between the wearer and an onlooker. It used an eye-contact sensor mounted on the brim of a baseball cap to inform potential callers when the recipient was in a face-to-face conversation. However, due to the parallax between the eyes and camera, eye-contact detection with this design was not precise [8]. By mounting the camera on a glasses-like headset Mann's EyeTap avoids visible parallax. This allows video to be recorded from a first-person perspective while an associated wearable computer streams video content to the web. An example of an early wearable facilitating automated editing and annotation of video content is LAFCam [10]. In LAFCam, points of interest in the video are established by monitoring nonverbal utterances made by the videographer during filming. This metadata is recorded in sync with the video channel giving human editors a quick and easy way to find interesting segments in the footage.

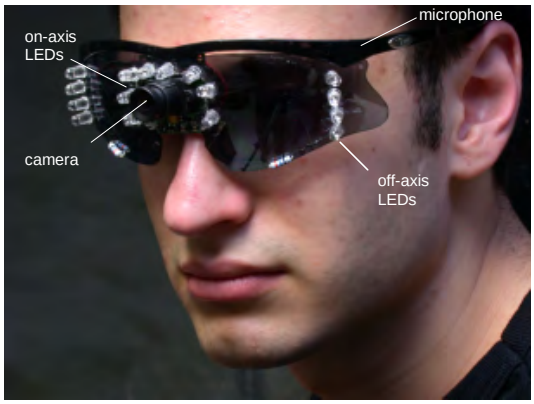


Figure 2. ECSGlasses: camera with LED illuminators

IMPLEMENTATION

Weblogs (or blogs) are regularly updated web pages with more recent posts appearing closer to the top of the page [11]. Blogging is a form of online communication that is rapidly gaining popularity with mainstream users due to its accessibility and ease of use. Typically blogs support single-click publishing of entries. According to Herring et al [12], the vast majority (over 70%) of blogs are authored by ordinary people for their own reference purposes and niche audiences. Blog entries are typically text, but can also include images, sounds, video and other rich media types. eyeBlog is essentially a video blogging system made up of three distinct components. ECSGlasses are a novel wearable camera system that allows a user to record video from a first person perspective upon detection of eye contact at the wearer. This allows the wearer to pay attention to the event at hand, rather than the device being used to record it. The associated recording software, running on a remote computer, uses the information from the ECSGlasses to start and stop recording. Recorded video segments are then appropriately compressed and filed for web publishing. Publishing is handled by an Apache web server and a modified installation of the Moveable Type blogging software and a proprietary Perl script called eyeBlogScript. This allows anyone with Internet access to annotate, grade, catalogue and search the video blog archive.

ECSGlasses

Eye-Contact Sensing (ECS) Glasses are a novel type of wearable input device for detecting the looking behavior of other people without any discernible parallax [1]. They are also capable of recognizing other image patterns such as glyphs. ECSGlasses consist of a standard pair of sunglasses, augmented with an eye-contact sensing camera [1]. We have developed both clear and dark glass versions, the latter is shown in figure 2. Unlike Eye-aRe [9], ECSGlasses do not require others to wear any machine recognizable tag. Instead, the glasses employ computer

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Fig 3. Processed Image: circles indicate eye contact detection



Fig 4. eyeBlog: image preview

vision to search for human eye gaze directed toward the wearer's eyes as well as detecting glyphs that appear within the frame. The current design employs an analog Infra Red sensitive camera mounted between the wearer's eyes. On-axis with the camera is a collection of Infrared Light Emitting Diodes (LEDs) surrounding the lens (see Fig. 2). Two more sets of LEDs are situated off-axis near the arms of the glasses. The LEDs illuminate the scene in front of the camera. The Mammalian retina acts as a retro-reflector, bouncing light back in the direction of origin. When the on-axis LEDs are illuminated, a red-eye effect is observed in the pupils of an onlooker. When the off-axis LEDs are illuminated the camera records a similar image, but with dark pupils instead. By syncing the LEDs with the camera clock, a bright and dark pupil effect is produced in alternate fields of each video frame. A simple algorithm finds any eyes in front of the user by subtracting the even and odd fields of each video frame. The LEDs also produce reflections on the corneas. These glints appear near the center of the detected pupils when the onlooker is looking at the eyes of the user, allowing the sensor to detect eye contact without calibration (see Fig. 3). Eye-contact sensing range depends on focal length and the camera resolution. With a 12mm lens and a 320x240 effective resolution, range is 1m with a 50cm field of view. Glyph detection is handled by ARToolkit [14], which searches for specific geometrical shapes arranged in a sequence. It recognizes glyphs by analyzing each image from the ECSGlasses' camera and applying pattern recognition algorithms. The number of possible glyphs is constrained only by the resolution of the camera. These unique graphical identifiers are used to differentiate between objects. ECSGlasses uses an RJ-45 cable that connects to a compact box worn at waist-level. The box supplies power using a 12-volt DC battery, and contains the LED timer circuit board as well as the wireless video transmitter. The video feed is processed on a computer with an associated wireless video receiver. This allows the ECSGlasses to operate untethered. The computer remotely performs image analysis to recognize glyphs or determine if any eyes are oriented at the wearer. After processing image data, the computer streams information about the co-ordinates and orientation of pupils and detected glyph IDs to connected appliances over a wireless network.

Recording

eyeBlog is a video blogging application designed to automatically record and publish face-to-face conversations and interactions with tagged objects. It addresses one of the major problems in video blogging: that of immediate editing and publishing of video content. Digital cameras are typically quite demanding of a user's attention. More often that not, a videographer's attention is focused on the device being used to record an event, rather than on the event being recorded. This is particularly problematic when recording documentaries of one's life experiences. First-person perspective video and automatic recording eases the creation of online video blogs by allowing the user to participate in the event rather than simply monitor it. To limit the amount of footage, current video bloggers are required to engage in the video recording process or manually edit video footage before posting. eyeBlog facilitates this process by using the signal from the eye-contact and glyph sensing camera in the ECSGlasses to decide when to record video from the ECSGlasses' camera. eyeBlog, which runs on a remote computing unit, statistically processes eye contact and glyph data. Recording is triggered when the percentage of eye contact over time reaches a preset threshold value or an object of interest and its associated glyph appears within the frame. Recorded video segments have a resolution of 640x480 and are updated 30 times per second. Videos are compressed using the MPEG-1 compression scheme producing a final average data-rate of 100 kilobits per second. Each resulting .mpg file is stored in the eyeBlog video directory on the web server. A single frame from the beginning of each video segment is used to create an image preview. These image previews are then stored as a .jpg file in the eyeBlog

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image directory on the web server. By displaying an image preview for each video, users can quickly see the content of a video segment without having to download it. This is shown in Figure 3. This facilitates participation of those who are browsing eyeBlog through low-bandwidth devices such as mobile phones and analog modems.

Blog Publishing

Blog entries are dynamically created as new video segments are recorded. This is handled by eyeBlogScript, which is a Perl script that monitors the video and image preview directories on the web server. When files are added to these directories, eyeBlogScript creates a new blog entry and submits it to Moveable Type where it formats the content for display and adds support for annotation, grading, cataloguing and searching. When a blog entry is created, the image preview is displayed. When a user clicks on the image preview, the associated video segment is revealed in a new browser window. Users have the ability to download the videos to a local drive for offline viewing. There is a space below the image preview reserved for the eyeBlogger's personal annotations. Below this area is a link that allows browsers of eyeBlog to add their own annotations. In addition to this, Moveable Type automatically generates an XML representation of the annotation, grading and cataloguing information from recent entries and stores this as a Rich Site Summary (RSS) feed. RSS is a simple way for bloggers to syndicate their content in digest form. Users can subscribe to the RSS feed and automatically be notified when eyeBlog is updated. Many RSS readers support the ability to filter feeds so only blog entries that match the specified conditions are displayed.

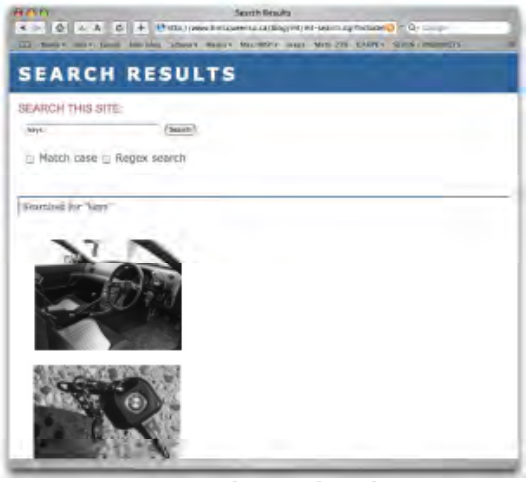


Fig. 5 eyeBlog: search results

SCENARIOS

We present three scenarios that depict how users can both augment memory and share experience with eyeBlog. eyeBlog bestows searchable videographic memory on the wearer. These memories can be accessed and effectively exploited by both the eyeBlog wearer and third parties. In scenario one we show how an individual with eyeBlog can mine their immediate personal history to inform their current decisions. The second scenario shows how future users of eyeBlog can recall, share and learn from the experiences of their ancestors. The final scenario shows how an eyeBlog wearer can enhance their knowledgebase.

Scenario 1: Augmenting Short-Term Memory

Maayke, is both an artist and film editor by trade. She is very busy and must manage her separate editing and portrait businesses. It is now 7:00 am and she is about to make her way to the gym for an early workout. As usual, she has misplaced her car keys. Because her keychain has an associated glyph attached to it, she knows that she can check eyeBlog to see where she left them the night before. She clicks the eyeBlog bookmark in her web browser and enters "car keys" into the search field of the eyeBlog interface. A collection of image previews appears in reverse-chronological order in her browser. No need to download the video segment, as she quickly sees that she left the keys in the ignition of her car (see Fig. 5). After her workout she stops for a cup of coffee before her big meeting with a major studio producer for a possible editing job. This is her third meeting with this producer and she really wants to make a good impression on him. She consults eyeBlog to see what transpired in their previous meetings. She constrains the search to "face-to-face," "business" and the "dates" that the meetings transpired. Another short collection of image previews appears. She clicks on the appropriate segments. From watching them she is reminded that that in their last meeting the producer was in a hurry, so he was unable to view her latest portfolio additions. She decides to quickly go back home and pick up the DVD with her most recent work.

Scenario 2: Augmenting Historical Memory

It is one hundred years in the future. Tarak and Julia are in 5th grade and have been paired together to work on a history presentation for class. They have chosen to learn about the pioneers who first colonized the Moon. Tarak is lucky because Julia's Grandfather was one of the initial colonists to migrate there. Because he was augmented with eyeBlog there is an ocean of first-hand data on the experience of being a Lunar colonist. Tarak and Julia surf through the contents of her Grandfather's eyeBlog and compile a collection of relevant links for the class presentation.

Scenario 3: Sharing Experience

Mark is retrofitting a jet engine on a commercial airliner. Although he has been an aviation engineer for over ten years, he still has a little difficulty remembering exactly how the fuel-line attaches. His colleague Owen has agreed to assist him when he reaches this critical step. Owen, who

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works across town has already subscribed to Mark's personal RSS feed and instructed his filter to alert him when Mark's eyeBlog registers the glyphs on the fuel-line. When the notification comes, Owen calls Mark to talk him through the procedure. After a few minutes Mark feels confident that he can finish the job on his own. He thanks Owen for his help and terminates the call. If he needs more information he can always consult Owen's eyeBlog entries that relate to the fuel-line.

FUTURE CONSIDERATIONS

Although applying glyphs is an easy and cheap way for eyeBlog to identify objects, it is not practical to augment all objects. Even if manufacturers agreed to augment all new objects with unique glyphs, there would still be the issue of untagged pre-existing objects. Object size is also of concern, as not all objects are large enough or of adequate shape to support the addition of glyphs. By adding better image recognition, eyeBlog would be able to recognize any arbitrary object that falls within the cameras field of view. This would allow a wearer who is interested in a particular object to indicate to the system that they are interested in this object, and to record any instance where the object appears in the frame of the camera. This same technology could also be used to recognize the face of interlocutors. Knowing the identity of people could be used to better categorize conversations. Adding speech recognition and a means for transcription would free the wearer of having to manually annotate eyeBlog entries. Incorporating other sensing mechanisms such as Global Positioning, electrocardiogram and brainwave telemetry in a fashion similar to Aizawa's video summary system [15] would further enrich meta-data and allow for more precise categorization of entries.

CONCERNS

eyeBlog is designed to record and publish a user's daily experiences. We have yet to incorporate a means to automatically maintain a user's privacy. As such, eyeBlog is bound to record instances that one may not want to make public. Currently users must manually delete sensitive material.

CONCLUSION

In this paper we presented eyeBlog, a personal recording and publishing system. eyeBlog automatically records events of interest. It determines interest by detecting mutual eye-gaze between interlocutors as well as registering the sightings of glyph-augmented objects. We gave example scenarios of the types of interactions and uses eyeBlog supports.

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We would like to thank all the students who comprise the Human Media Lab, particularly our Engineer, Changuk Sohn. David Fono and Daniel Cheng also deserve kudos for their invaluable software development skills.

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Appendix BBB

US008482488B2

(12) **United States Patent**
Jannard

(10) **Patent No.: US 8,482,488 B2**
(45) **Date of Patent: Jul. 9, 2013**

(54) **DATA INPUT MANAGEMENT SYSTEM FOR WEARABLE ELECTRONICALLY ENABLED INTERFACE**

(75) Inventor: **James H. Jannard**, Eastsound, WA (US)

(73) Assignee: **Oakley, Inc.**, Foothill Ranch, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 673 days.

(21) Appl. No.: **11/022,367**

(22) Filed: **Dec. 22, 2004**

(65) **Prior Publication Data**

US 2006/0132382 A1 Jun. 22, 2006

(51) **Int. Cl.**
G09G 5/00 (2006.01)
G02C 1/00 (2006.01)
H04R 25/00 (2006.01)

(52) **U.S. Cl.**
USPC **345/8**; 351/158; 381/381

(58) **Field of Classification Search**
USPC 345/7–8; 455/66, 557–569.1, 347–351; 351/158, 41, 111, 123; 381/327–329, 370–379, 381/381
See application file for complete search history.

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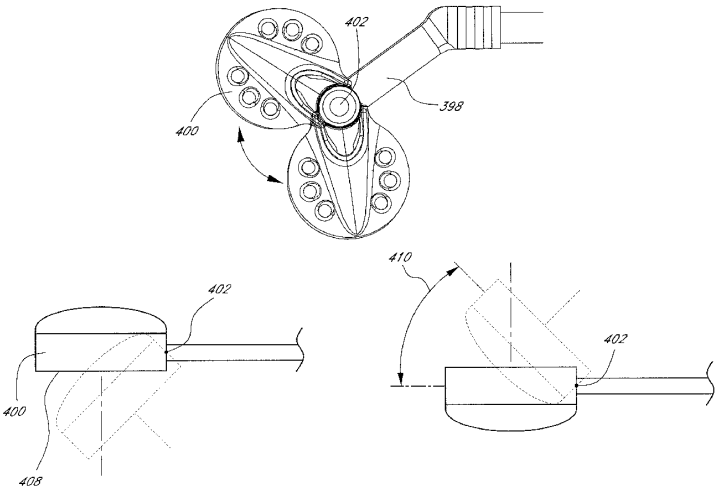
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Primary Examiner — Rodney Amadiz
(74) *Attorney, Agent, or Firm* — Knobbe, Martens, Olson & Bear LLP

(57) **ABSTRACT**

A data input management system is disclosed, for allowing a user to select one or more data sources, to be placed either simultaneously or one at a time into electrical communication with a single user interface. The user interface may comprise a wearable support, such as an eyeglass frame, adapted to carry one or more of speakers, microphone and video display, depending upon the desired functionality. Source electronics may be carried by the support or carried remotely, and in wireless communication with the support using Bluetooth protocols or other data transmission technology.

26 Claims, 47 Drawing Sheets



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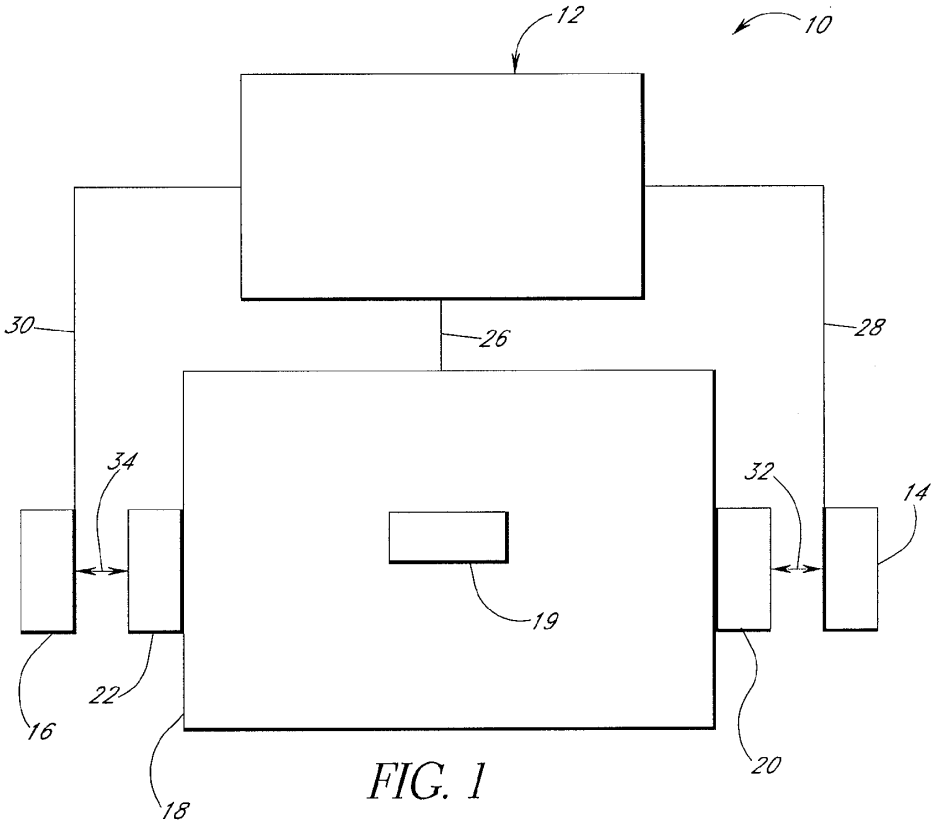


FIG. 1

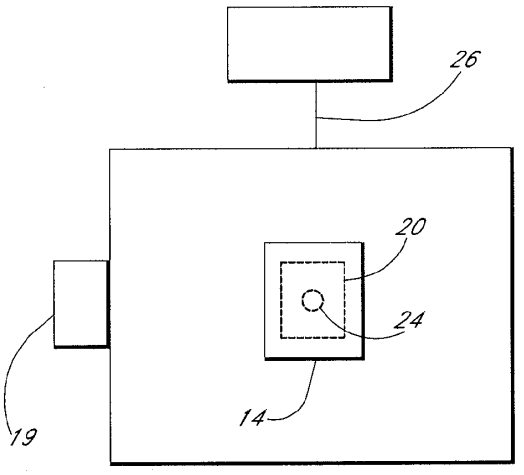


FIG. 2

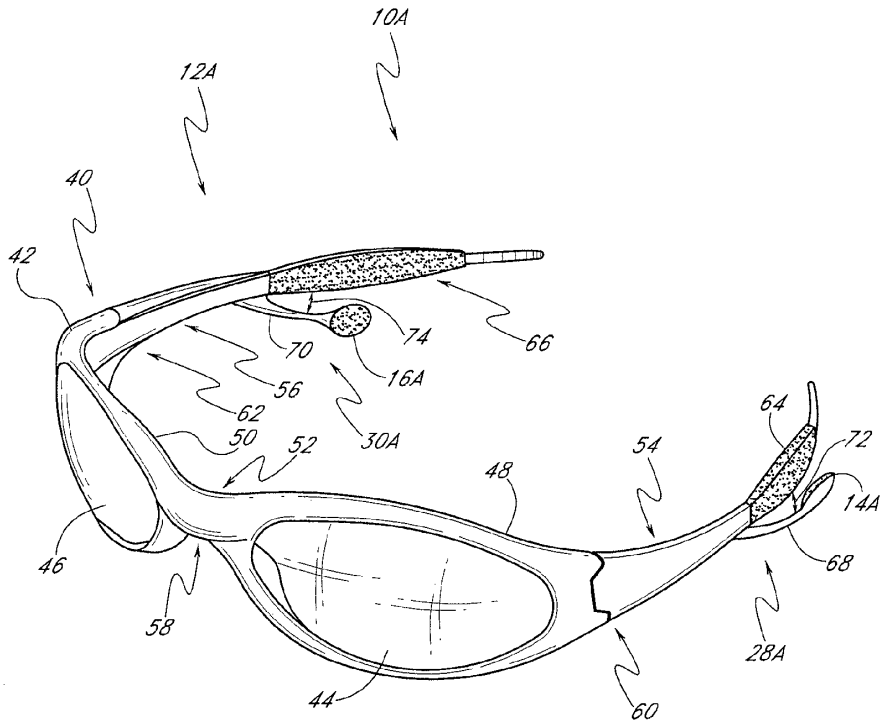

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FIG. 3A

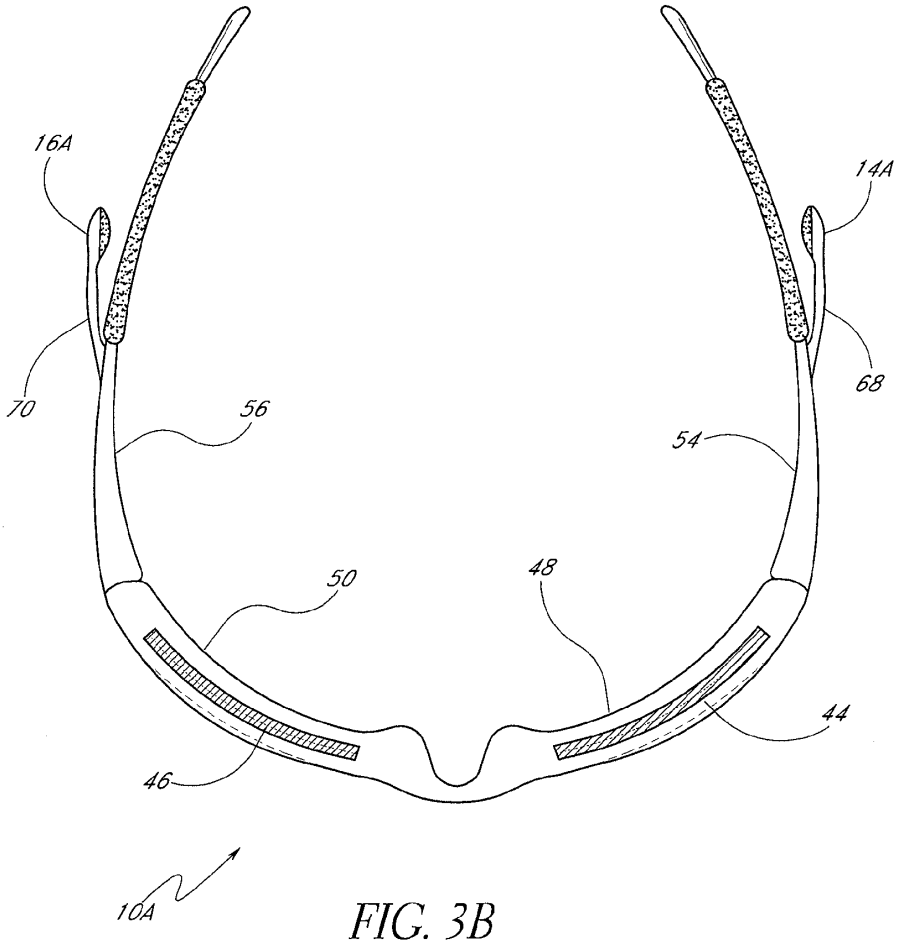


FIG. 3B

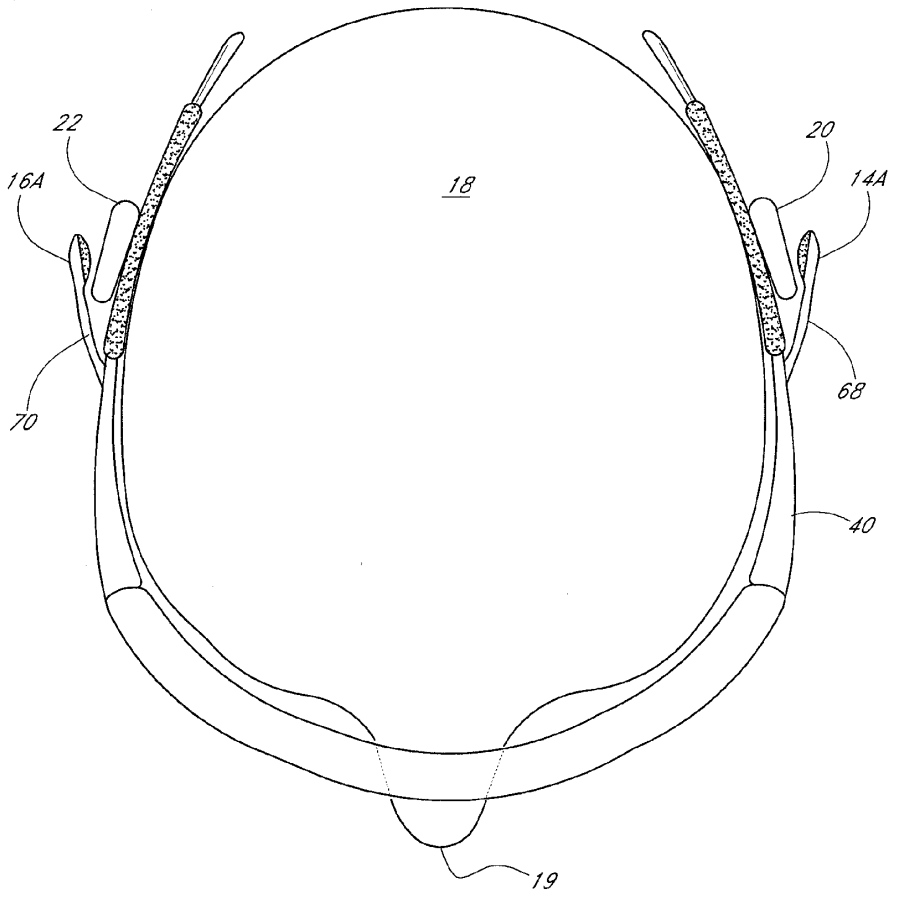


FIG. 3C

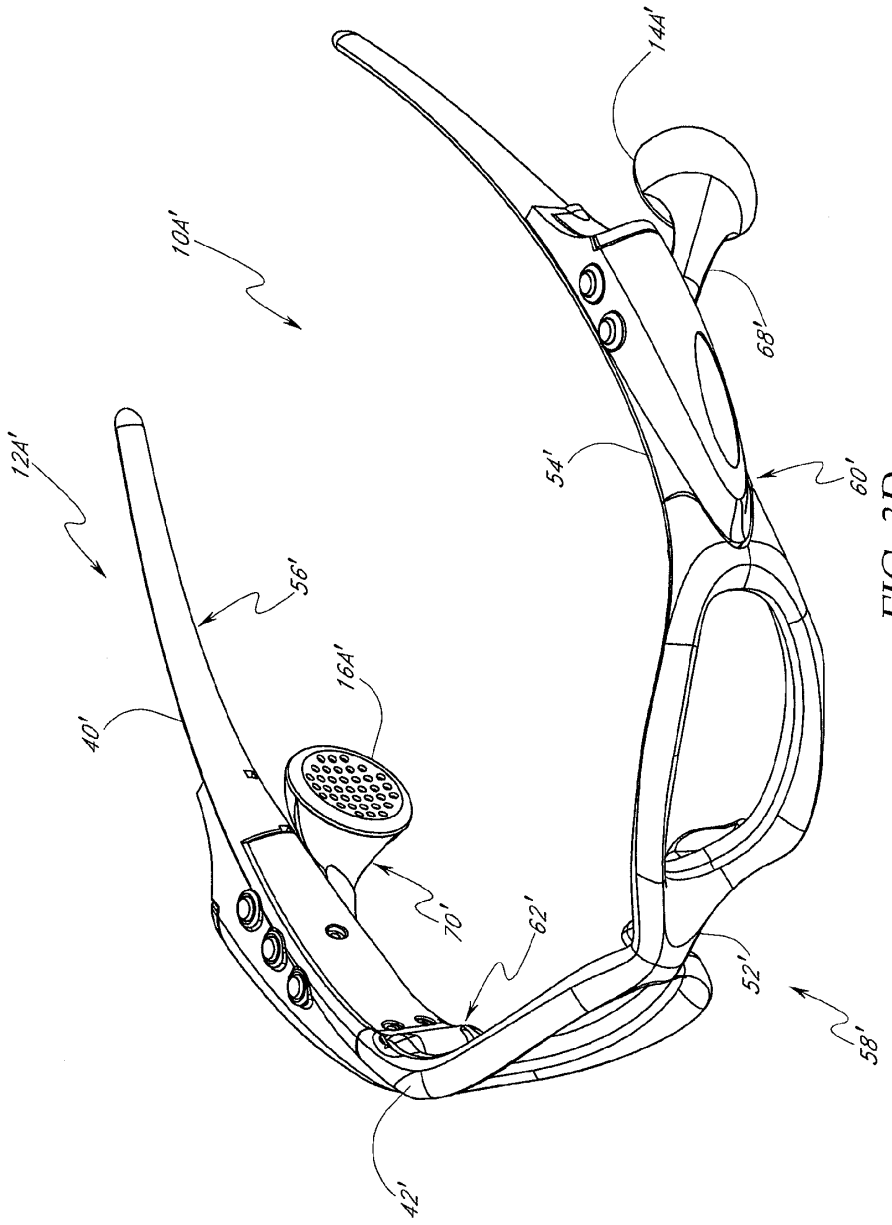


FIG. 3D

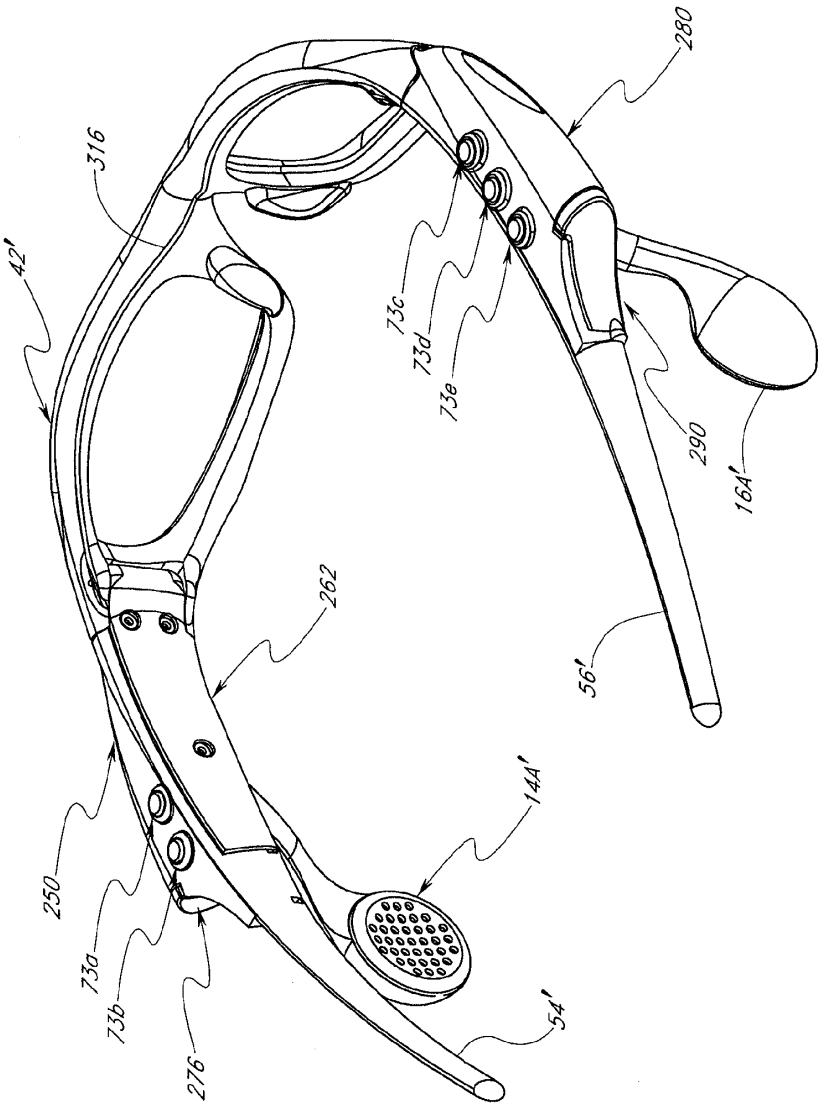


FIG. 3E

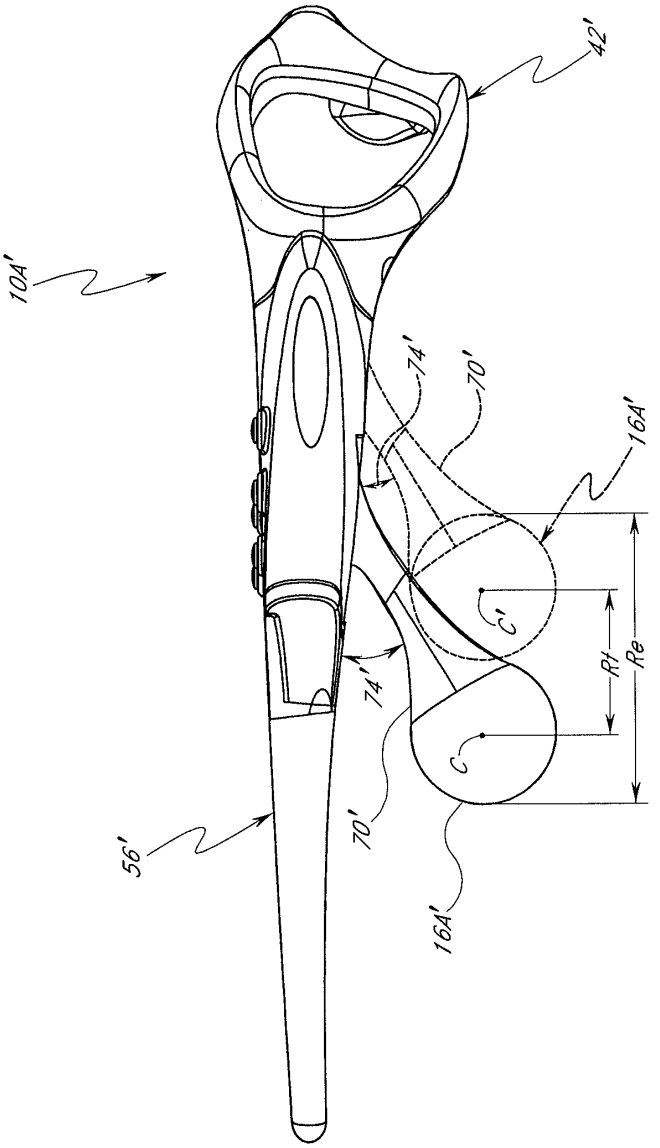


FIG. 3F

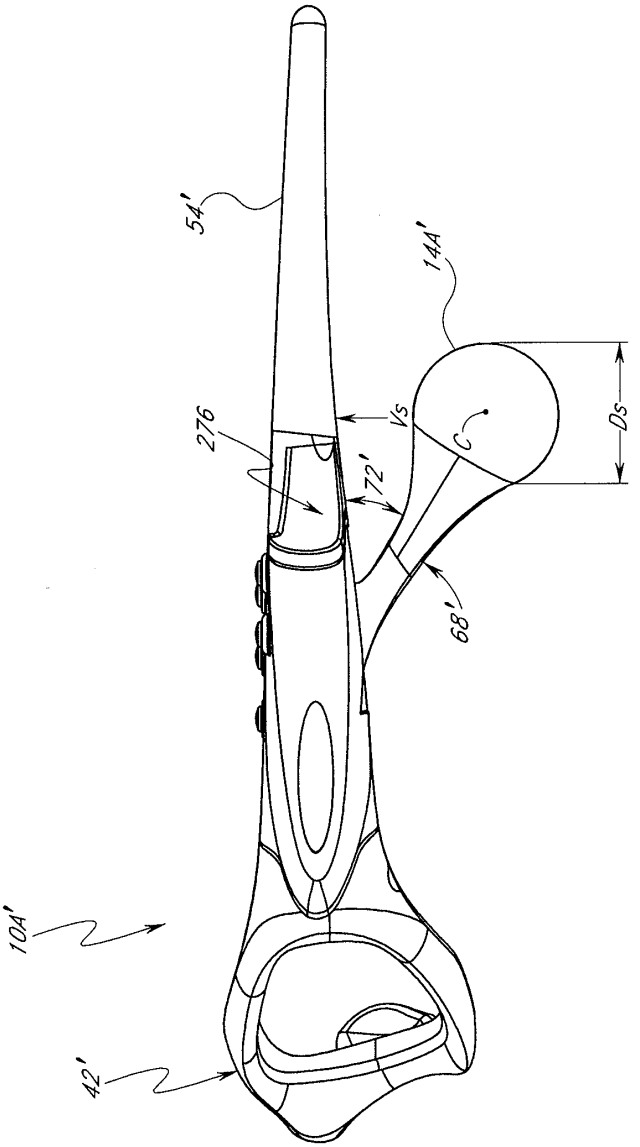


FIG. 3G

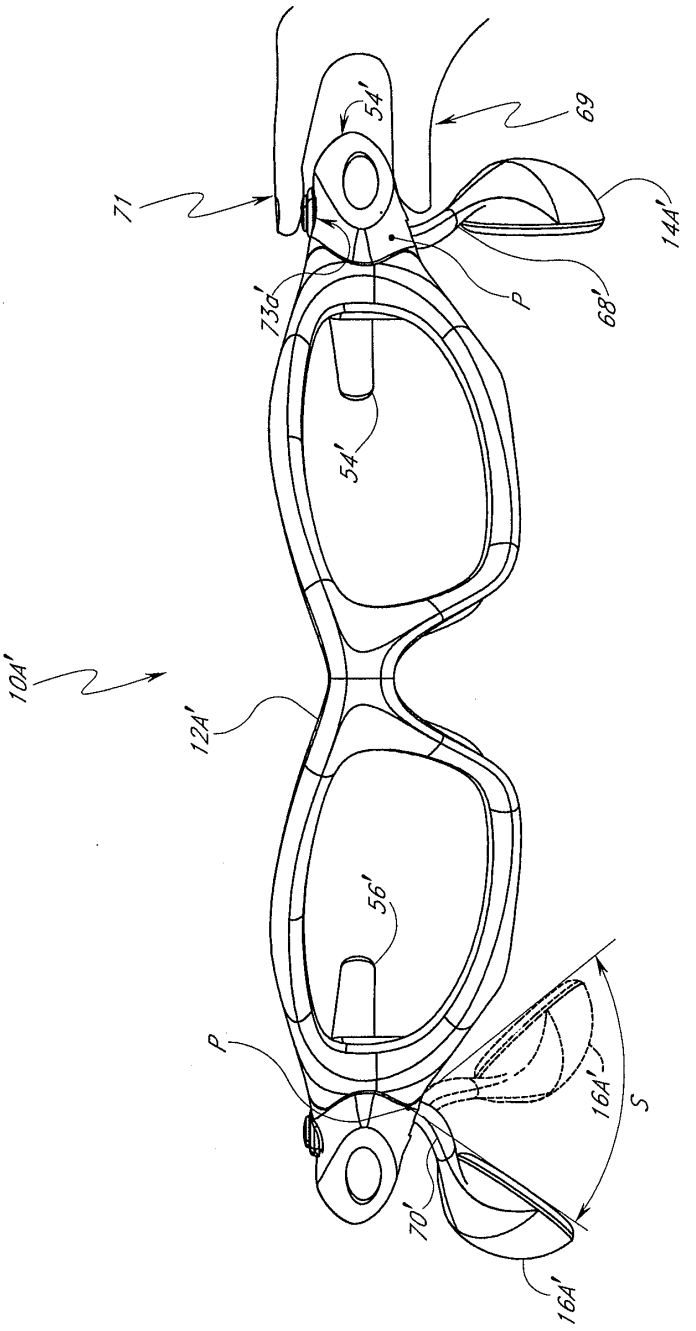


FIG. 3H

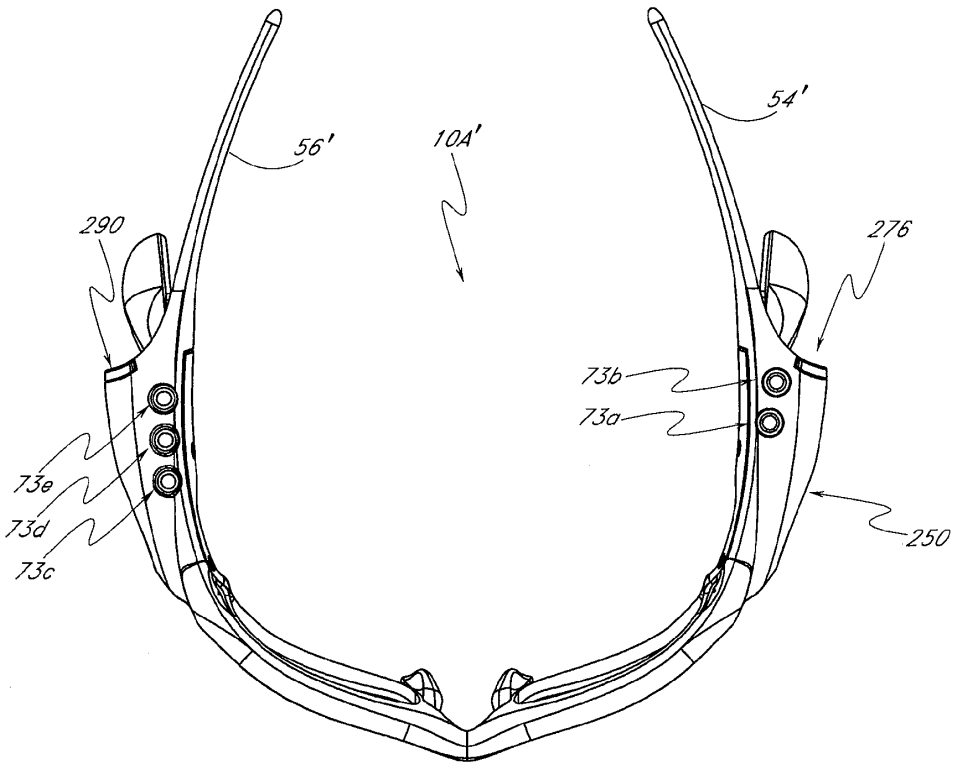


FIG. 3I

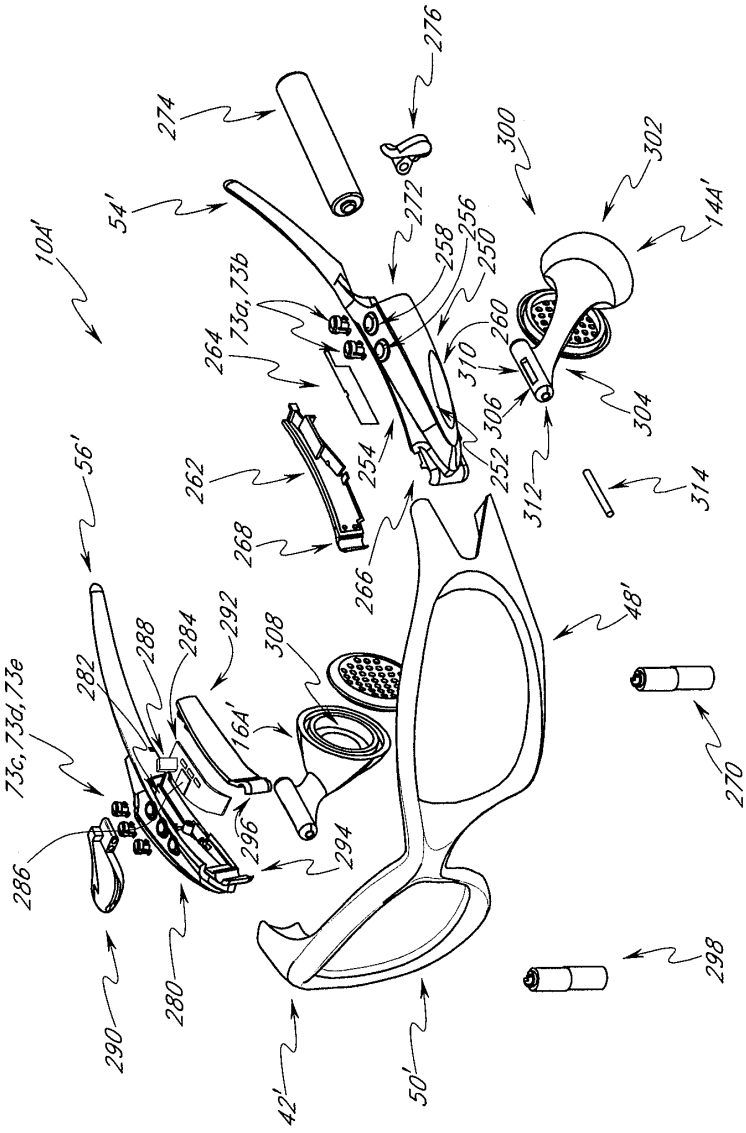

276
274
300
302
54'
272
144'
104'
258
256
250
73a, 73b
264
260
310
306
304
56'
254
262
252
312
314
268
266
48'
292
284
288
282
308
73c, 73d, 73e
16A'
270
286
296
294
280
290
298
42'
50'

FIG. 3J

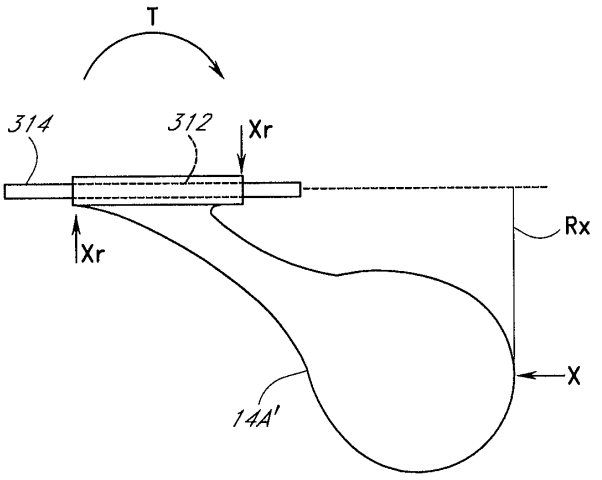


FIG. 3K

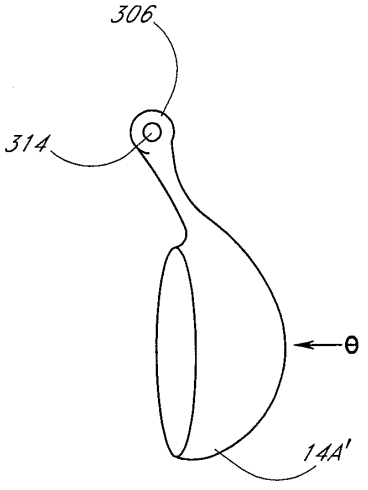


FIG. 3L

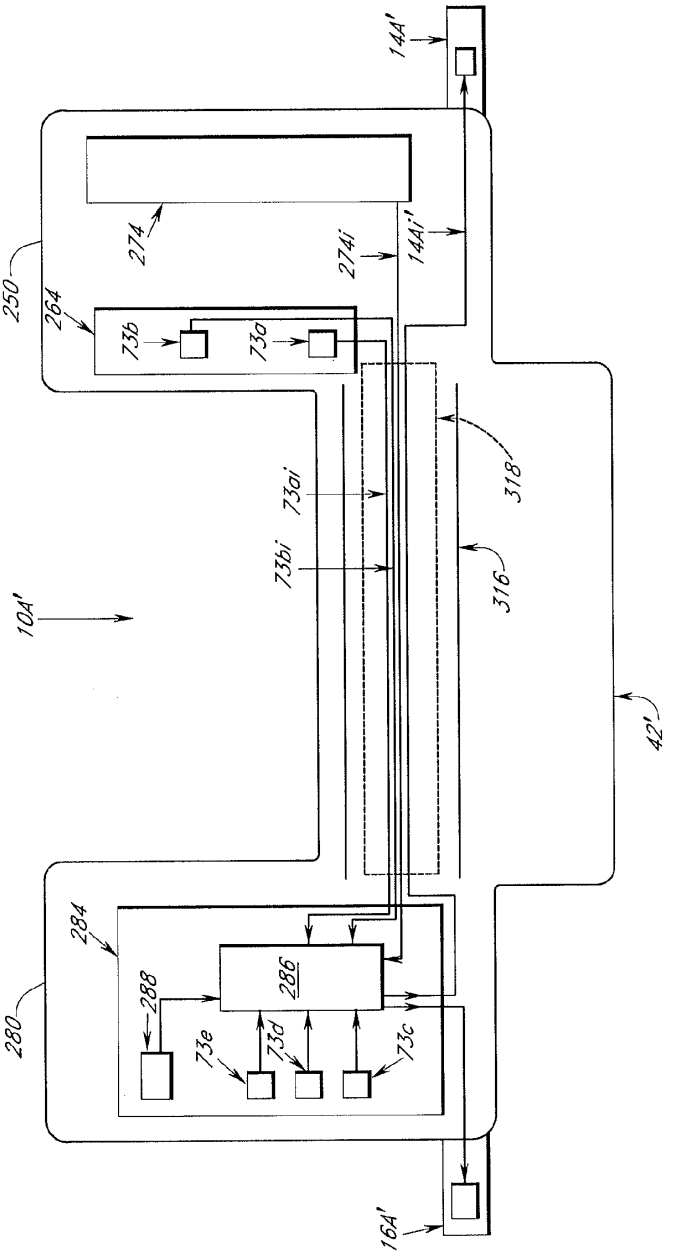

14A'
274
274i
14Ai'
250
264
73b
73a
73ai
73bi
318
316
10A'
42'
284
286
288
280
73e
73d
73c
16A'

FIG. 3M

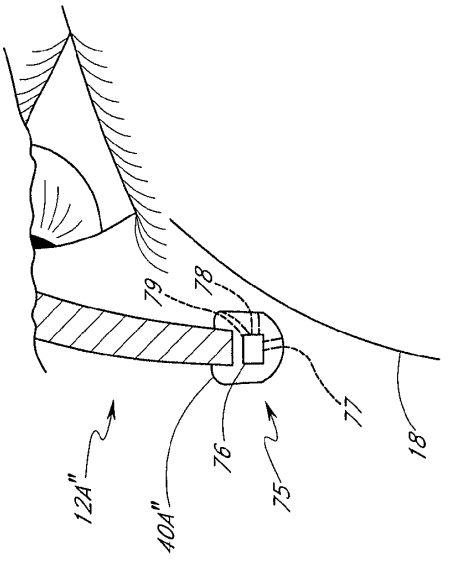


FIG. 4B

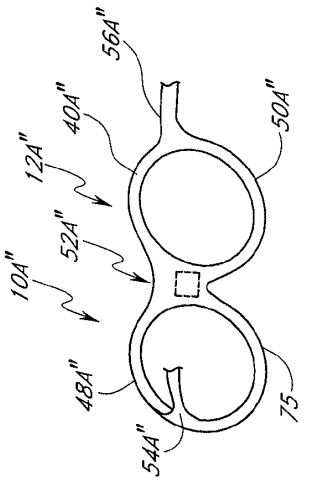


FIG. 4A

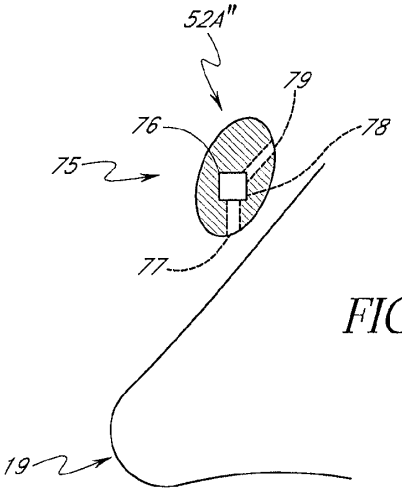


FIG. 5A

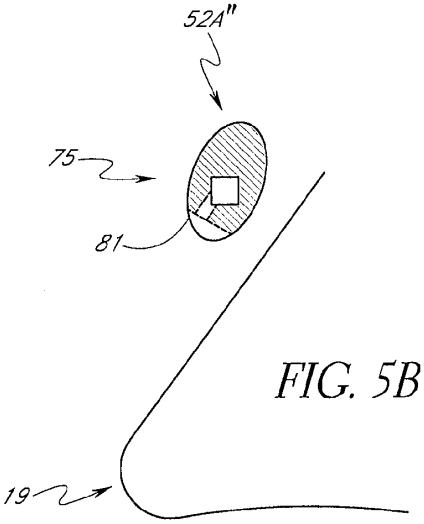


FIG. 5B

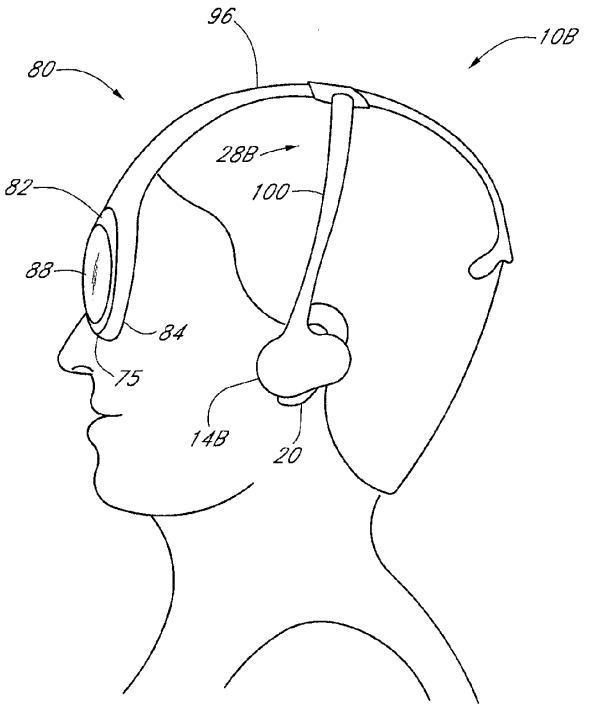


FIG. 6

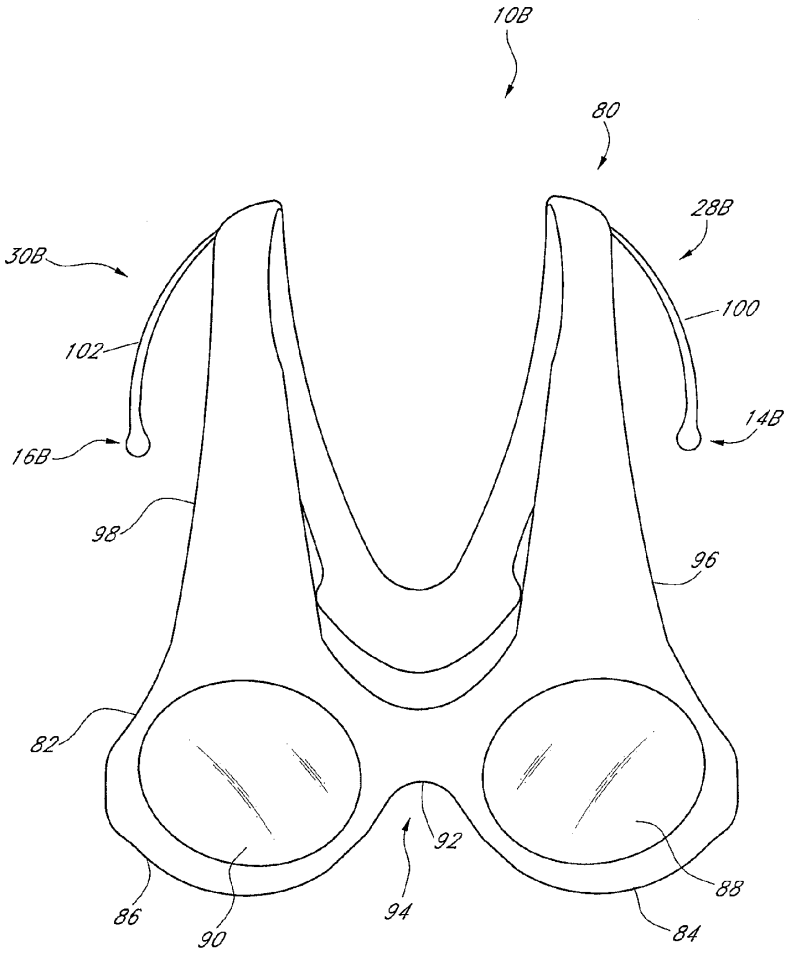


FIG. 7

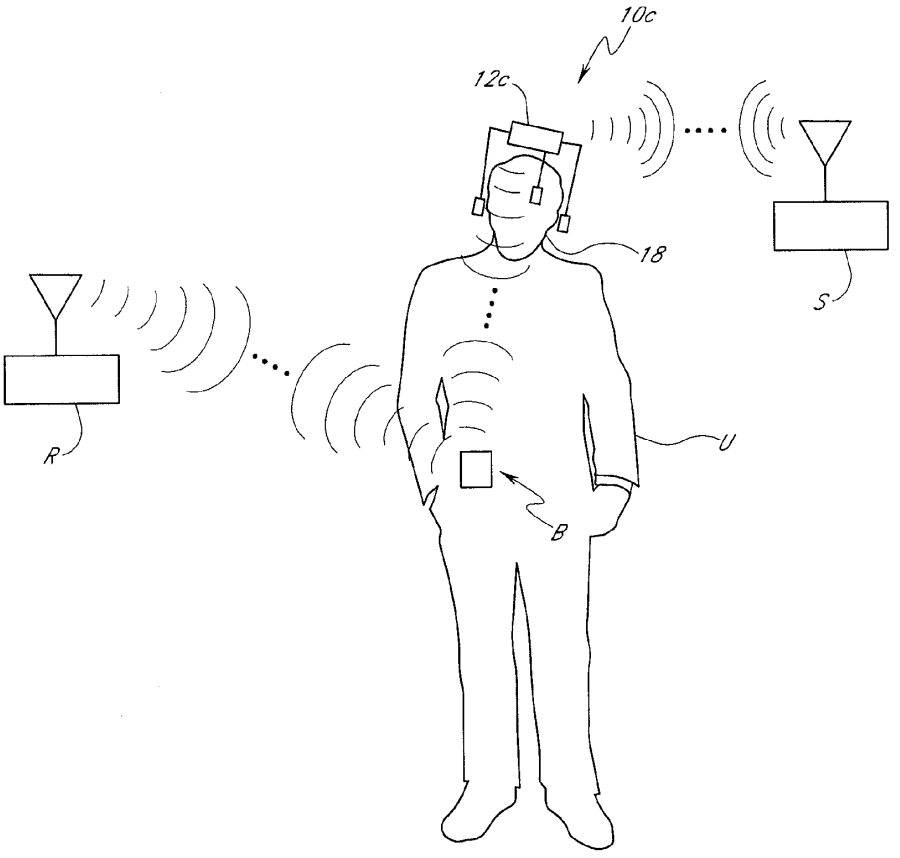


FIG. 8

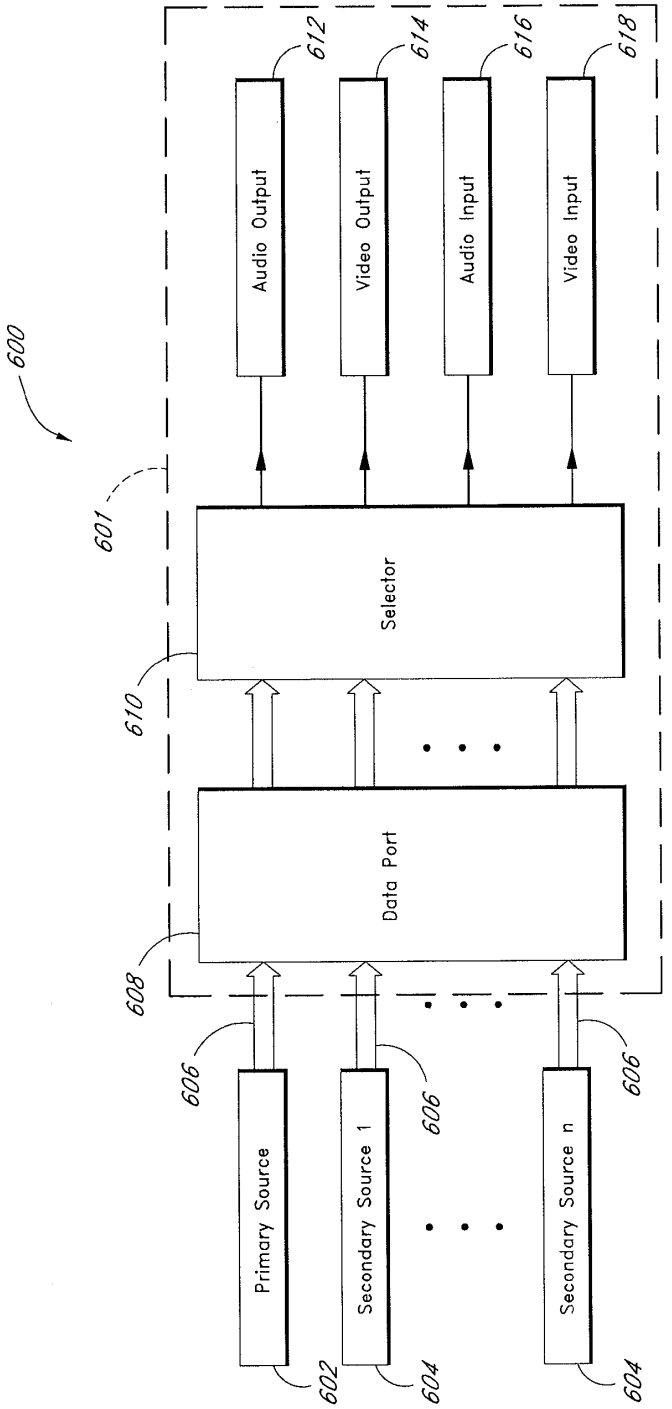

600
601
610
608
606
606
606
602
604
604
612
614
616
618
Audio Output
Video Output
Audio Input
Video Input
Selector
Data Port
Primary Source
Secondary Source 1
Secondary Source n

FIG. 8A

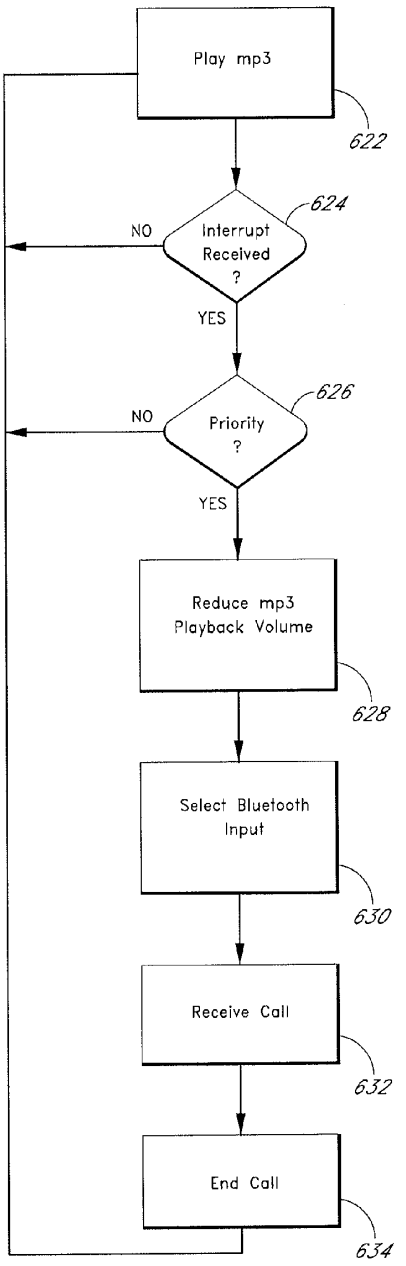

Play mp3
622
620
624
NO
Interrupt Received ?
YES
626
NO
Priority ?
YES
Reduce mp3 Playback Volume
628
Select Bluetooth Input
630
Receive Call
632
End Call
634

FIG. 8B

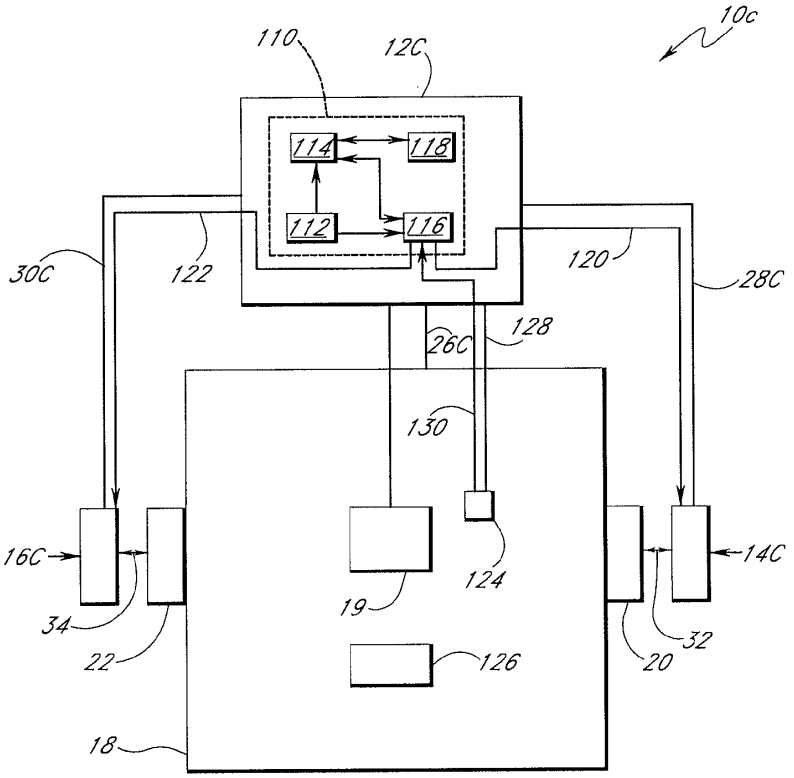

10c
110
12C
114
118
112
116
30C
122
120
28C
26C
128
130
16C
14C
124
19
34
32
22
20
126
18

FIG. 9A

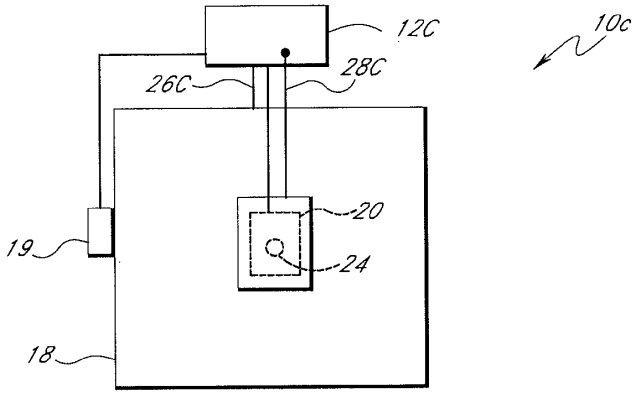

12C
10c
26C
28C
20
19
24
18

FIG. 9B

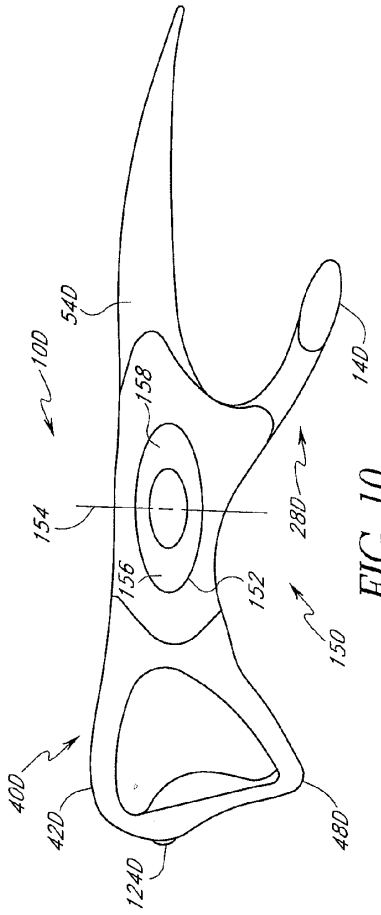

100
540
158
140
154
280
156
152
150
400
420
480
1240

FIG. 10

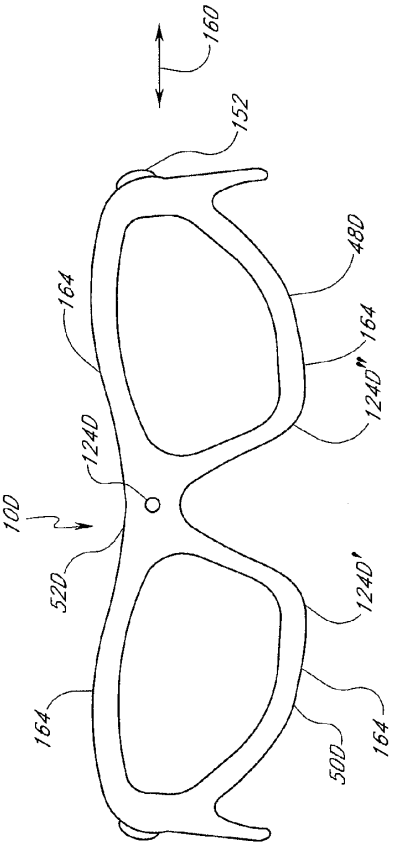

160
152
480
164
164
1240"
1240
100
520
1240'
164
500
164

FIG. 11

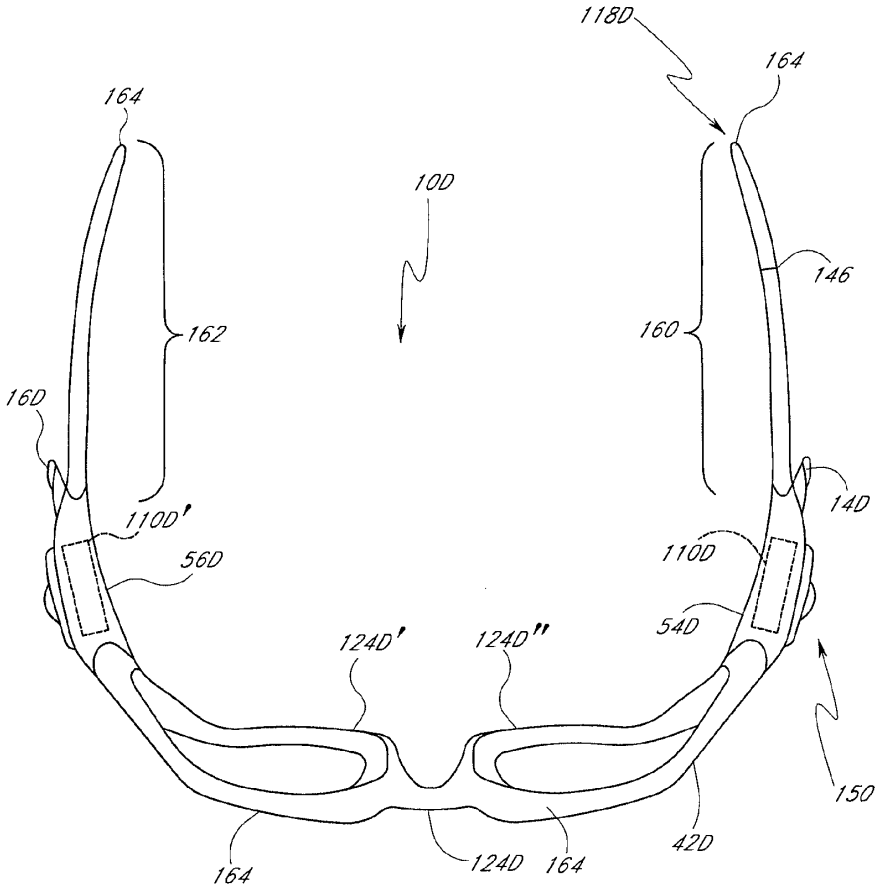

118D
164
164
10D
146
162
160
16D
14D
110D'
110D
56D
54D
124D'
124D''
150
42D
164
124D
164

FIG. 12

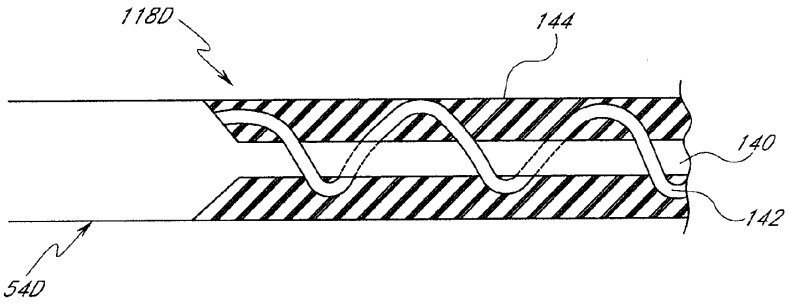


FIG. 13

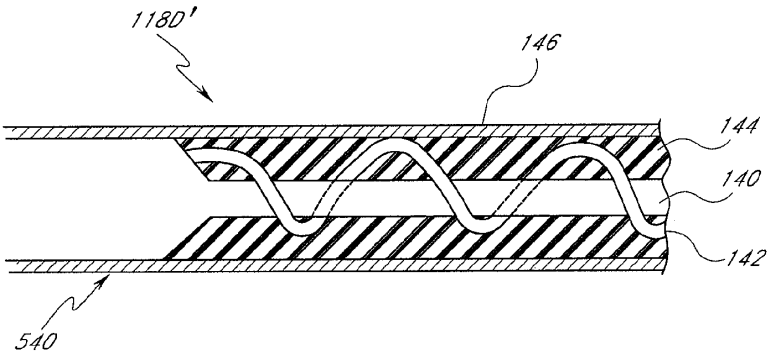


FIG. 14

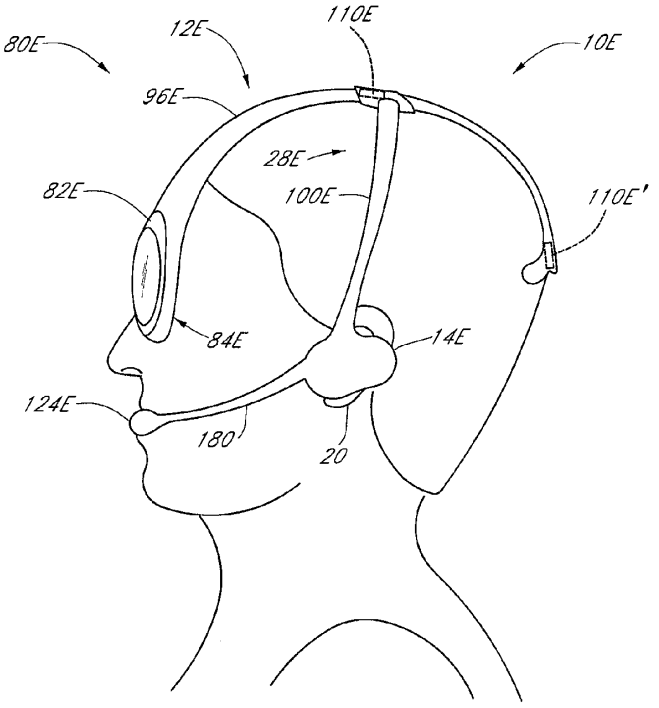


FIG. 15

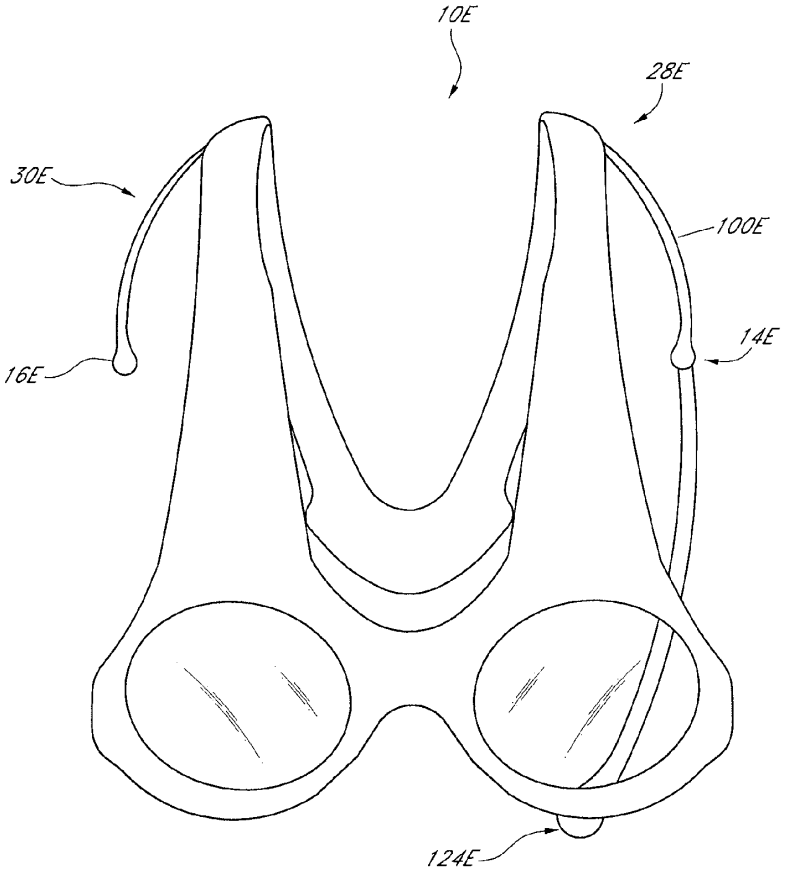


FIG. 16

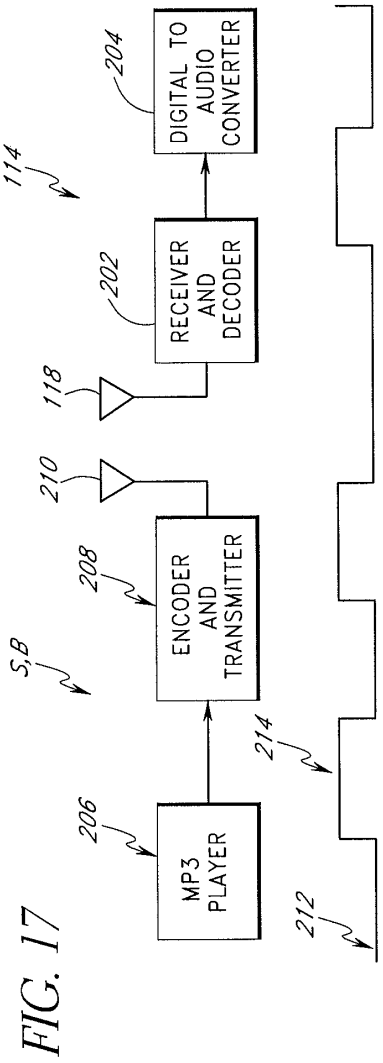

MP3 PLAYER
206
ENCODER AND TRANSMITTER
208
S,B
210
118
RECEIVER AND DECODER
202
DIGITAL TO AUDIO CONVERTER
204
114
212
214
216
218
220
222
48 MHz
50 MHz
49 MHz

FIG. 17

FIG. 18

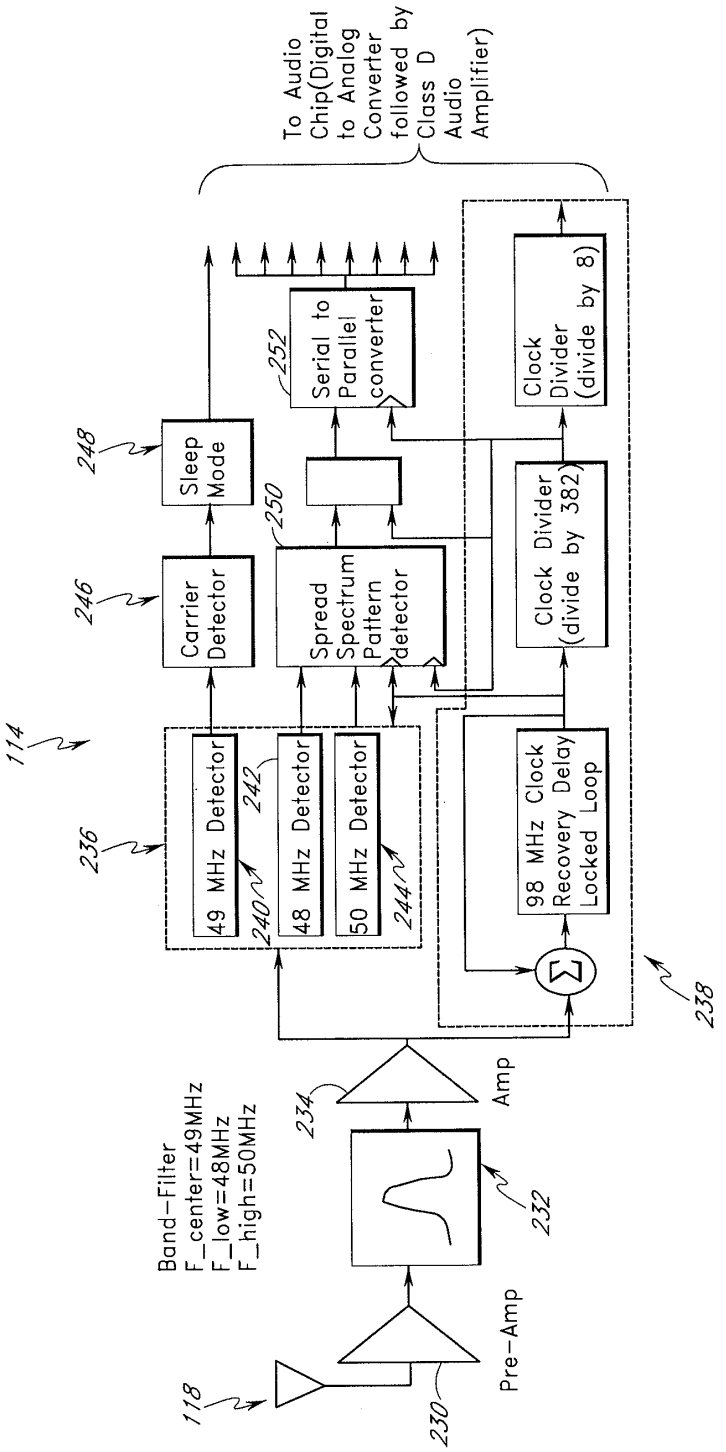

To Audio Chip(Digital to Analog Converter followed by Class D Audio Amplifier)
Serial to Parallel converter
252
Clock Divider (divide by 8)
Sleep Mode
248
Clock Divider (divide by 382)
250
Carrier Detector
246
Spread Spectrum Pattern detector
114
49 MHz Detector
242
48 MHz Detector
50 MHz Detector
236
240
244
98 MHz Clock Recovery Delay Locked Loop
238
Amp
234
Band-Filter
F_center=49MHz
F_low=48MHz
F_high=50MHz
232
Pre-Amp
118
230

FIG. 19

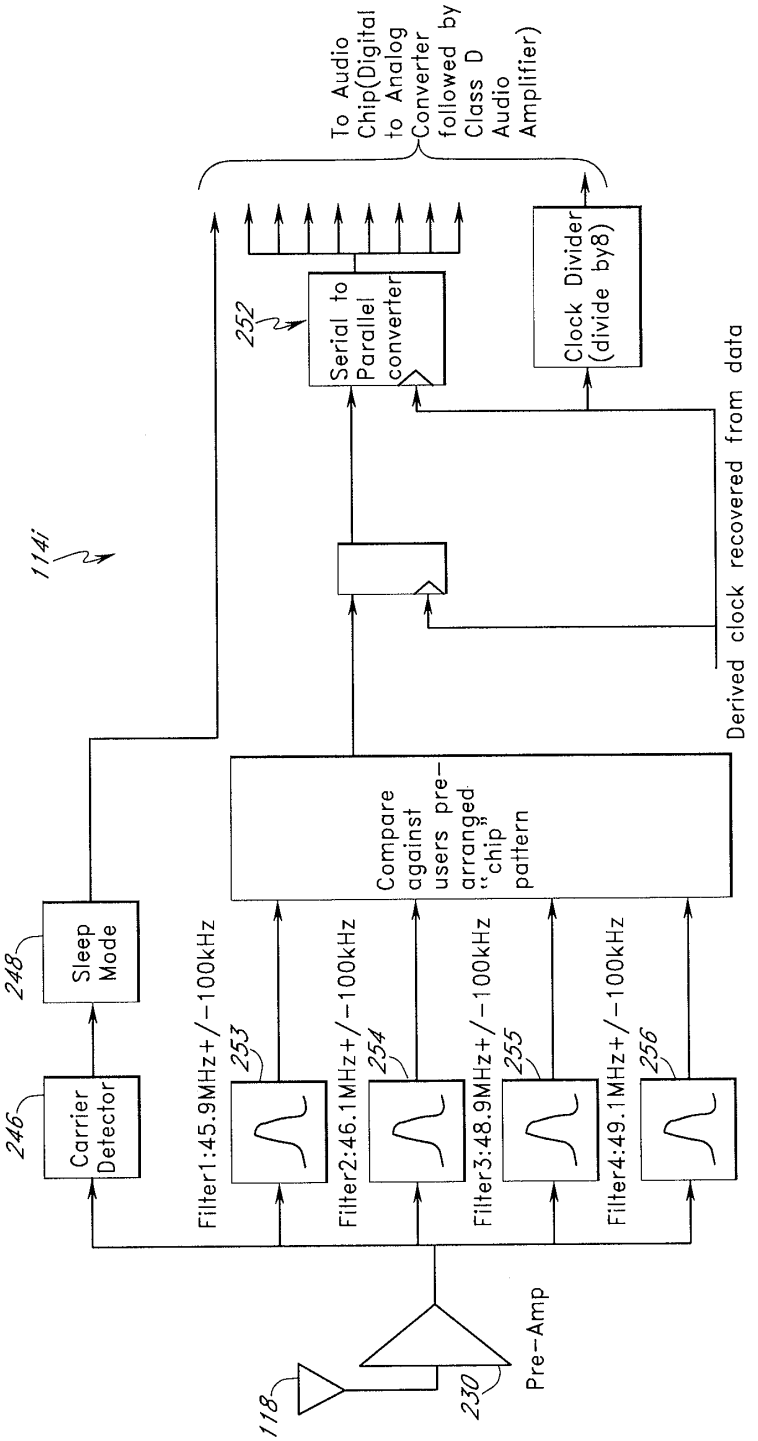

To Audio Chip(Digital to Analog Converter followed by Class D Audio Amplifier)
Clock Divider (divide by8)
252
Serial to Parallel converter
114i
Derived clock recovered from data
Compare against users pre-arranged "chip" pattern
248
Sleep Mode
246
Carrier Detector
Filter1:45.9MHz+/-100kHz
253
Filter2:46.1MHz+/-100kHz
254
Filter3:48.9MHz+/-100kHz
255
Filter4:49.1MHz+/-100kHz
256
Pre-Amp
230
118

FIG. 20

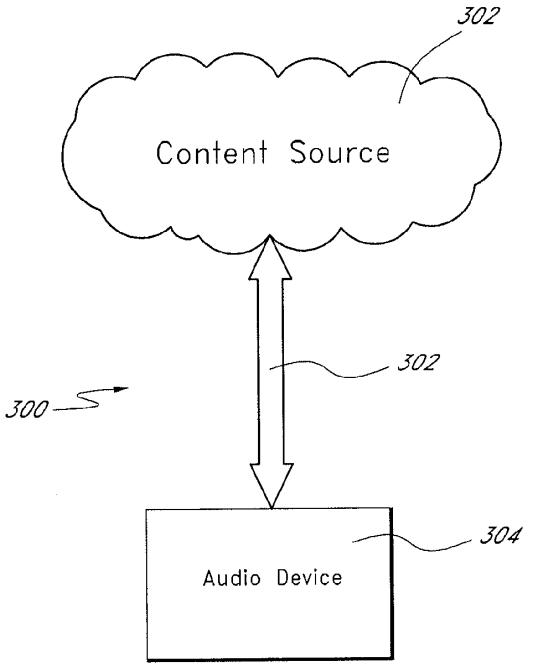


FIG. 21

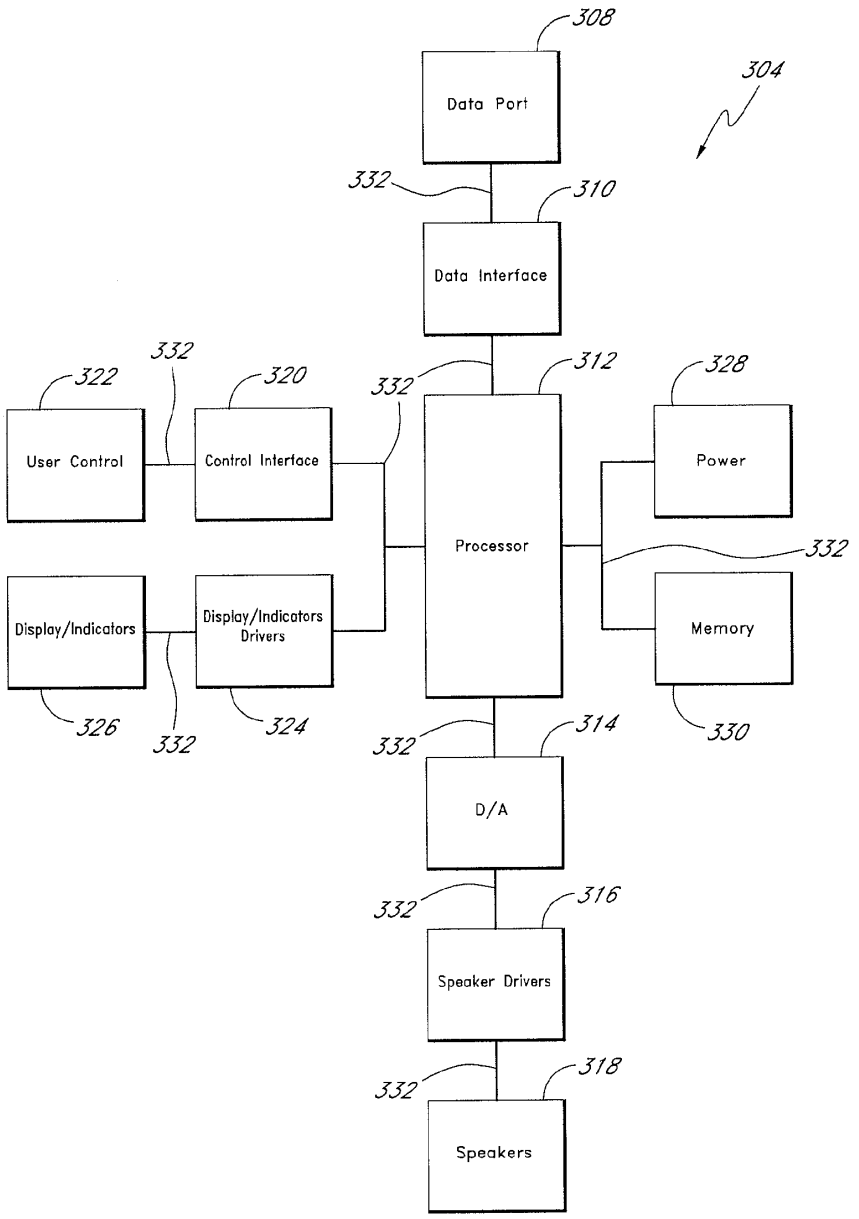

308
Data Port
304
332
310
Data Interface
332
322
320
332
312
328
User Control
Control Interface
Power
Processor
332
Display/Indicators
Display/Indicators Drivers
Memory
326
332
324
330
332
314
D/A
332
316
Speaker Drivers
332
318
Speakers

FIG. 22

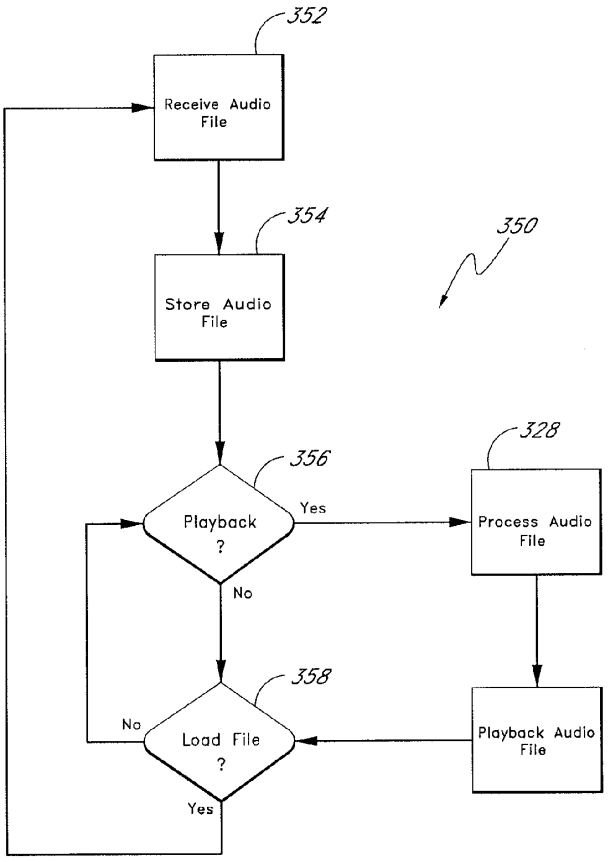

352
Receive Audio File
354
Store Audio File
350
328
356
Playback ?
Yes
Process Audio File
No
358
No
Load File ?
Playback Audio File
Yes

FIG. 23

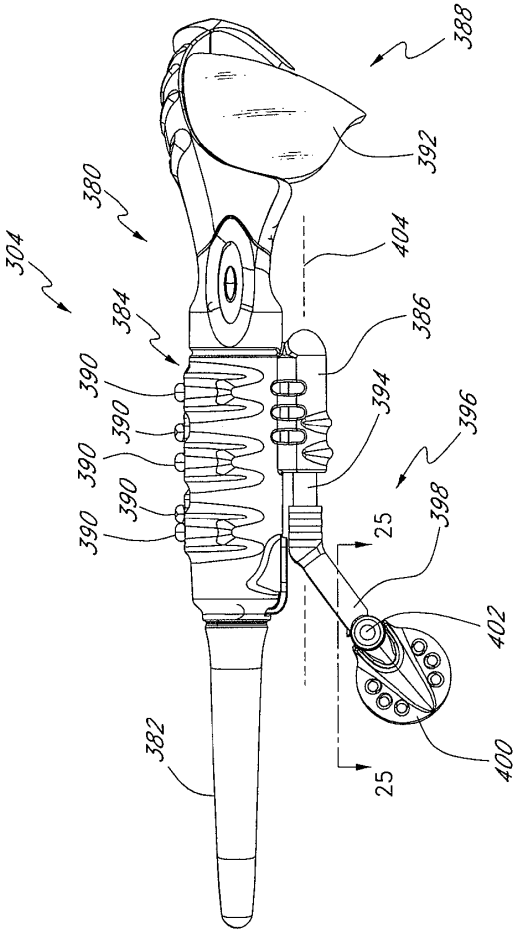

388
392
380
404
304
384
386
390
390
390
390
390
394
396
398
25
402
382
400
25

FIG. 24

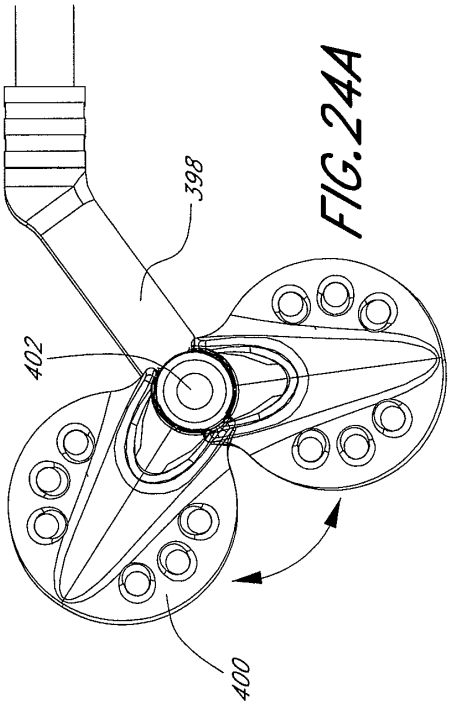


FIG. 24A

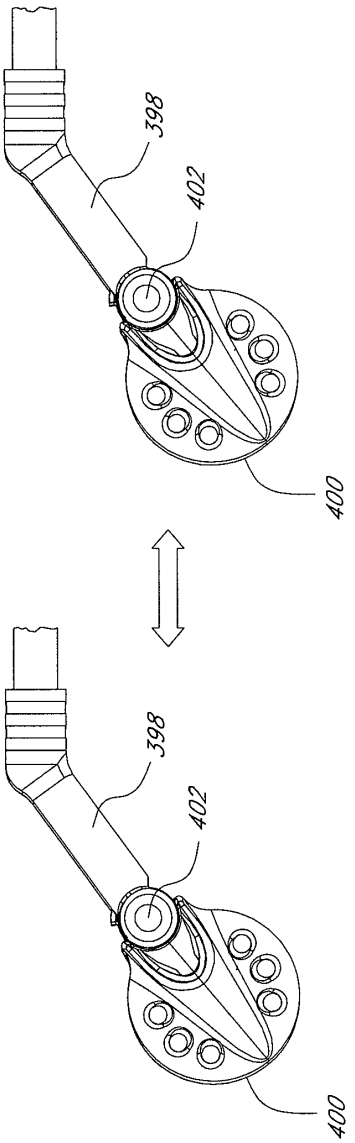


FIG. 24B

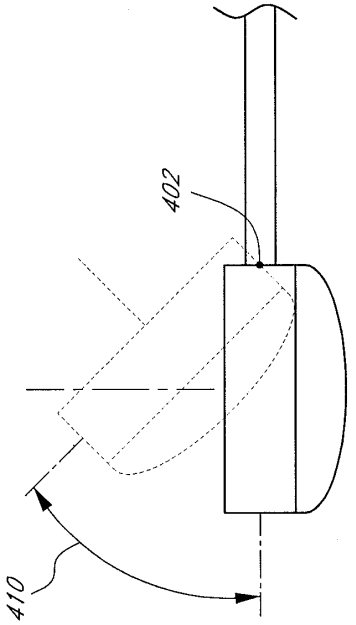
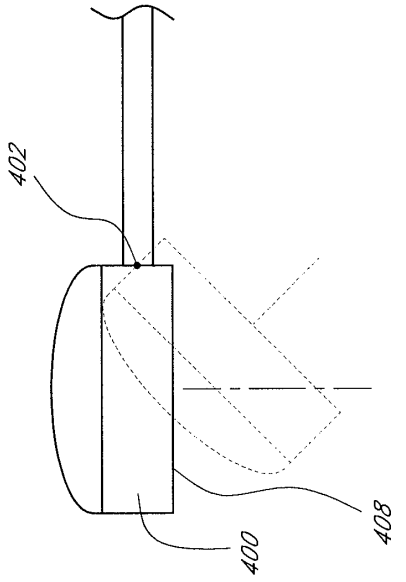


FIG.25



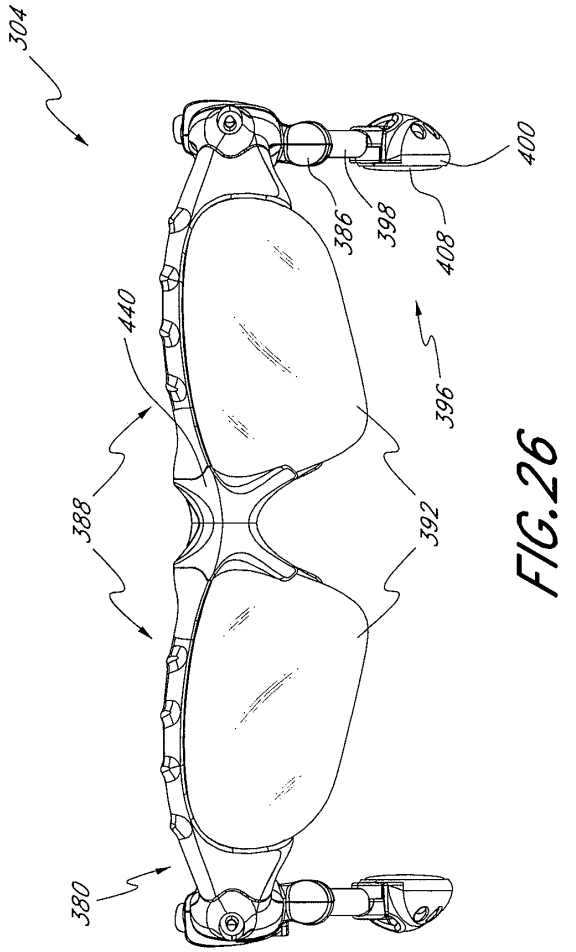


FIG.26

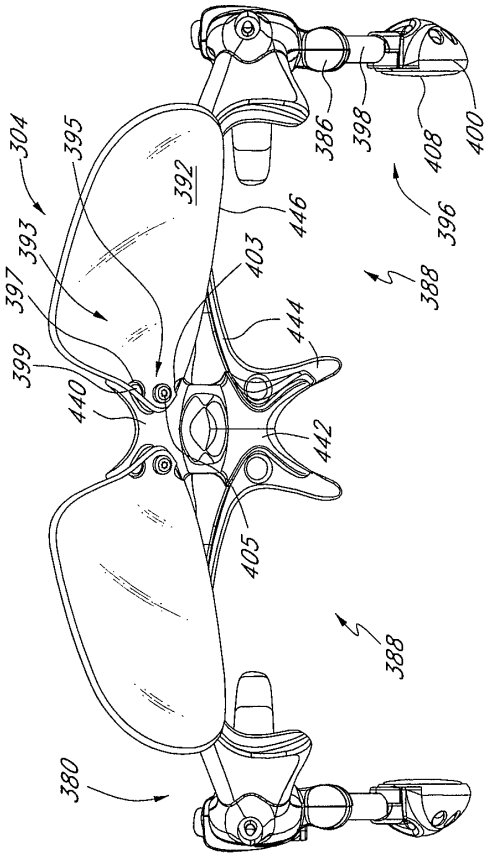

304
395
392
386
398
408
400
396
446
403
393
397
388
444
399
440
442
405
388
380

FIG.27

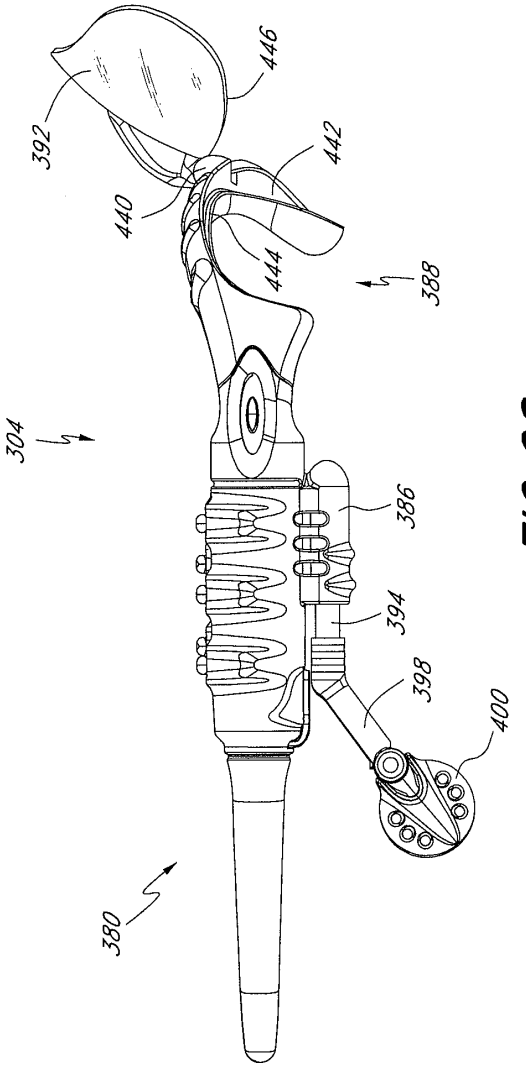


FIG. 28

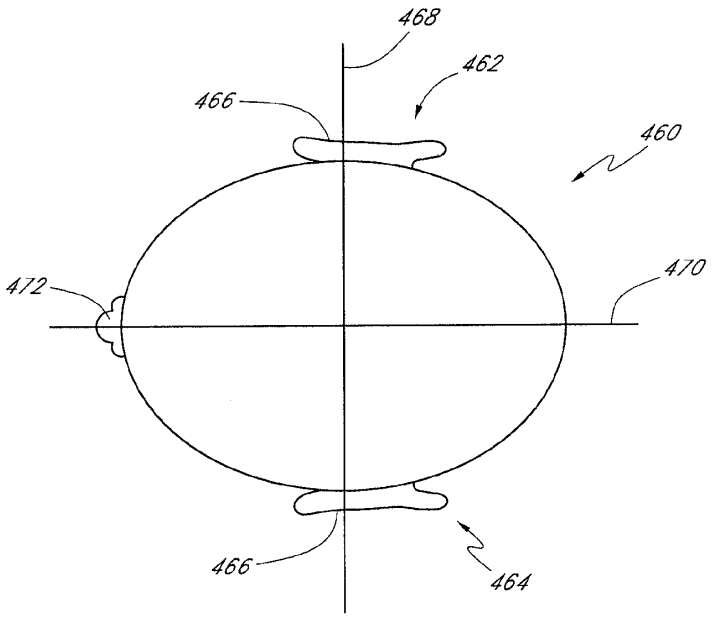


FIG. 29

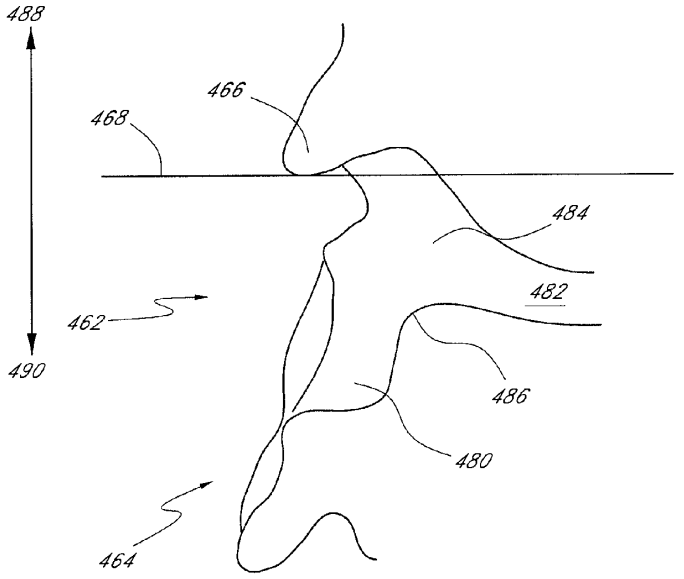


FIG. 30

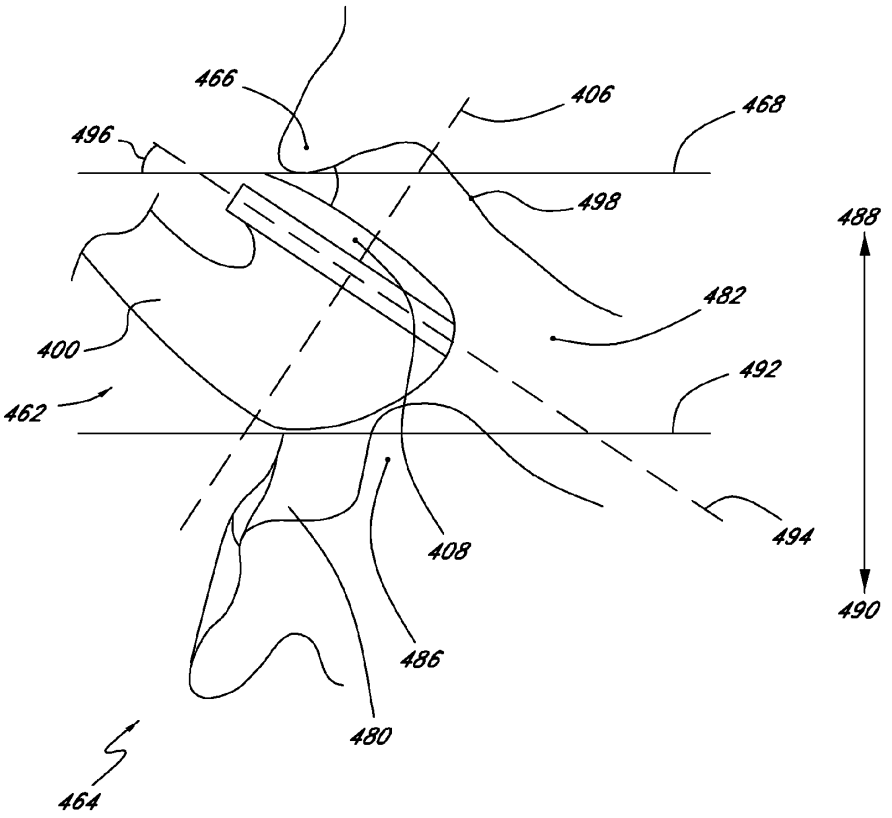


FIG. 31

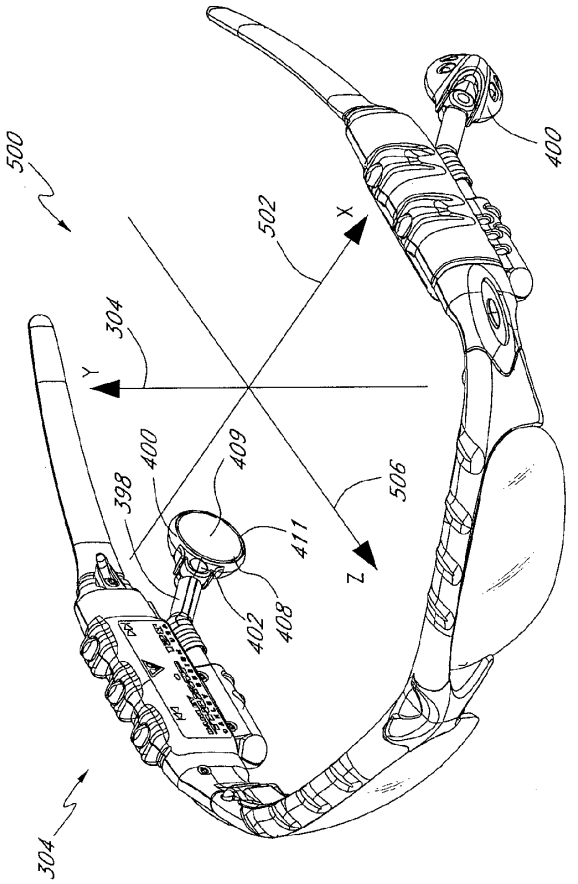


FIG. 32

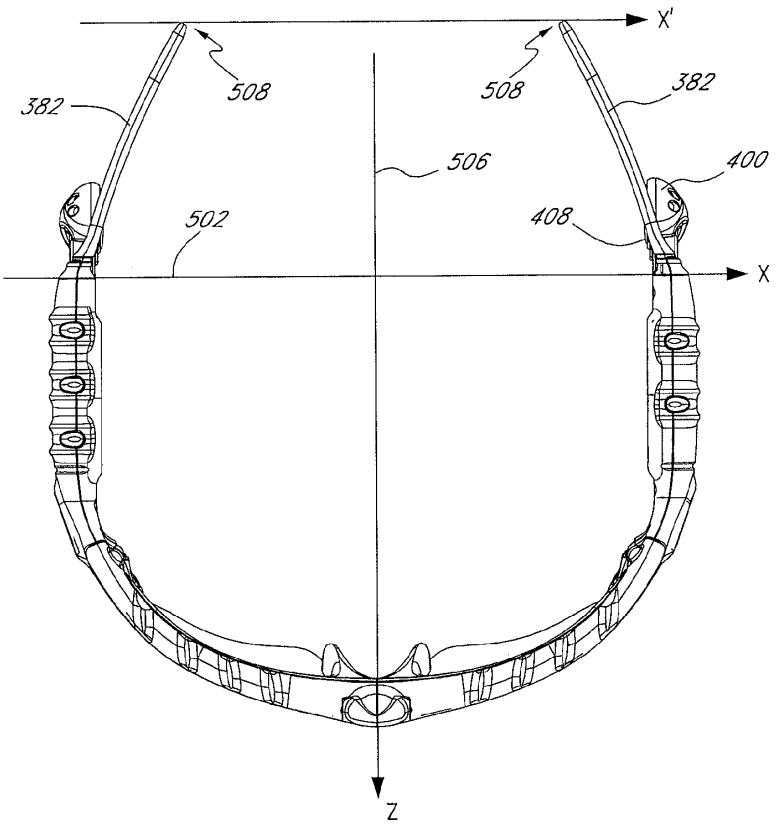


FIG. 33

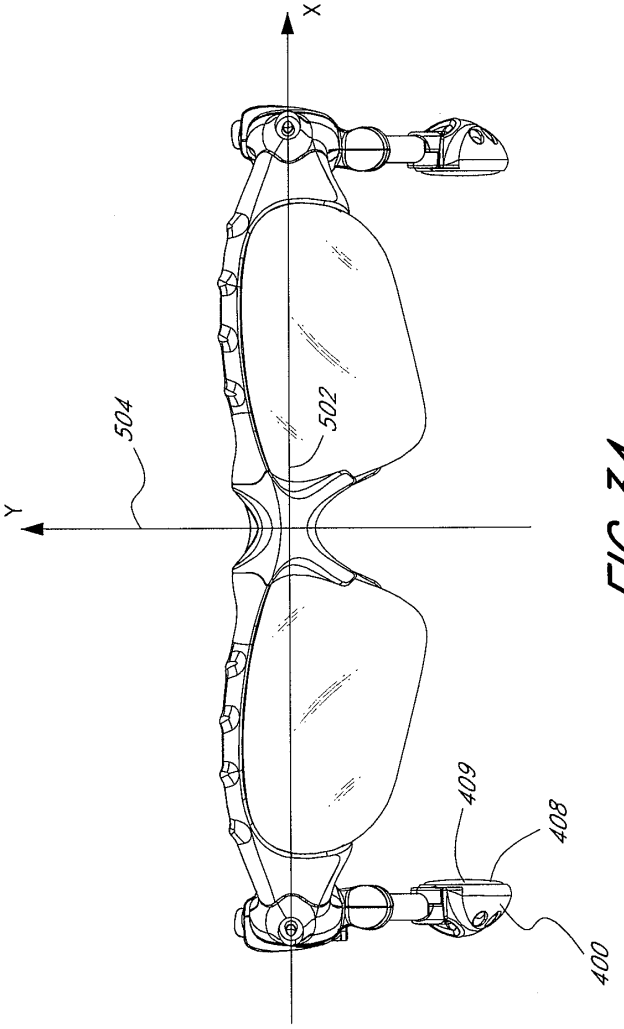


FIG. 34

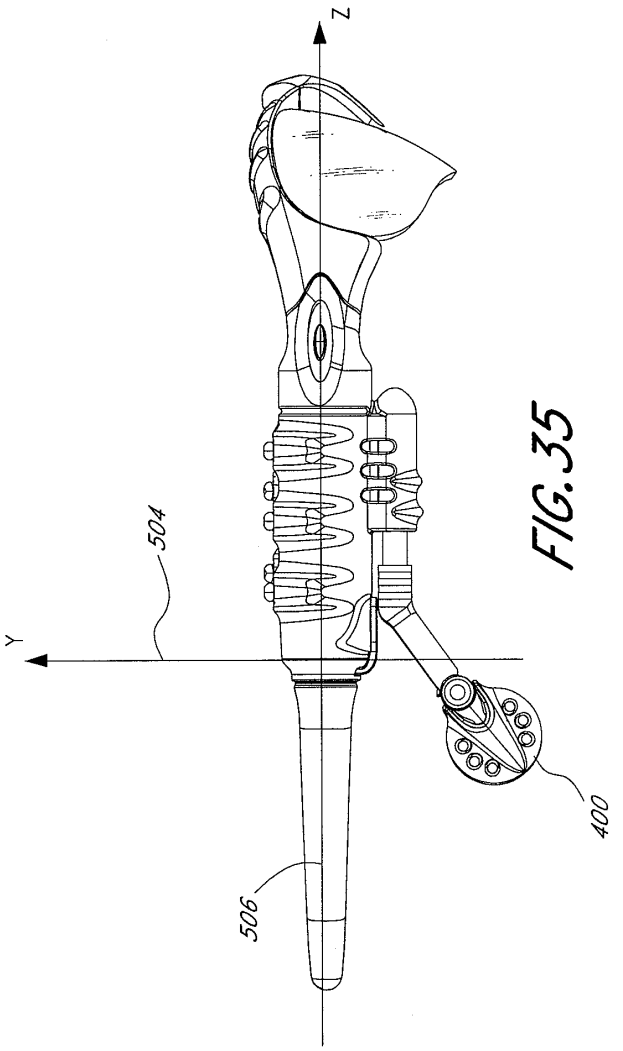


FIG. 35

DATA INPUT MANAGEMENT SYSTEM FOR WEARABLE ELECTRONICALLY ENABLED INTERFACE

RELATED APPLICATIONS

This application is a continuation-in-part of U.S. application Ser. No. 10/993,217, filed Nov. 19, 2004, which is a continuation-in-part of U.S. application Ser. No. 10/628,831, filed Jul. 28, 2003, which claims priority from U.S. Provisional No. 60/399,317, filed Jul. 26, 2002 and U.S. Provisional No. 60/460,154, filed Apr. 3, 2003, and which is a continuation-in-part of U.S. application Ser. No. 10/004,543, filed Dec. 4, 2001, now U.S. Pat. No. 6,966,647, which is a continuation of U.S. application Ser. No. 09/585,593, filed Jun. 2, 2000, now U.S. Pat. No. 6,325,507.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to wearable electronically enabled devices, and in particular, to systems for managing which of a plurality of data sources is connected to the wearable device.

2. Description of the Related Art

A variety of portable audio playback devices, such as MP3 players, allow a user to listen to audio files with the use of an audio interface such as headphones or speakers carried by ear plugs. For example, a user can wear a headset or ear "buds" connected by a flexible cable to an MP3 player, which can be worn on the belt. However, whenever a user wants to receive a cell phone call or even wear glasses or sunglasses, they must adjust or remove the audio interface from their ears.

Another commonly used device which must interface with the user is the cellular telephone. Typically, the cellular telephone has an input (microphone) which may be mounted on the cellular telephone housing, or on a wire which also connects to an earphone. The cellular telephone speaker may either be on the earphone, or mounted within the housing of the cellular telephone.

Although still under development, a variety of audiovisual data sources have been proposed which will provide audio input through a speaker, and video input through either opaque or see through heads-up display technology which can be incorporated into eyeglasses, helmets or other headwear.

A variety of other data sources are known, which require some form of audio or video input to a user, such as display screens on personal digital assistants, Blackberry® type communication devices, and others known in the art.

Each of the foregoing devices require an interface for providing audio or visual data to the user, and, where relevant, for receiving audio information from the user for inputting into the device. At the present time, the use of multiple data sources requires the user to switch between any of a variety of user interfaces, in accordance with the particular device sought to be used at a particular time.

In view of the foregoing, there remains a need for better management of input signals from multiple data sources, which will allow the user to more conveniently select input from any of a variety of sources.

SUMMARY OF THE INVENTION

In general, the data input management system in accordance with the present invention enables the user to select one or more data sources to be placed either simultaneously or one at a time into electrical communication with a single user interface. The interface may comprise any of a variety of physical forms, including electronically enabled eyeglasses. In one configuration, the user may select one source as a primary input source and a second source as a secondary input source. One primary input source might comprise a source of music, such as an MP3 player. A secondary input source might comprise a cellular telephone. The user may toggle between the input sources, to provide input to the user either automatically, or in response to demand by the user or other electronic prioritization protocol.

There is provided in accordance with one aspect of the present invention, a wearable cell phone and music system. The system comprises a wearable support, having a cell phone in communication with the support and a music source in communication with the support. An electronic interface is carried by the support. A selector is provided, for regulating the transmission of data from at least one of the cell phone and the music source to the interface. The selector may be a button carried by the support (e.g., on an earstem or on an orbital in an eyeglass configuration) to allow the wearer to switch between the cell phone and music source.

The wearable cell phone and music system may additionally comprise radiofrequency electronics such as a Bluetooth receiver or transceiver, for wireless communication between the cell phone and the support. The system may additionally comprise radiofrequency electronics for wireless communication between the music source and the support. The music source may either be carried by the support, or exist remotely from the support and communicate wirelessly with the support. In one embodiment, the music source comprises an MP3 player.

In accordance with another aspect of the present invention, there is provided a method of managing multiple signal sources configured to provide signals to a single wearable interface. The method comprises the steps of enabling data from a first source to reach a wearer through the interface. The wearer is provided with a signal indicative of data available from the second source. Data from the second source is enabled to reach the wearer through the interface in response to activation of a control by the wearer.

In one implementation of the invention, the first source comprises a source of music, or an audio track from a hand held entertainment device such as a DVD player. The second source may comprise a telephone. In one configuration of the invention, data from the first source is no longer provided to the interface (e.g., it is muted or put on pause) in response to activation of the control to select the second source. As a further option, transmission of data from the first source to the interface may be resumed in response to interruption of transmission of data from the second source to the interface. Alternatively data from the first source can continue to run through the interface in the background while the second source is simultaneously connected to the interface.

In accordance with a further aspect of the present invention, there is provided a wearable electronically enabled interface system, for providing audio and or video input to the wearer from at least two sources. The system comprises a wearable support, for carrying at least a portion of the interface. At least one data port is carried by the support, for receiving data from at least a first and optionally a second source. A selector is provided, enabling the wearer to direct data from a desired one of the first and second sources to the interface.

The wearable support may comprise an eyeglass frame. The data port may comprise a radiofrequency receiver or transceiver. The interface may comprise at least one speaker,

and, in certain implementations, the interface comprises two speakers. The interface may additionally comprise at least one microphone. The interface may further comprise a video display. The selector may comprise a wearer activated control such as a button, switch or voice activated electronic control.

Further features and advantages of the present invention will become apparent to those of skill in the art in view of the detailed description of preferred embodiments which follows, when considered together with the attached drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic representation of a front elevational view of a wearable audio device supported by a human head.

FIG. **2** is a left side elevational view of an implementation of the audio device illustrated in FIG. **1**.

FIG. **3**A is a front, left side, and top perspective view of a modification of the wearable audio device illustrated in FIGS. **1** and **2**.

FIG. **3**B is a top plan view of the audio device illustrated in FIG. **3**A.

FIG. **3**C is a schematic top plan view of the audio device of FIG. **3**A worn on the head of a wearer.

FIG. **3**D is a front, top, and left side perspective view of another modification of the wearable audio devices illustrated in FIGS. **1**, **2** and **3**A-C.

FIG. **3**E is a rear, top, and right side perspective view of the wearable audio device illustrated in FIG. **3**D.

FIG. **3**F is a right side elevational view of the wearable audio device illustrated in FIG. **3**D.

FIG. **3**G is a left side elevational view of the wearable audio device illustrated in FIG. **3**D.

FIG. **3**H is a front elevational view of the wearable audio device illustrated in FIG. **3**D.

FIG. **3**I is a top plan view of the wearable audio device illustrated in FIG. **3**D.

FIG. **3**J is a front, top, and left side perspective and exploded view of the wearable audio device illustrated in FIG. **3**D.

FIG. **3**K is an enlarged left side elevational view of one of the speakers of the audio device illustrated in FIG. **3**D.

FIG. **3**L is an enlarged front elevational view of the speaker illustrated in FIG. **3**K.

FIG. **3**M is a schematic illustration of the audio device illustrated in FIG. **3**D.

FIG. **4**A is a schematic representation of a rear and left side perspective view of a further modification of the wearable audio devices illustrated in FIGS. **1**, **2**, and **3**A-J.

FIG. **4**B is a schematic representation of a partial sectional and left side elevational view of the wearable audio device illustrated in FIG. **4**A worn by a wearer.

FIG. **5**A is a partial sectional and side elevational view of a modification of the wearable audio device illustrated in FIG. **4**A.

FIG. **5**B is a partial sectional and side elevational view of a modification of the wearable audio device illustrated in FIG. **5**A.

FIG. **6** is a left side elevational view of a modification of the audio device illustrated in FIGS. **3-5** worn on the head of a user.

FIG. **7** is a front elevational view of the audio device illustrated in FIG. **6**.

FIG. **8** is a schematic representation of a front elevational view of a further modification of the audio device illustrated in FIGS. **1** and **2** worn by a wearer and interacting with source electronics.

FIG. **8**A is a schematic illustration of an input data management system in accordance with the present invention.

FIG. **8**B is a schematic illustration of one configuration of operation for the input management system of FIG. **8**A.

FIG. **9**A is an enlarged schematic representation of a front elevational view of the audio device illustrated in FIG. **8**.

FIG. **9**B is a schematic representation of a left side elevational view of the audio device illustrated in FIG. **9**A.

FIG. **10** is a schematic left side elevational view of a modification of the audio device illustrated in FIGS. **8** and **9**A, B.

FIG. **11** is a front elevational view of the audio device illustrated in FIG. **10**.

FIG. **12** is a top plan view of the audio device illustrated in FIG. **10**.

FIG. **13** is a schematic representation of a partial cross-sectional view of a portion of any of the audio devices illustrated in FIGS. **1-12**.

FIG. **14** is a schematic representation of a partial cross-sectional view of a modification of the portion illustrated in FIG. **13**.

FIG. **15** is a left side elevational view of a modification of the audio devices illustrated in FIGS. **8-12**.

FIG. **16** is a front elevational view of the audio device illustrated in FIG. **15**.

FIG. **17** is a schematic illustration of communication hardware which can be incorporated into any of the wearable audio device as illustrated in FIGS. **1-16** and the communication hardware of another device.

FIG. **18** is a schematic representation showing three output signals, the uppermost signal being the output of a source device, and the lower signals being the representation of the output of an encoder/decoder device illustrated in FIG. **17**.

FIG. **19** is a schematic illustration of the decoder illustrated in FIG. **17**.

FIG. **20** is a schematic illustration of a modification of the decoder illustrated in FIG. **19**, which can be incorporated into any of the wearable audio devices illustrated in FIGS. **1-16**.

FIG. **21** is a schematic representation of an audio network.

FIG. **22** is a schematic representation of the audio device illustrated in FIG. **21**.

FIG. **23** is a schematic representation of an audio playback method.

FIG. **24** is a right side elevational view of an audio device.

FIG. **24**A is a detail view of a speaker pivot as in FIG. **24**.

FIG. **24**B is a detail view of an axially extendable speaker support.

FIG. **25** is a schematic of a cross-sectional view taken along line **25-25** of FIG. **24**.

FIG. **26** is a front elevational view of the audio device of FIG. **24**.

FIG. **27** is a front elevational view of the audio device of FIG. **24** shown in a second configuration.

FIG. **28** is a left side elevational view of the audio device of FIG. **27**.

FIG. **29** is a schematic representation of a top plan view of a wearer's head.

FIG. **30** is a schematic representation of a partial horizontal cross-sectional view of the left ear of the wearer's head of FIG. **29**.

FIG. **31** is a schematic representation of a partial cross-sectional view of the left ear of the wearer's head of FIG. **29**, illustrating a speaker positioned therein.

FIG. **32** is an elevational perspective view of an audio device in relation to a reference system.

FIG. **33** is a top plan view of the audio device and reference system of FIG. **32**.

FIG. **34** is a front elevational view of the audio device and reference system of FIG. **32**.

FIG. **35** is a side elevational view of the audio device and reference system of FIG. **32**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIGS. **1** and **2**, an audio device **10** includes a support **12** and left and right speakers **14**, **16**.

The audio device **10** is illustrated as being supported on the head **18** of a human. The head **18** includes a nose **19**, and left and right ears **20**, **22**. The schematic representation of human ears **20** and **22** are intended to represent the tissue forming the pinna of a human ear. With reference to FIG. **2**, the meatus of the external auditory canal **24** is illustrated schematically as a circle (in phantom) generally at the center of the left ear **20**.

The support **12** is configured to be supported by the head **18**. Thus, the support **12** can be in the form of any of a variety of wearable garments or devices, such as any known headwear. For example, but without limitation, the support **12** can be in the form of a hat, sweatband, tiara, helmet, headphones, visor, and any of a variety of eyewear such as goggles, masks, face shields and eyeglasses.

Advantageously, the support **12** is configured to support the speakers **14**, **16** at a position juxtaposed to the ears **20**, **22**, respectively, without applying a force against the ears **20**, **22** sufficient for anchoring the speakers **14**, **16** in place. Thus, the support **12** contacts the head **18** at a position other than the outer surface of the ears **20**, **22**. As shown in FIG. **1**, the support **12** is supported by the head **18** by a support portion **26** which contacts a portion of the head **18** other than the outer surface of the ears **20**, **22**. For example, but without limitation, the support **26** can contact the top of the head **18**, the sides of the head **18**, top of the nose **19**, forehead, occipital lobe, etc.

The audio device **10** also includes support members **28**, **30** which extend from the support **12** to the speakers **14**, **16**, respectively. The support members **28**, **30** are provided with sufficient strength to maintain the position of the speakers **14**, **16** such that the speakers **14**, **16** are spaced from the outer surface of the ears **20**, **22**.

Optionally, the support members **28**, **30** can be made from a flexible material configured to allow the speakers **14**, **16** to be moved toward and away from the ears **20**, **22**, respectively. For example, any of a variety of flexible metallic structures such as wire can be provided with a flexible polymer coating, to permit adjustability of the speakers **14**, **16**. Metal or polymeric segmented support members **28**, **30** can also be provided. In general, the support members in accordance with this aspect of the invention are sufficiently flexible that they may be moved by manual force between a first position in front of the ear of the wearer, and a second position, spaced apart from the first position. The support member **28**, **30** are then able to retain the position into which they have been moved.

Alternatively, the support members **28**, **30** can be mounted relative to the support **12** with a mechanical device configured to allow the speakers **14**, **16** to be moved toward and away from the ears **20**, **22** respectively. The same mechanical device or an additional mechanical device can also optionally be configured to allow the speakers **14**, **16** and/or supports **28**, **30** to be translated forward and rearwardly relative to the support **12**. Further, such mechanical devices can be used in conjunction with the flexibility provided to the support members **28**, **30** from a flexible material noted above. As such, the user can adjust the spacing between the speakers **14**, **16** and the ears **20**, **22** to provide the desired spacing.

As noted above, the speakers **14**, **16** are spaced from the ears **20**, **22** such that the speakers **14**, **16** do not engage the outer surface of the ears **20**, **22** with sufficient force to provide an anchoring effect for the speakers **14**, **16**. Thus, the speakers **14**, **16** can make contact with the ears **20**, **22**, at a pressure less than that sufficient to cause discomfort to the user.

Comfort of the user is further enhanced if the support **12** is configured to maintain gaps **32**, **34** between the speakers **14**, **16** and the ears **20**, **22**, respectively. As such, the chance of irritation to the user's ears **20**, **22** is eliminated. Preferably, the gaps **32**, **34** are within the range from about 2 mm to about 3 cm. The gaps **32**, **34** can be measured from the inner surface of the speakers **14**, **16** and the outer surface of the tragus (small projection along the front edge of a human ear which partially overlies the meatus of the external auditory canal **24**) (FIG. **2**).

Such a spacing can allow the support **12** to be removed and replaced onto the head **18** of the user without rubbing against the ears **20**, **22**. This makes the audio device **10** more convenient to use.

A modification of the audio device **10** is illustrated in FIG. **3**A, and referred to generally by the reference numeral **10**A. Components of the audio device **10**A that are the same as the audio device **10** have been given the same reference numeral, except that a letter "A" has been added thereto.

In the illustrated embodiment of the audio device **10**A, the support **12**A is in the form of an eyeglass **40**. The eyeglass **40** comprises a frame **42** which supports left and right lenses **44**, **46**. Although the present audio device **10**A will be described with reference to a dual lens eyeglass, it is to be understood that the methods and principles discussed herein are readily applicable to the production of frames for unitary lens eyeglass systems and protective goggle systems as well. Further, the lenses **44**, **46** can be completely omitted. Optionally, at least one of the lenses **44**, **46** can be in the form of a view finder or a video display unit configured to be viewable by a wearer of the support **12**A.

Preferably, the lenses **44**, **46** are configured to provide variable light attenuation. For example, each of the lenses **44**, **46** can comprise a pair of stacked polarized lenses, with one of the pair being rotatable relative to the other. For example, each lens of the stacked pairs can comprise an iodine stained polarizing element. By rotating one lens relative to the other, the alignment of the polar directions of the lenses changes, thereby changing the amount of light that can pass through the pair. U.S. Pat. No. 2,237,567 discloses iodine stained polarizers and is hereby expressly incorporated herein by reference. Additionally, rotatable lens designs are disclosed in U.S. Pat. No. 4,149,780, which is hereby expressly incorporated herein by reference.

Alternatively, the lenses **44**, **46**, can comprise photochromic compositions that darken in bright light and fade in lower light environments. Such compositions can include, for example, but without limitation, silver, copper, and cadmium halides. Photochromic compounds for lenses are disclosed in U.S. Pat. Nos. 6,312,811, 5,658,502, 4,537,612, each of which are hereby expressly incorporated by reference.

More preferably, the lenses **44**, **46** comprise a dichroic dye guest-host device configured to provide variable light attenuation. For example, the lenses **44**, **46** can comprise spaced substrates coated with a conducting layer, an alignment layer, and preferably a passivation layer. Disposed between the substrates is a guest-host solution which comprises a host material and a light-absorbing dichroic dye guest. A power circuit (not shown) can be supported by the frame **42**. The power circuit is provided with a power supply connected to the conducting layers. Adjustment of the power supply alters

the orientation of the host material which in turn alters the orientation of the dichroic dye. Light is absorbed by the dichroic dye, depending upon its orientation, and thus provides variable light attenuation. Such a dichroic dye guest-host device is disclosed in U.S. Pat. No. 6,239,778, which is hereby expressly incorporated by reference.

Alternatively, the lenses may be pivotably or hingeably connected to the frame, so that they may be partially or completely rotated out of the field of sight. See the discussion of FIGS. **25** and **26**, below.

The frame **42** also comprises left and right orbitals **48**, **50** for supporting the left and right lenses **44**, **46**, respectively. Although the present invention will be described in the context of a pair of orbitals **48**, **50** which surround the respective lenses **44**, **46**, the principles of the present inventions also apply to eyeglass systems in which the orbitals only partially surround the lens or lenses, or contacts only one edge or a portion of one edge of the lens or each lens as well. In the illustrated embodiment, the orbitals **48**, **50** are connected by a bridge portion **52**.

The eyeglass **40** is also provided with a pair of generally rearwardly extending ear stems **54**, **56** configured to retain the eyeglass **40** on the head of a wearer. In addition, an open region **58** is configured to receive the nose of the wearer, as is understood in the art. The open region **58** may optionally be provided with a nose piece, either connected to the lens orbitals **48**, **50**, or the bridge **52**, or directly to the lenses, depending on the particular embodiment. Alternatively, the nose piece may be formed by appropriately sculpting the medial edges of the orbitals **48**, **50** and the lower edge of the bridge **52**, as in the illustrated embodiment.

The frame **42** and the ear stems **54**, **56** can be made from any appropriate material, including polymers and metals. Preferably, the frame **42** and the ear stems **54**, **56** are manufactured from a polymer. The orbitals **48**, **50** can be separately formed and assembled later with a separately manufactured bridge **52**, or the orbitals **48**, **50** and bridge **52** can be integrally molded or cast. When a metal material is used, casting the eyeglass components directly into the final configuration desirably eliminates the need to bend metal parts.

The ear stems **54**, **56** are pivotally connected to the frame **42** with hinges **60**, **62**. Additionally, the ear stems **54**, **56** preferably include padded portions **64**, **66**, respectively. The padded portions preferably comprise a foam, rubber, or other soft material for enhancing comfort for a wearer. The padded portions **64**, **66** preferably are positioned such that when the audio device **10**A is worn by a wearer, the padded portions **64**, **66** contact the wearer between the side of the user's head and the superior crux and/or upper portion of the helix of the wearer's ears.

In the illustrated embodiment, the support members **28**A, **30**A are in the form of support arms **68**, **70** extending downwardly from the ear stems **54**, **56**, respectively. As such, the speakers **14**A, **16**A can be precisely positioned relative to the ears **20**, **22** (FIG. **1**) of a wearer's head **18**. Because the eyeglass **40** is generally supported at three points of contact with the wearer's head, the alignment of the speakers **14**A, **16**A with the ears **20**, **22** can be reliably repeated. In particular, the eyeglass **40** is supported at the left ear stem in the vicinity of the left ear **20**, at the bridge **52** by a portion of the user's head **18** in the vicinity of the nose **19**, and at the right ear stem **56** by a portion of the user's head **18** in the vicinity of the ear **22**.

Optionally, the support arms **68**, **70** can be flexible. Thus, users can adjust the spacing **32**, **34** (FIG. **1**) between the speakers **14**A, **16**A and the ears **20**, **22**, respectively. Once a wearer adjusts the spacing of the speakers **14**A, **16**A from the ears **20**, **22**, respectively, the spacing will be preserved each time the wearer puts on or removes the eyeglass **40**. The various degrees of adjustability for the speakers will be discussed in detail below.

Further, the support arms **68**, **70** can be attached to the ear stems **54**, **56**, respectively, with mechanical devices (not shown) configured to allow the support arms **68**, **70** to be adjustable. For example, such a mechanical device can allow the support arms **68**, **70** to be pivoted, rotated, and/or translated so as to adjust a spacing between the speakers **14**A, **16**A and the ears **20**, **22**. The same mechanical devices or other mechanical devices can be configured to allow the support arm **68**, **70** to be pivoted, rotated, and/or translated to adjust a forward to rearward alignment and/or an up-down alignment of the speakers **14**A, **16**A and the ears **20**, **22**, respectively. Such mechanical devices are described in greater detail below with reference to FIGS. **3**D-J and FIGS. **23**-**30**, below.

With the configuration shown in FIG. **3**A, the audio device **10**A maintains the speakers **14**A, **16**A in a juxtaposed position relative to the ears **20**, **22**, respectively, and spaced therefrom. Thus, the user is not likely to experience discomfort from wearing and using the audio device **10**A.

Preferably, the support arms **68**, **70** are raked rearwardly along the ear stems **54**, **56**, respectively. As such, the support arms **68**, **70** better cooperate with the shape of the human ear. For example, the helix and the lobe of the human ear are generally raised and extend outwardly from the side of a human head. The helix extends generally from an upper forward portion of the ear, along the top edge of the ear, then downwardly along a rearward edge of the ear, terminating at the lobe. However, the tragus is nearly flush with the side of the human head. Thus, by arranging the support arm **68**, **70** in a rearwardly raked orientation, the support arms **68**, **70** are less likely to make contact with any portion of the ear. Particularly, the support arms **68**, **70** can be positioned so as to be lower than and medial to the upper portion of the helix, above the lobe, and preferably overlie the tragus.

Alternatively, the support arms **68**, **70** can be attached to the ear stems **54**, **56**, respectively, at a position rearward from the meatus of the ears **20**, **22** when the eyeglass **40** is worn by a user. As such, the support arms **68**, **70** preferably are raked forwardly so as to extend around the helix and position the speakers **14**A, **16**A approximately over the tragus. This construction provides a further advantage in that if a user rotates the eyeglass **40** such that the lenses **44**, **46** are moved upwardly out of the field of view of the wearer (such that the eyeglasses are worn across the forehead or across the top of the head), the speakers **14**A, **16**A can be more easily maintained in alignment with the ears **20**, **22** of the wearer.

Preferably, the support arms **68**, **70** are raked rearwardly so as to form angles **72**, **74** relative to an approximate longitudinal axis of the ear stems **54**, **56**. The angles **72**, **74** can be between 0 and 90 degrees. Preferably, the angles **72**, **74** are between 10 and 70 degrees. More preferably, the angles **72**, **74** are between 20 and 50 degrees. The angles **72**, **74** can be between about 35 and 45 degrees. In the illustrated embodiment, the angles **72**, **74** are about 40 degrees.

Optionally, the support arm **68**, **70** can be curved within an anterior—posterior plane. In this configuration, the angles **72**, **74** can be measured between the longitudinal axis of the ear stems **54**, **56** and a line extending from the point at which the support arm **68**, **70** connect to the ear stems **54**, **56** and the speakers **14**A, **16**A.

The audio device **10**A can be used as an audio output device for any type of device which provides an audio output signal. The audio device **10**A can include an audio input terminal or jack disposed anywhere on the eyeglass **40** for

receiving a digital or analog audio signal. Preferably, wires connecting the input jack (not shown) with the speakers **14**A, **16**A extend through the interior of the ear stems **54**, **56** so as to preserve the outer appearance of the eyeglass **40**. Alternatively, the audio device **10**A can include a wireless receiver or transceiver for receiving digital signals from another device.

With reference to FIGS. **3**D-**3**J, a modification of the audio devices **10**, **10**A is illustrated therein and referred to generally by the reference numeral **10**A'. The audio device **10**A' can include the same components as the audio devices **10**, **10**A except as noted below. Components of the audio device **10**A' that are similar to the corresponding components of the audio devices **10**, **10**A may be identified with the same reference numerals except, that a "" has been added thereto.

The audio device **10**A' is in the form of an eyeglass **12**A' having a frame **40**A'. The audio device **10**A' also includes a device for the storage and playback of a sound recording.

As noted above, an aspect of at least one of the inventions disclosed herein includes a realization that the forward to rearward spacing of the bridge of a human nose to the auditory canal of the ear falls into a relatively narrow range of distances for large portions of the population. For example, the forward-to-rearward spacing from the bridge of the nose to the auditory canal is normally between about 4⅞ inches to about 5⅛ inches, and often between about 4¾ inches and about 5¼ inches. Corresponding anterior-posterior plane adjustability of the speakers is preferably provided.

Thus, with reference to FIG. **3**F, the audio device **10**A' is configured such that the supports **68'**, **70'**, can translate, along a forward to rearward direction, over a range identified generally by the reference numeral Rt. Preferably, the range Rt is at least about ⅛ of one inch. Further, the range Rt can be at least about ¼ of one inch. Further, the range Rt can be in the range of from about 0.25 inches to about 1.5 inches, and in one construction is about 0.75 of one inch. The midpoint of the anterior-posterior range of motion is generally positioned with respect to the bridge of the nose within the range of from about 4⅞ inches to about 5⅛ inches posteriorly of the eyeglass nose bridge. As such, a substantial percentage of the human population will be able to align a Center (C) of the speakers **14**A', **16**A' with their auditory canal.

With reference to FIG. **3**G, a further advantage is provided where the diameter Ds of the speakers **14**A', **16**A' is greater than about 0.5 inches, such as about 1 inch or greater. As such, an effective range Re (FIG. **3**F) over which the speakers **14**A', **16**A' can reach, is significantly enhanced with respect to the above-noted nose bridge to auditory canal spacings for humans.

Thus, the connection between the supports **68'**, **70'** to the ear stems **54'**, **56'**, respectively, can be configured to allow a limited anterior-posterior translational range of movement of Rt yet provide a larger range of coverage Re.

Preferably, the connection between the support **68'**, **70'** and the ear stems **54'**, **56'**, is configured such that the translational position of the speakers **14**A', **16**A' is maintained when a user removes the audio device **10**A' from their head. For example, the connection between the supports **68'**, **70'**, and the ear stems **54'**, **56'** can generate sufficient friction so as to resist movement due to the weight of the supports **68'**, **70'** and the speakers **14**A', **16**A'. Alternatively, the connection or an adjustment device can include locks, clips, or other structures to prevent unwanted translational movement of the speakers **14**A', **16**A'. As such, a further advantage is provided in that a user can repeatedly remove and replace the audio device **10**A' without having to readjust the translational position of the speakers **14**A', **16**A'.

Another advantage is provided where the supports **68'**, **70'** are made from a material or design that is substantially rigid, at least at room temperature. For example, with reference to FIG. **3**F, the angles **72'**, **74'** defined between the supports **68'**, **70'** and the ear stems **54'**, **56'**, respectively, can be maintained at a predetermined value while the speakers **14**A', **16**A' can be moved along an anterior-posterior axis over the range Rt. Thus, as noted above with reference to FIG. **3**A and the description of the angles **72**, **74**, the angles **72'**, **74'** can be maintained at a desired angle as a user moves the speakers **14**A', **16**A' over the range Rt.

Optionally, the supports **68'**, **70'** can be made from a material that can be deformed at room temperature. However, more preferably the material is sufficiently rigid such that substantial pressure is required to change the angle **74'**. Alternatively, the supports **68'**, **70'** can be made from a thermally sensitive material that can be softened with the application of heat. Thus, a wearer of the audio device **10**A' can heat the supports **68'**, **70'** and adjust the angle **74'** to optimize comfort for the particular wearer. Such thermal sensitive materials are widely used in the eyewear industry and thus a further description of such materials is not deemed necessary for one of ordinary skill in the art to make and use the inventions disclosed herein. Alternatively, the speakers can be pivotably mounted to the supports, and/or the supports can be pivotably mounted to the ear stems, to allow further adjustability in the anterior-posterior plane as well as in the lateral or medial direction.

Preferably, the angles **72'**, **74'** and lengths of the corresponding supports are selected such that the spacing Vs between the center C of the speakers **14**A', **16**A' and a lower surface of the ear stems **54'**, **56'** is within the range of about 0.25 inch to about 1.75 inch, and often within the range of from about 0.75 of an inch to about 1.25 inches. One aspect of at least one of the inventions disclosed herein includes the realization that there is little variation in the spacing for adult humans between the center of the auditory canal and the connecting tissue between the pinna of the ear and the skin on the side of the head. In particular, it has been found that in virtually all humans, the distance between the upper most connection of the ear and the head to the center of the auditory canal is between 0.75 of an inch and 1.25 inches. Thus, by sizing the angles **72'**, **74'** such that the spacing Vs is between about 0.75 of an inch and 1.25 inches, the audio device **10**A can be worn by virtually any adult human and has sufficient alignment between the wearer's auditory canal and the center C of the speakers **14**A', **16**A'. Further, where the diameter Ds of the speakers **14**A', **16**A' is about 1 inch, almost any human can wear the audio device **10**A' without having to adjust the angles **72'**, **74'**. In other words, the auditory canal of virtually any human would be aligned with a portion of the speakers **14**A', **16**A' although the wearer's auditory canal might not be precisely aligned with the center C of the speakers **14**A', **16**A'.

With reference to FIG. **3**H, the supports **68'**, **70'** are configured to allow the speakers **14**A', **16**A', respectively, to pivot toward and away from an ear of a user. For example, as shown in FIG. **3**H, the supports **68'**, **70'** are connected to the ear stems **54'**, **56'**, respectively, so as to be pivotable about a pivot axis P. As such, the speakers **14**A', **16**A' can be pivoted or swung about the pivot axis P.

The range of motion provided by the connection between the supports **68'**, **70'** and the ear stems **54'**, **56'** is identified by the angle S in FIG. **3**H. In FIG. **3**H, the speaker **14**A' is illustrated in an intermediate position in the range of motion provided by the connection between the support **68'** and the ear stem **54'**.

The illustration of the speaker **16**A' includes a solid line representation showing a maximum outward position of the speaker **16**A' (not to actual scale). Additionally, FIG. **3**H includes a phantom illustration of the speaker **16**A' in a maximum inward position. The angle S illustrates a range of motion between a maximum outward position (solid line) and a maximum inward position (phantom line) of the speaker **16**A'.

Preferably, the range of motion S is sufficiently large to allow any human wearer of the audio device **10**A' to position the speakers **14**A', **16**A' such that sound emitted from the speakers **14**A', **16**A' is clearly audible yet comfortable for the wearer of the audio device **10**A'. For example, human ears vary in the precise shape and size of the external anatomy. As such, one wearer of the audio device **10**A' may have outer facing features of their ear that project further than another wearer of the audio device **10**A'. Thus, one wearer may prefer the speakers **14**A', **16**A' to be positioned more inwardly than another wearer.

Further, some wearers of the audio device **10**A' may prefer to press the speakers **14**A', **16**A' into contact with the outer surfaces of their ears. For example, some users may desire to experience to loudest possible volume or the best possible signal to ambient noise ratio from the speakers **14**A', **16**A'. Thus, by pressing the speakers **14**A', **16**A' against their ears, the perceived volume of the sound emitted from the speakers **14**A', **16**A' and the signal to external noise ratio will be the greatest.

Alternatively, other users may prefer to have the speakers spaced from the outer surfaces of their ear so as to prevent contact with the ear, yet maintain a close spacing to preserve the perceived volume of the sound emitted from the speakers **14**A', **16**A'. Additionally, a user may occasionally wish to move the speakers **14**A', **16**A' further away from their ears, to allow the wearer to better hear other ambient sounds when the speakers **14**A', **16**A' are not operating.

For example, a wearer of the audio device **10**A' might wish to use a cellular phone while wearing the audio device **10**A'. Thus, the wearer can pivot one of the speakers **14**A', **16**A' to a maximum outward position (e.g., the solid line illustration of speaker **16**A' in FIG. **3**H) to allow a speaker of the cell phone to be inserted in the space between the speaker **16**A' and the ear of the wearer. As such, the wearer can continue to wear the audio device **10**A' and use another audio device, such as a cell phone. This provides a further advantage in that, because the audio device **10**A' is in the form of eyeglasses **12**A', which may include prescription lenses or tinted lenses, the wearer of the audio device **10**A' can continue to receive the benefits of such tinted or prescription lenses, as well as audio signal from the other speaker while using the other audio device.

Any of the audio devices disclosed herein may additionally be provided with a pause, mute, or on/off switch which is activated by the position of the speakers **14**A, **16**A. If the wearer laterally advances one of the speakers from a first position adjacent the ear to a second position, spaced apart from the ear such as to permit the use of a cell phone, the signal to both speakers can be automatically stopped such as to permit use of the cell phone without audio interference. Advancing the speaker from the second position back to the first position thereafter automatically resumes delivery of signal to the speakers **14**A, **16**A.

An additional advantage is provided where the pivotal movement of the supports **68'**, **70'** is isolated from the translational movement thereof. For example, the connection between the supports **68'**, **70'** and the ear stems **54'**, **56'** can be configured so as to allow a user to pivot the supports **68'**, **70'** without substantially translating the supports **68'**, **70'** forwardly or rearwardly. In one embodiment, the connections can be configured to provide more perceived frictional resistance against translational movement than the frictional resistance against pivotal movement about the pivot axis P (FIG. **3**H). Thus, a user can easily pivot the speakers **14**A', **16**A' toward and away from their ears without translating the speakers **14**A', **16**A'. Thus, the procedure for moving the speakers **14**A', **16**A' toward and away from a wearer's ears can be performed more easily and, advantageously, with one hand.

The range of motion S is generally no greater than about 180°, and often less than about 90°. In one preferred embodiment, the range of motion S is no more than about 30° or 40°. The connection between the support **68'**, **70'** and the ear stems **54'**, **56'**, respectively, is generally configured to provide a sufficient holding force for maintaining a rotational orientation of the speakers **14**A', **16**A' about the pivot axis P. For example, the connection between the supports **68'**, **70'** and the ear stems **54'**, **56'**, respectively, can be configured to generate sufficient friction to resist the forces generated by normal movements of a wearer's head.

A further advantage is achieved where sufficient friction is generated to prevent the pivotal movement of the speakers **14**A', **16**A' when the audio device **10**A' is removed from the wearer and placed on a surface such that the speakers **14**A', **16**A' support at least some of the weight of the audio device **10**A'. For example, when a wearer of the audio device **10**A' removes the audio device **10**A' and places it on a table with the speakers **14**A', **16**A' facing downwardly, the speakers **14**A', **16**A' would support at least some of the weight of the audio device **10**A'. Thus, by providing sufficient friction in the connection between the supports **68'**, **70'** and the ear stems **54'**, **56'**, respectively, the position of the speakers **14**A', **16**A' can be maintained. Thus, when the wearer replaces the audio device **10**A', the speakers **14**A', **16**A' will be in the same position, thereby avoiding the need for the wearer to reposition speakers **14**A', **16**A'.

As noted above, an aspect of one of the inventions disclosed herein includes the realization that where an electronic device that is worn in the same manner as a pair of eyeglasses includes a user operable switch for controlling a function of the electronics, the comfort of the wearer of the audio device can be enhanced where the switches are operable without transferring a substantial load to the head of the wearer. For example, where the electronic device includes buttons for controlling an aspect of the device, a further advantage is provided where a support surface is provided opposite the button such that a user can apply a balancing force to the actuation force applied to the button, thereby preventing a substantial force from being transferred to the head of the wearer.

With reference to FIG. **3**I, the audio device **10**A' can include at least one button **73***a*. In the illustrated embodiment, the audio device **10**A' includes five buttons; a first button **73***a* and a second button **73***b* mounted to the left ear stem **54'**, and a third button **73***c*, a fourth button **73***d*, and a fifth button **73***e* mounted to the right ear stem **56'**. Of course, this is one preferred embodiment of the arrangement of the buttons **73***a*, **73***b*, **73***c*, **73***d*, **73***e*. Other numbers of buttons and other arrangements of buttons are also applicable.

As shown in FIG. **3**H, the button **73***a* is mounted on an upwardly facing surface of the ear stem **54'**. Additionally, the ear stem **54'** has a lower surface that faces in a generally opposite direction to the direction towards which the upper surface of the ear stem **54'** faces. Thus, as shown in FIG. **3**H, the user can use a finger **71** to actuate the button **73***a* and a

thumb **69** to counteract the actuation force of the finger **71** by pressing on the lower surface of the ear stem **54'**. As such, the wearer or user of the audio device **10**A' can actuate the button **73***a* without imparting a substantial load to the wearer of the audio device **10**A'.

This provides a further advantage in that a repeated application of a force against the audio device **10**A' that is transferred to the head of the wearer of the audio device **10**A' is avoided. For example, where the audio **10**A' is in the form of eyeglasses **12**A', a wearer of the eyeglasses **12**A' can be subjected to irritations if the wearer repeatedly presses the eyeglasses **12**A' to actuate a switch. Further, such repeated loads can cause headaches. Thus, by configuring the ear stems **54**A' such that the button **73***a* can be depressed without transferring a substantial load to the wearer of the ear glasses **12**A', such irritations and headaches can be avoided.

Further, by disposing the button **73***a* on an upper portion of the ear stems **54**A', and by providing the ear stems **54**A' with an opposite lower surface that faces an opposite direction relative to the upper surface, a wearer can grasp the ear stems **54**A' from the side, as illustrated in FIG. **38**, thereby allowing the user to counteract the actuation force required to actuate the button **73***a* without having to insert a finger between a side of the wearer's head and ear stems **54**A'. In any of the embodiments herein, the surface which opposes the buttons may be provided with any of a variety of tactile feedback structures, such as ridges or bumps, that have a predetermined alignment with respect to the buttons. This can assist the user in positioning their thumb in the identical position each time, so that the user, after a learning period, can rapidly reach for the controls, position their hand and identify with which button their fingers are aligned. See, for example, the tactile indicium illustrated in FIG. **24**.

FIG. **3**J illustrates an exploded view of an exemplary embodiment of the audio device **10**A'. As shown in FIG. **3**J, the left side ear stem **54**A' defines an electronic housing portion **250** which defines an internal cavity **252** configured to receive electronic components. The electronics housing **250** includes an upper surface **254** and lower surface **260**. The upper surface **254** extends generally outwardly from the ear stems **54**A' and around the internal cavity **252**. The upper surface also includes apertures **256**, **258** through which buttons **73***a*, **73***b*, respectively, extend.

The housing **250** includes a lower surface **260**. The lower surface **260** (which may contain ridges, apertures or slots) faces in an opposite direction from the upper surface **254** of the housing **250**. Preferably, the lower surface **260** is at least about 0.25 inches, and may be 0.5 inches or 0.75 inches or more wide. As such, the lower surface **260** provides a surface which allows a wearer to easily grasp the ear stem **54**A' so as to balance an actuation force supplied to the button **73***a*, **73***b*.

A cover member **262** cooperates with the housing **250** to define the closed internal cavity **252**. In the illustrated embodiment, the internal cavity **252** includes at least one compartment configured to receive an electronic circuit board **264** which includes at least one switch for each of the buttons **73***a*, **73***b*. In an exemplary but non-limiting embodiment, the board **264** can include two switches, one for each of the buttons **73***a*, **73***b*, which are configured to control a volume output from the speakers **14**A', **16**A'. The cover **262** can be attached to the ear stem **54**A' with any type of fastener, such as, for example, but without limitation, screws, rivets, bolts, adhesive, and the like.

In the illustrated embodiment, the housing **250** also defines a hinge recess **266**. Additionally, the cover member **262** includes a complimentary hinge recess **268**. The recesses **266**, **268** are sized to receive a hinge pin **270**. In the illustrated embodiment, the hinge pin **270** is hollow and includes an aperture therethrough. The ends of the hinge pin **270** are configured to be engaged with corresponding portions of the frame **42'** so as to anchor the position of the hinge pin **270** relative to the frame **42'**. When the cover **262** is attached to the housing **250**, with the hinge pin **270** disposed in the recesses **266**, **268**, the ear stem **54**A' is pivotally mounted to the frame **42'**. The aperture extending through the hinge pin **270** provides a passage through which electrical conduits can pass, described in greater detail below.

The housing **250** also includes a power source recess (not shown). The power source recess includes an opening **272** sized to receive a power storage device **274**. In the illustrated embodiment, the power storage device **274** is in the form of an AAAA-sized battery. Of course, the power storage device **274** can be in the form of any type or any size of battery and can have any shape. However, a further advantage is provided where a standard-sized battery such as an AAAA battery is used. For example, as described in greater detail below, this size battery can be conveniently balanced with other electronic components configured for playback of a sound recording.

A door **276** is configured to close the opening **272**. In the illustrated embodiment, the door **276** is preferably hingedly connected to a housing **250** so as to allow the door to be rotated between an open position and a closed position. FIGS. **3**D-**3**I illustrate the door **276** in a closed position.

The right ear stem **56'** includes a housing **280** defining an internal cavity **282** configured to receive at least one electronic component. The housing **280** also includes upper and lower surfaces (unnumbered) that can be configured identically or similarly to the upper and lower surfaces **254**, **260** of the housing **250**. However, in the illustrated embodiment, the upper surface of the housing **280** includes 3 apertures configured to receive portions of the buttons **73***c*, **73***d*, **73***e*. Thus, a further description of the housing **280** is not necessary for one of ordinary skill in the art to make and use the inventions disclosed herein.

The internal cavity **282**, in the illustrated embodiment, is configured to receive electronics such as a printed circuit board **284**. In the illustrated embodiment, the printed circuit board **284** includes one switch for each of the buttons **73***c*, **73***d*, and **73***e*. Additionally, the printed circuit board **284** includes an audio file storage and playback device **286**.

The device **286** can be configured to store and playback any desired type of electronic audio and/or video file. In the illustrated embodiment, the device **286** includes a memory, an amplifier, and a processor. The memory, amplifier, and the processor are configured to operate together to function as an audio storage and playback system. For example, the audio storage and playback system can be configured to store MP3 files in a memory and to play back the MP3 files through the speakers **14**A', **16**A'. Suitable electronics for enabling and amplifying MP3 storage and playback are well known in the art, and may be commercially available from Sigmatel, Inc. or Atmel, Inc. Thus, further description of the hardware and software for operating the device **286** as a storage and playback device is not necessary for one of ordinary skill in the art to make and use the inventions disclosed herein.

Advantageously, the printed circuit board **284** also includes or is in electrical communication with a data transfer port **288**. In the illustrated embodiment, the housing **280** includes an aperture (not shown) disposed in a position similar to the position of the aperture **272** on the housing **250**. In the housing **280**, however, the aperture is aligned with the data

transfer port **288**. Thus, when the printed circuit board **284** is received in the internal cavity **282**, the data transfer port **288** is aligned with the aperture.

A door **290** is configured to open and close the aperture through which the data port **288** is exposed. Preferably, the door **290** is hingedly engaged to the housing **280**, in an identical or similar manner as the door **276**. In the illustrated embodiment, the door **290** can be pivoted relative to housing **280**, thereby exposing the data transfer port **288**. In the illustrated embodiment, the data transfer port is configured to operate according to the universal serial bus (USB) transfer protocol. In one implementation of the invention, the earstem is provided with a mini USB port. The mini USB port enables both downloading of digital music from a source into the eyeglass, as well as charging a rechargeable battery carried by the eyeglass. Optical data ports may alternatively be used. As a further alternative, MP3 files may be uploaded from a source using wireless systems, such as BLUETOOTH® protocols, as is discussed below. Further, the device **286** is configured to receive audio files from another computer, through the data transfer port **288** and to store the files into the memory incorporated into the device **286**.

A cover **292** is configured to close the internal cavity **282**. The cover **292** can be configured in accordance with the description of the cover **262**. Similarly to the housing **250** and cover **262**, the housing **280** and cover **292** include recesses **294**, **296** configured to receive a hinge pin **298**. The hinge pin **298** can be constructed identically or similarly to the hinge pin **270**. Thus, with the hinge pin **298** engaged with a frame **42'**, the cover member **292** can be attached to the housing **280** with the hinge pin **298** received within the recesses **294**, **296**. As such, the ear stem **56**A' can be pivoted relative to the frame **42'**.

With continued reference to FIG. **3**J, the speakers **14**A', **16**A' can be constructed in a similar manner, as a mirror image of each other. Each of the speakers **14**A', **16**A', include a housing member **300**. Each housing member **300** includes a transducer housing **302**, a support stem **304**, and a guide portion **306**.

The transducer housing portion **302** includes an internal recess **308** (identified in the illustration of speaker **16**A'). The transducer recess **308** can be sized to receive any type of acoustic transducer. For example, but without limitation, the transducer recess **308** can be configured to receive a standard acoustic speaker commonly used for headphones. In a non-limiting embodiment, the speaker transducer (not shown) has an outer diameter of at least about 0.6 inches. However, this is merely exemplary, and other sizes of transducers can be used.

With reference to the illustration of the speaker **14**A', the support stem **304** connects the transducer housing **302** with the guide portion **306**. The support stem **304** includes an aperture therethrough (not shown) which connects the transducer recess **308** with the guide portion **306**.

The guide portion **306** includes an aperture **310** which communicates with the aperture extending through the support stem **304**. Thus, an electric conduit, described in greater detail below, can extend through the aperture **310**, through the stem **304**, and then to the transducer recess **308**.

The guide portion **306** also includes a guide aperture **312**. The guide aperture **312** is configured to receive a guide pin **314**.

The guide pin **314** can be made from any of a variety of materials. In the illustrated embodiment, the guide pin **314** is a rod having an outer diameter of about 0.0625 of an inch. When assembled, the guide pin **314** is disposed within an open recess (not shown) disposed on an under surface of the housing **250**. The aperture **312** is sized so as to slidably receive the pin **314**. Thus, the guide portion **306** can translate relative to the pin **314** as well as rotate relative to the pin **314**. The size of the aperture **312** can be configured to provide a slip fit with sufficient friction to provide the stable positions noted above with reference to FIGS. **3**D-**3**I.

In this embodiment, the guide pin **314** and the aperture **312** provide both translational and pivotal movement. Additionally, the guide pin **314** and the aperture **312** can be configured to resistance to both translational movement and pivotal movement, with the resistance to translational movement being greater. For example, the axial length and diameter of the aperture **312**, controls the maximum contact area between the guide pin **314** and the guide portion **306** and thus affects the frictional force generated therebetween. Thus, the length and diameter of the aperture **312** can be adjusted to achieve the desired frictional forces.

Additionally, with reference to FIG. **3**K, when a translational force X is applied to the speaker **14**A', a torque T is created, which results in reaction forces Xr urging the guide portion **306** against the guide pin **314** at the forward and rearward ends thereof. These reaction forces Xr increase the frictional resistance against the translational movement of the speaker **14**A'. However, as shown in FIG. **3**L, when a pivot force Θ is applied to the speaker **14**A', such reaction forces are not created, and the speaker **14**A' can pivot about the guide pin **314** with seemingly less force applied as compared to the force X required to move the speaker **14**A' in a direction parallel to the guide pin **314**.

With reference again to FIG. **3**J, the recess on the lower surface of the housings **250**, **280**, are sized so as to allow the guide portion **306** to slide in a forward to rearward direction in the range Rt, described above with reference to FIG. **3**F. Additionally, the open recess on the lower surface of the housings **250**, **280** is provided with a width to limit the range of motion S of the speakers **14**A', **16**A', described above with reference to FIG. **3**H.

With reference to FIG. **3**E, the frame **42'** includes an interior electrical conduit channel **316** configured to receive an electrical conduit for connecting the speakers **14'**, **16'**, the printed circuit boards **264**, **284**, and the power storage device **274**. For example, with reference to FIG. **3**M, the buttons **73***a*, **73***b*, are connected to the device **286** through conduits **73***ai*, **73***bi*. The storage device **274** is connected to the device **286** through a power line **274***i*. Additionally, the speaker **14**A' is connected to the device **286** with an audio output conduit **14**Ai'.

As illustrated in FIG. **3**M, portions of the conduits **73***ai*, **73***bi*, **274***i* and **14**Ai', extend through the channel **316**. In an exemplary embodiment, the conduits **73***ai*, **73***bi*, **274***i*, and **14**Ai', can be in the form of a ribbon connector **318** extending through the channel **316**. Thus, with reference to FIGS. **3**J and **3**M, the ribbon connector **318** can extend from the housing **280**, into the recesses **294**, **296**, through an aperture (not shown) in the hinge pin **298** to the upper opening within the hinge pin **298**, then through the channel **316** (FIG. **3**E), to an upper opening of the hinge pin **270**, out through an aperture (not shown) through a side of a hinge pin **270**, through the recesses **266**, **268** of the housing **250**, and then to the speaker **14**A', printed circuit board **264**, and the power storage device **274**.

The conduit **14**Ai'can extend to the aperture **310** in the guide portion **306**, through a central aperture of the support stem **304**, and into the transducer recess **308**, as to connect to a transducer disposed therein. Optionally, the portion of the conduit **14**Ai' that extends out of the housing **250** and into the transducer housing **300** can be formed from an insulated

metal conduit, or any other known conduit. The speaker **16**A' can be connected to the printed circuit board **284** in a similar manner.

The buttons **73***c*, **73***d*, **73***e* and the data transfer port **288** are connected to the device **286** through printed conduits incorporated into the printed circuit board **284**.

As noted above, one aspect of at least one of the inventions disclosed herein includes the realization that a desirable balance can be achieved by disposing a power storage device in one ear stem of an eyeglass and play-back device into the second ear stem. Thus, as illustrated in FIGS. **3**J and **3**K, the power storage device **274** is disposed in the left ear stem **54'** and the storage and play-back device **286** is disposed in the right ear stem **56'**.

In the illustrated embodiment, the buttons **73***a* and **73***b* for controlling the volume of the sound output from the speakers **14**A', **16**A'. For example, the button **73***a* can be used for increasing volume and the button **73***b* can be used for decreasing volume. Alternatively, the button **73***b* can be for increasing volume and the button **73***a* can be for decreasing volume. When a wearer of the audio device **10**A' presses one of the buttons **73***a*, **73***b*, a simple on-off signal can be transmitted to the device **286**. The device **286** can be configured to interpret the on-off signals from the buttons **73***a*, **73***b* as volume control signals and adjust the volume to the speakers **14**A', **16**A' accordingly.

Optionally, a third command can be generated by pressing both of the buttons **73***a*, **73***b* simultaneously. For example, but without limitation, the device **286** can be configured to interpret simultaneous signals from both the buttons **73***a*, **73***b*, as a signal for turning on and off an additional feature. For example, but without limitation, the additional feature can be a bass boost feature which increases the bass of the audio signal transmitted to the speakers **14**A', **16**A'. Of course, other functions can be associated with the buttons **73***a*, **73***b*.

The buttons **73***c*, **73***d*, **73***e* can be figured to operate switches to transmit control signals to the device **286** similarly to the buttons **73***a*, **73***b*. For example, but without limitation, the button **73***c* corresponds to a power button. For example, the device **286** can be configured to recognize a signal from the button **73***c* as a power on or power off request. In this embodiment, when the device **286** is off, and a signal from the button **73***c* is received, the device **286** can turn on. Additionally, the device **286**, when in an on state, can be configured to turn off when a signal from the button **73***c* is received. Optionally, the device **286** can be configured to, when in an off or standby state, turn on and begin to play an audio file when a signal from the button **73***c* is received. Additionally, the device **286** can be configured to pause when another signal from the button **73***c* is received. In this embodiment, the device **286** can be configured to turn off only if the button **73***c* is held down for a predetermined amount of time. For example, the device **286** can be configured to turn off if the button **73***c* is held down for more than two seconds or for three seconds or for other periods of time.

The buttons **73***d* and **73***e* can correspond to forward and reverse functions. For example, the button **73***d* can correspond to a track skip function. In an illustrative but non-limiting example, such a track skip function can cause the device **286** to skip to a next audio file in the memory of the device **286**. Similarly, the button **73***e* can correspond to a reverse track skip function in which the device **286** skips to the previous audio file.

Optionally, the buttons **73***d*, **73***e* can be correlated to fast forward and rewind functions. For example, the device **286** can be configured to fast forward through an audio file, and play the corresponding sounds at a fast forward speed, when the button **73***d* is held down and to stop and play the normal speed when the button **73***d* is released. Similarly, the device **286** can be configured to play an audio file backwards at an elevated speed, when the button **73***e* is held down, and to resume normal forward play when the button **73***e* is released. This arrangement of the buttons **73***a*, **73***b*, **73***c*, **73***d*, **73***e* provides certain advantages noted above. However, other arrangements of the buttons **73***a*, **73***b*, **73***c*, **73***d*, **73***e* and the corresponding functions thereof can be modified.

With reference to FIGS. **4**A-**4**B, a modification of the audio devices **10**, **10**A, **10**A' is illustrated therein and referred to generally by the reference numeral **10**A". The audio device **10**A" can include the same components as the audio devices **10**, **10**A, **10**A' except as noted below. Components of the audio device **10**A" that are similar to corresponding components of the audio devices **10**, **10**A, **10**A' are identified with the same reference numerals, except that a "" has been added thereto.

The audio device **10**A" is in the form of a eyeglass **12**A" having a frame **40**A". The audio device **10**A" also includes at least one microphone **75**. Advantageously, the microphone **75** is disposed so as to face toward the wearer.

FIG. **4**B illustrates a partial cross-sectional view of the eyeglass **12**A" on the head **18** of a wearer. The microphone **75** is schematically illustrated and includes a transducer unit **76**. In the illustrated embodiment, the transducer **76** is disposed within the frame **40**A" and at least one aperture **77** extends from the transducer unit **76** to the outer surface of the frame **40**A". Alternatively, the transducer can be positioned so as to be exposed on the outer surface of the frame **40**A".

Advantageously, the aperture **77** is disposed so as to face toward the head of the user **18**. The illustrated aperture **77** faces downward and toward the head **18** of the wearer. By configuring the aperture to extend downwardly and toward the head **18**, the aperture is disposed as close as possible to the mouth of the wearer while benefiting from the wind protection provided by positioning the aperture **77** on the portion of the frame **40**A' facing toward the head **18**.

Alternatively, the aperture can be positioned so as to extend generally horizontally from the transducer **76** to an outer surface of the frame **40**A", this configuration being illustrated and identified by the numeral **78**. By configuring the aperture **78** to extending generally horizontally toward the head **18**, the aperture **78** is better protected from wind.

As another alternative, the aperture can be configured to extend upwardly from the transducer and toward the head **18**, this configuration being identified by the numeral **79**. By configuring the aperture **79** to extend upwardly from the transducer **76** and toward the head **18**, the aperture **79** is further protected from wind which can cause noise. However, in this orientation, the aperture **79** is more likely to collect water that may inadvertently splash onto the aperture **79**. Thus, the aperture configuration identified by the numeral **77** provides a further advantage in that water is less likely to enter the aperture **77**. Any water that may enter the aperture **77** will drain therefrom due to gravity.

The microphone **75** can be disposed anywhere on the frame **40**A', including the orbitals **48**A", **50**A", the bridge **52**A", or the ear stems **54**A", **56**A". Optionally, the microphone **75** can be in the form of a bone conduction microphone. As such, the microphone **75** is disposed such that the when a user wears the audio device **10**A', the microphone **75** is in contact with the user's head **18**. For example, but without limitation, the microphone can be positioned anywhere on the anywhere on the frame **40**A', including the orbitals **48**A", **50**A", the bridge **52**A", or the ear stems **54**A", **56**A" such that the microphone contacts the user's head. More preferably, the microphone **75**

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is positioned such that it contacts a portion of the user's head **18** near a bone, such that vibrations generated from the user's voice and traveling through the bone, are conducted to the microphone. A bone conduction microphone may be built into a nosepad, or into each nosepad, for direct contact with the wearer. In another alternative, the microphone **75** can be configured to be inserted into the meatus **24** (FIG. **2**) of the ear canal of the user. Thus, in this modification, the microphone **75** can be substituted for one of the speakers **14**, **16**. Alternatively, an ear-canal type bone conduction microphone can be combined with a speaker so as to provide two-way communication with the user through a single ear canal.

Further, the audio device **10**A" can include noise cancellation electronics (not shown) configured to filter wind-generated noise from an audio signal transmitted from the microphone **75**.

FIG. **5**A illustrates a modification in which the microphone **75** is disposed on the bridge **52**A". Similarly to the configuration illustrated in FIG. **4**B, the bridge **52**A" can include an aperture **77** which extends downwardly and toward the nose **19** of the wearer, horizontally extending aperture **78**, or an upwardly extending aperture **79**.

Alternatively, the microphone **75** can include a forwardly facing aperture, as illustrated in FIG. **5**B, and a wind sock **81** disposed over the aperture. The wind sock **81** can be made in any known manner. For example, the wind sock **81** can be made from a shaped piece of expanded foam. Configuring the bridge portion **52**A' as such is particularly advantageous because the bridge portion of an eyeglass is typically somewhat bulbous. A wind sock can be shaped complementarily to the bridge portion **52**A'. Thus, the sock **81** can be made so as to appear to be part of a normal bridge portion of an eyeglass.

The audio device **10**A" can include electrical conduits extending through the frame **40**A" to an audio output jack (not shown). The audio output jack can be disposed at the end of the ear stems **54**A", **56**A", or anywhere else on the frame **40**A". Thus, a user can wear the audio device **10**A' and use the microphone **75** in order to transform the voice of the wearer or other sounds into an electrical signal. The electrical signal can be transmitted to another audio device, such as a palm top computer, a laptop computer, a digital or analog audio recorder, a cell phone, and the like. Additionally, the audio device **10**A" can include speakers, such as the speakers **14**A", **16**A" illustrated in FIG. **3**A. As such, the audio device **10**A" can be configured to provide two-way audio for the wearer, e.g., audio input being transmitted to the user through the speakers **14**A", **16**A", and audio output being transmitted from the wearer, through the microphone **75**, and out through the audio output jack. As such, a user can use the audio device **10**A" for two-way audio communication in a comfortable manner.

With reference to FIGS. **6** and **7**, a modification of the audio devices **10**, **10**A, **10**A', **10**A" is illustrated therein and referred to generally by the reference numeral **10**B. Components of the audio device **10**B corresponding to components of the audio devices **10**, **10**A, **10**A', **10**A" are identified with the same reference numerals, except that letter "C" has been added thereto.

The audio device **10**B is in the form of an eyeglass **80**. The eyeglass **80** includes a frame **82**. The frame **82** includes left and right orbitals **84**, **86**. Each of the orbitals **84**, **86** support a lens **88**, **90**. The frame **82** also includes a bridge portion **92**. Similarly to the bridge portion **52** of the audio device **10**A, the bridge portion **92** connects the orbitals **84**, **86**. Additionally, the bridge portion **92** defines an open space **94** configured to receive the nose **19** of a wearer. The inner sides of the orbitals **84**, **86** and/or the bridge portion **92** is configured to support the frames **82** on the nose of a user.

The eyeglass **80** also includes support stems **96**, **98** extending from the upper portions of the orbitals **84**, **86** toward a posterior of a wearer's head. In the illustrated embodiment, the stems **96**, **98** extend along an upper surface of the wearer's head. Thus, the stems **96**, **98**, along with the bridge portion **92**, support the eyeglass **80** on the wearer's head **18**. The support members **28**B, **30**B are comprised of support arms **100**, **102**.

With reference to FIGS. **5**, **6** and **7**, the support arms **100**, **102** extend downwardly from the stems **96**, **98**, respectively. In the illustrated embodiment, the support arms **100**, **102** extend in an "L" shape. In particular, the support arm **100** extends from the stem **96** to a point just forward (anterior) from the tragus of the user's ear **20**. From this point, the support arm **100** extends rearwardly so as to support the speaker **14**B at a position juxtaposed and spaced from the ear **20**. Preferably, the speaker **14**B is maintained in a position from about 2 mm to 3 cm from the tragus of the ear **20**. Similarly to the audio device **10**A, the audio device **10**B can include an audio input through a wired arrangement or through a wireless transceiver.

With reference to FIGS. **8**, **9**A, and **9**B, another modification of the audio device **10** is illustrated therein and referred to generally by the reference numeral **10**C. Similar components of the audio device **10**C have been given the same reference numerals, except that that a "C" has been added thereto.

As illustrated in FIG. **8**, the audio device **10**C can be worn on the head **18** of a user U. Preferably, the audio device **10**C is configured to provide one or two-way wireless communication with a source device, or the source device can be incorporated into the audio device **10**C. The source device can be carried by the user U, mounted to a moveable object, stationary, or part of a local area or personal area network.

The user U can carry a "body borne" source device B such as, for example, but without limitation, a cellular phone, an MP3 player, a "two-way" radio, a palmtop computer, or a laptop computer. As such, the user U can use the audio device **10**C to receive and listen to audio signals from the source device B, and/or transmit audio signals to the source device B. Optionally, the audio device **10**C can also be configured to transmit and receive data signals to and from the source device B, described in greater detail below.

Optionally, the device B can also be configured to communicate, via long or short range wireless networking protocols, with a remote source R. The remote source R can be, for example, but without limitation, a cellular phone service provider, a satellite radio provider, or a wireless internet service provider. For example, but without limitation, the source device B can be configured to communicate with other wireless data networks such as via, for example, but without limitation, long-range packet-switched network protocols including PCS, GSM, and GPRS. As such, the audio device **10**C can be used as an audio interface for the source device B. For example, but without limitation, where the source device B is a cellular phone, the user U can listen to the audio output of the cellular phone, such as the voice of a caller, through sound transducers in the audio device **10**C. Optionally, the user U can send voice signals or commands to the cellular phone by speaking into a microphone on the audio device **10**C, described in greater detail below. Thus, the audio device **10**C may advantageously be a receiver and/or a transmitter for telecommunications.

In general, the component configuration of FIG. **8** enables the audio device **10**C to carry interface electronics with the user, such as audio output and audio input. However, the source electronics such as the MP3 player, cellular phone,

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computer or the like may be off board, or located remotely from the audio device **10**C. This enables the audio device **10**C to accomplish complex electronic functions, while retaining a sleek, low weight configuration. Thus, the audio device **10**C is in communication with the off board source electronics device B. The off board source device B may be located anywhere within the working range of the audio device **10**C. In many applications, the source electronics B will be carried by the wearer, such as on a belt clip, pocket, purse, backpack, shoe, integrated with "smart" clothing, or the like. This accomplishes the function of off loading the bulk and weight of the source electronics from the headset.

The source electronics B may also be located within a short range of the wearer, such as within the room or same building. For example, personnel in an office building or factory may remain in contact with each, and with the cellular telephone system, internet or the like by positioning transmitter/receiver antenna for the off board electronics B throughout the hallways or rooms of the building. In shorter range, or personal applications, the out board electronics B may be the form of a desktop unit, or other device adapted for positioning within relatively short (e.g. no greater than about 10 feet, no greater than about 20 feet, no greater than about 50 feet, no greater than 100 feet) of the user during the normal use activities.

In all of the foregoing constructions of the invention, the off board electronics B may communicate remotely with the remote source R. Source R may be the cellular telephone network, or other remote source. In this manner, the driver electronics may be off loaded from the headset, to reduce bulk, weight and power consumption characteristics. The headset may nonetheless communicate with a remote source R, by relaying the signal through the off board electronics B with or without modification.

Optionally, the audio device **10**C can be configured to provide one or two-way communication with a stationary source device S. The stationary source device can be, for example, but without limitation, a cellular phone mounted in an automobile, a computer, or a local area network.

With reference to FIGS. **9**A and **9**B, the audio device **10**C preferably comprises a wearable wireless audio interface device which includes a support **12**C supported on the head **18** of a user by the support **26**C and includes an interface device **110**. The interface device **110** includes a power source **112**, a transceiver **114**, an interface **116**, and an antenna **118**.

The power source **112** can be in the form of disposable or rechargeable batteries. Optionally, the power source **112** can be in the form of solar panels and a power regulator.

The transceiver **114** can be in the form of a digital wireless transceiver for one-way or two-way communication. For example, the transceiver **114** can be a transceiver used in known wireless networking devices that operate under the standards of 802.11a, 802.11b, or preferably, the standard that has become known as BLUETOOTH™. As illustrated in BLUETOOTH™-related publications discussed below, the BLUETOOTH™ standard advantageously provides low-cost, low-power, and wireless links using a short-range, radio-based technology. Systems that employ the BLUETOOTH™ standard and similar systems advantageously allow creation of a short-range, wireless "personal area network" by using small radio transmitters. Consequently, with BLUETOOTH™-enabled systems and similar systems, components within these systems may communicate wirelessly via a personal area network. Personal area networks advantageously may include voice/data, may include voice over data, may include digital and analogue communication, and may provide wireless connectivity to source electronics. Personal area networks may advantageously have a range of about 30 feet; however, longer or shorter ranges are possible. The antenna **118** can be in the form of an onboard antenna integral with the transceiver **114** or an antenna external to the transceiver **114**. In another implementation, the transceiver **114** can support data speeds of up to 721 kilo-bits per second as well as three voice channels.

In one implementation, the transceiver **114** can operate at least two power levels: a lower power level that covers a range of about ten yards and a higher power level. The higher level covers a range of about one hundred yards, can function even in very noisy radio environments, and can be audible under severe conditions. The transceiver **114** can advantageously limit its output with reference to system requirements. For example, without limitation, if the source electronics B is only a short distance from audio device **10**C, the transceiver **114** modifies its signal to be suitable for the distance. In another implementation, the transceiver **114** can switch to a low-power mode when traffic volume becomes low or stops.

The interface **116** can be configured to receive signals from the transceiver **114** that are in the form of digital or analog audio signals. The interface **116** can then send the audio signals to the speakers **14**C, **16**C through speaker lines **120**, **122**, respectively, discussed in greater detail below.

Optionally, the audio device **10**C can include a microphone **124**. Preferably, the support **12**C is configured to support the microphone **124** in the vicinity of a mouth **126** of a user. As such, the support **12**C includes a support member **128** supporting the microphone **124** in the vicinity of the mouth **126**.

The microphone **124** is connected to the interface **116** through a microphone line **130**. Thus, the transceiver **114** can receive audio signals from the microphone **124** through the interface **116**. As such, the audio device **10**C can wirelessly interact with an interactive audio device, such as a cellular phone, cordless phone, or a computer which responds to voice commands. The microphone **124** can also be in any of the forms discussed above with reference to the microphone **75**.

As noted above with reference to the audio device **10** in FIGS. **1** and **2**, by configuring the support **12**C to support the speakers **14**C, **16**C in a position juxtaposed and spaced from the ears **20**, **22** of the head **18**, the audio device **10**C provides enhanced comfort for a user.

One embodiment of an input data management system **600** in accordance with the present invention is schematically illustrated in FIG. **8**A. The data management system **600** includes a wearable electronic interface **601** for providing data from one or more selected data sources to the wearer. The interface **601** is in communication with a primary data source **602** and optionally at least one secondary source **604**. Communication between the primary source **602** and any secondary source **604** and the interface **601** is accomplished via at least one communication link **606**. In one embodiment, the wearable electronic interface **601** is in communication with one, two, three, or n secondary sources **604**.

In general, the data input management system is configured to allow a user to select one or more data sources, to be placed either simultaneously or one at a time into electrical communication with a single user interface. This allows the wearer to obtain the benefits of multiple input sources, without the need to replace or make any changes to the interface. As will be discussed in greater detail below, the user may select only a single data source for connection to the interface. Alternatively, the user may select one source as a primary input source and a second source as the secondary input source. The interface may toggle between the input sources, to provide input to the user either automatically, or in response to demand by the user or other electronic prioritization system.

The primary source **602** and secondary source **604** may be any source, conduit, or provider of audio, video or audio/video information selected by the wearer or by the manufacturer. The examples identified below will therefore be designated generically as source electronics. For example, the source electronics may include a computing device, such as a computer, a server, a network, drive, RAM, ROM or other non-removable or removable memory chip.

The source electronics may alternatively comprise a digital audio player, such as an mp3 player, an IPOD®, or a multimedia player such as a portable DVD player where the audio track is to be routed to the support.

Any of a variety of current electronic devices can be converted into wireless source electronics for use in the present system. For example, a device such as a portable DVD player is conventionally provided with internal speakers and a headphone jack for enabling wired connection to an external headphone. The portable DVD player can be converted for use as a source in the system of the present invention by providing a Bluetooth or other radio frequency transmitter and power supply in a small housing, provided with an externally projecting plug of a size corresponding to the earphone jack. The converter can be plugged into the external earphone or external speaker jack of any conventional source of electrical signal, and convert the source into a Bluetooth or other RF enabled signal source for use with the interface with the present invention.

The source electronics may be a microphone or a radio, such as a terrestrial-based or satellite-based radio, including XM® or SIRIUS® brand satellite radios. In other embodiments, the source electronics may be a telephone, a cellular telephone, a personal digital assistant (PDA), a BLACKBERRY®, or a pager. A variety of currently available devices, for example, a BLACKBERRY®, pager, any of a variety of PDA's and e-mail enabled devices such as notebook computers provide incoming text messages. In one aspect of the present invention any of these text message devices is provided with text to voice software, enabling the text to be read out loud. This enables the user to listen to a primary source such as music, or the sound track from a portable DVD player, and incoming e-mails will be read out loud to the wearer, while the primary source is either placed on pause, or remains running in the background. Text to voice software can either be carried by the support, or carried by the underlying source such as the BLACKBERRY® or other PDA.

In other embodiments, the source electronics may be a two-way radio, a CB-radio, a NEXTEL® telephone, a cordless telephone, or a walkie-talkie.

In alternate embodiments, the source electronics includes a time measuring device, such as a clock or a timer. In another embodiment, the source electronics may be a sensor for measuring a body biometric, such as a wearer's pulse, temperature, or blood parameter such as blood oxygen saturation, blood glucose level or blood pressure. The sensor may be configured to provide an alarm, or a signal indicative of a time, or a sensed biometric to a wearer when certain threshold levels are measured, or during periodic intervals. Such thresholds and periodic intervals may be selected or programmed by the wearer, or may be preset.

The sensor type of source electronics may sense the position or orientation of the head, arms, legs, eyes, or other body part of the wearer of the wearable electronic interface **601**. For example, in one embodiment, the sensor determines the direction in which the wearer is looking by sensing the position of the wearer's eyes. Such techniques are well known to those of skill in the art, and include methods of measuring reflected light off of a wearer's eye.

In another embodiment, the sensor of the source electronics measures distance or determines position or location. For example, the source electronics may include a global positioning system (GPS) or an altimeter. Such sensors may be used to determine the distance from an object, including the distance from a location, distance traveled from a starting point, or the distance to a target. Such distance sensors may also be configured to provide an alarm, or a signal indicative of a distance to a wearer when certain threshold levels are measured, or during periodic intervals. For example, a runner may select a music source (e.g. MP3) as the primary source, and a GPS distance traveled device as the secondary source. This allows the runner to listen to music in the background. When a preprogrammed reporting milestone has been reached, the GPS device interrupts the music to report the desired data. For example, at the appropriate time, the GPS device might interrupt the music to report to the wearer "You have completed 5 miles. Average time is 5 minutes and 45 seconds per mile." Reportable events from any source electronics designated as a secondary source can be given a priority to interrupt the primary source and report the event to the wearer.

The sensor may measure a time-varying parameter, such as speed, acceleration, or jerk (e.g., the rate of change in acceleration). The sensor may provide a signal indicative of an instantaneous or an average time-varying parameter at fixed, or at user-selectable intervals. For example, in one embodiment, the primary source **602** includes a GPS receiver and a clock and calculates velocity by dividing a measurement of distance traveled (as provided by the GPS receiver) by a measurement of time elapsed (as provided by the clock).

The source electronics may be external to the wearable electronic interface **601**, as illustrated in FIG. **8**A, in which case the communication link **606** may either be a direct electrical coupling (for example hard wiring, or inductive coupling through the body), or wireless.

Wireless source electronics may be infrared enabled or radiofrequency-communication enabled, such as BLUETOOTH enabled. For example, in one embodiment, the source includes a BLUETOOTH enabled cellular telephone, although any of the source electronics described herein may be radiofrequency-communication enabled.

The source electronics may alternatively be carried by or internal to (carried in a cavity or alternatively embedded within) the wearable electronic interface **601**. For example the primary source **602** may include a digital audio player, such as an mp3 player or other memory device, which is attached to or located within the frame of a pair of eyeglasses. Electronically-enabled eyewear as a wearable electronic interface **601** is described in greater detail herein. The secondary source may be a cell phone, GPS device or other external device which is in radio communication as needed, with the interface. The primary and secondary sources can both be completely contained on the wearable interface, such as built into or carried by a pair of eyewear.

The source electronics may provide substantially discrete packets of information, or may provide a substantially continuous stream of information to the wearable electronic interface **601**. Information packet sizes may be varied depending upon the communication link **606** used to transfer information from the source to the wearable electronic interface **601**.

In further embodiments, the source electronics may include a video source, or an audio/video source. For example, in one embodiment, the source includes a camera for real time viewing of a remote location or viewing direction, or a video playback device such as a DVD or VCR or

solid state video storage device. The source electronics may alternatively be a tuner, a television receiver, or any other device capable of providing a signal indicative of still or moving images. In one embodiment, the primary source **602** provides a photograph, a video clip, an email, a videomail or a voicemail message in accordance with any of the embodiments described herein.

Any of the source electronics identified above can be selected as the primary source **602** or secondary source **604**. The secondary source **604** communicates with the wearable electronic interface **601** via a communication link **606** as well. Secondary source **604** and primary source **602** may also include any content source **302** described in greater detail below with respect to FIG. **21**.

The communication link **606** is any device, technology or information conduit for providing communication between two or more electronic components. For example, in one embodiment, the communication link **606** includes a physical connection, such as a wire, cable, fiberoptic cable, or trace on a PC board. Such communication links **606** include USB, serial, RS-232, IEEE-1394, and FIREWIRE cables.

In another embodiment, the communication link **606** includes a wireless coupling, such as radiofrequency (RF), infrared (IR), acoustic, or optical coupling. Such communication links **606** include BLUETOOTH and other wireless communications protocols and their associated hardware, as is well known to those of skill in the art. Communication link **606** includes any communications link **306** described in greater detail below with reference to FIG. **21**.

Referring again to FIG. **8**A, in one embodiment, the system **600** comprises a wearable electronic interface **601**. In one embodiment, the wearable electronic interface **601** is any electronic device that may be worn by a wearer, and that provides an interface between an information source, such as primary source **602** and secondary source **604**, and the wearer.

In one embodiment, the wearable electronic interface **601** is electronically enabled eyewear including audio, video or audio-video interface capabilities such as described in greater detail elsewhere herein. However, wearable electronic interface **601** may be any wearable device, and may be in the form of any wearable support structure, including a wristwatch, armband, jewelry, headwear and clothing. Examples of such wearable electronic interface **601** clothing include headphones, ear phones, a hat, helmet, goggles, mask, visor, headband, hair band, shirt, scarf, sweater, jacket, belt, pants, vest, etc.

The wearable electronic interface **601** generally includes a data port **608**, a selector **610**, and an audio output **612**. In addition, in some embodiments, the wearable electronic interface **601** further includes a video output **614**, an audio input **616**, and/or a video input **618**.

The data port **608** is any device capable of receiving information from a primary source **602** (or secondary source **604**) via its associated communication link **606**. For example, in one embodiment, the data port **608** is a physical connector such as a mini-USB connector depending upon the nature of the communication link **606**. In such embodiment, the primary source **602** or secondary source **604** might be coupled to the wearable electronic interface **601** via a USB cable having a mating mini-USB connector on at least one of its ends. In another embodiment, the data port **608** includes a wireless transceiver for providing wireless communication between the primary source **602** (or secondary source **604**) and the wearable electronic interface **601**. For example, in one embodiment, the data port **608** includes a BLUETOOTH receiver or transceiver. The data port **608** includes any data port **308** described in greater detail below with respect to FIG. **22**.

In one embodiment, the data port **608** is able to communicate with multiple source devices **602**, **604**, either simultaneously, sequentially or serially. For example, in one embodiment, the data port **608** is a BLUETOOTH transceiver that is configured to communicate with more than one BLUETOOTH enabled source device (e.g., a telephone and an mp3 player).

Outputs from data port **608** are provided to a selector **610**, which selects the source to be provided to the wearer of the wearable electronic interface **601** at any particular time. The selector **610** may be any of a variety of switching devices suitable for switching between multiple electronic input sources.

The selector **610** may include a mechanical, electrical, or an electro-mechanical switch. For example, in one embodiment, the selector **610** includes a manually operable control such as a toggle switch, a rocker switch, a jumper, a dial, a button, a knob, or a combination thereof. In another embodiment, the selector **610** includes an electronically operable control such as a transistor, a bank of transistors, a relay, a circuit, logic, a RAM, a ROM, a PLD, an EPROM, an EEPROM, a microprocessor, a microcontroller, a multiplexor, a demultiplexor, or a combination thereof. In addition, the selector **610** may be a voice-activated switch, or a voice-activated control that controls selection between primary and secondary sources **602**, **604** based upon verbal commands provided by the wearer.

The selector **610** may also be coupled to an audio output **612**, a video output **614**, an audio input **616**, and a video input **618** depending upon the desired functionality of the system. The audio output **612** includes any device suitable for providing an audio signal to the wearer of the wearable electronic interface **601**. For example, the audio output **612** may include a speaker, including a bone conduction speaker, a buzzer, a beeper, an alarm, or any other device that produces an audible signal.

The selector **610** may be located on the wearable electronic interface **601**, or may be remote from it. For example, in one embodiment, the wearable electronic interface **601** includes a pair of electronically enabled eyeglasses, and the selector **610** comprises a manually activated control such as a button or touch pad located on an earstem, an orbital or the bridge, or on a remote associated component such as the cell phone or a wristwatch. Any other wearable electronic interface **601** or selector **610** location may be utilized.

The video output **614** includes any device suitable for providing a video signal to the wearer of the selector **610**. For example, in one embodiment, the video output **614** includes a light, a lamp, an LED, or any of a variety of image displays such as a screen, a display, a monitor, a head-mounted display, or any other device that produces a visible signal or image.

The audio input **616** of the wearable electronic interface **601** includes any device suitable for converting an audible signal into an electronic signal that can be processed or carried by the wearable electronic interface **601**. For example, in one embodiment, the audio input **616** includes a microphone, including a bone conduction microphone.

The video input **618** of the wearable electronic interface **601** includes any device suitable for converting an image, or visual information into an electronic signal that can be processed or carried by the wearable electronic interface **601**. For example, in one embodiment, the video input **618** includes a camera, a still camera, or a video camera. See generally U.S.

Pat. No. 6,349,001 to Spitzer, entitled Eyeglass Interface System, the disclosure of which is incorporated in its entirety herein by reference.

In one embodiment, during operation, the wearer of the wearable electronic interface **601** manually selects which input source **602**, **604** is placed in communication with the interface output. The wearer can switch input sources by activation of the selector at any time. In another embodiment, the wearable electronic interface **601** automatically selects the particular input source **602**, **604** for communication based upon a prioritization schedule configured by the wearer.

In one embodiment of manual selection operation, the primary source **602** coupled to the wearable electronic interface **601** is an mp3 player, and the secondary source **604** is a BLUETOOTH enabled cellular telephone. In this embodiment, the wearer listens to mp3 audio provided by the primary source **602** through audio output **612** (e.g., speakers) coupled to the wearable electronic interface **601**. Various embodiments of such wearable electronic interfaces **601** containing or carrying mp3 or other digital audio players are discussed in greater detail herein.

In manual selection operation, when a telephone call is received via a secondary source **604**, the secondary source **604** sends a signal or an alarm to the wearer to inform the wearer that an incoming call is occurring. The signal or alarm may be an audio signal provided by the audio output **612**, it may be a visual signal, such as a flashing light, provided by the video output **614**, a conventional vibrator or cell phone "ring" or it may be a combination of signals. In one embodiment, the signal includes caller identification information.

If the wearer determines that he would like to answer the incoming telephone call, the wearer activates the selector **610** using any mechanism described above. For example, in one embodiment, the wearer presses a button on the selector **610** to accept the incoming call from the secondary source **604**, and to simultaneously pause, stop, mute, or partially decrease the playback volume from the primary source **602**.

When the selector **610** is activated, information from the secondary source **604** is provided through the associated communication link **606** and data port **608** to the selector **610**. The selector **610** routes the communication from the secondary source **604** to the audio output **612** so that the wearer can hear the incoming call without having to remove or adjust the wearable electronic interface **601**.

In addition, the selector **610** includes sufficient logic to know that when an incoming telephone call is being received from a source **602**, **604**, the audio input **616** (e.g., microphone) of the wearable electronic interface **601** will be activated to provide communication from the wearer back to the secondary source **604**. Similarly, if the source electronics selected by the user carries video signals, the selector **610** additionally activates the video display carried by the eyeglasses or other support structure. If the source electronics selected by the user or automatically by the selector **610** includes only an audio signal, the microphone and video display, if present, remain dormant.

When the telephone call is terminated, the wearable electronic interface **601** may be configured to resume playback of the mp3 file, to increase the playback volume to previous levels, or to take no further action. The wearer may customize wearable electronic interface **601** operation as desired.

One example of automatic operation of the input selectable system **600** is illustrated in the method **620** of FIG. **8**B. In the illustrated example, at step **622**, the wearer of the wearable electronic interface **601** listens to an mp3 file through audio output **612** (e.g., speakers) coupled to the wearable electronic interface **601**.

In this example, an mp3 player is the primary source **602**, although any source electronics discussed above may alternatively be used. Although not illustrated in FIG. **8**B, in the present example, a BLUETOOTH enabled cellular telephone is coupled to the wearer's wearable electronic interface **601** as a secondary source **604**.

At step **624**, the selector **610** determines whether or not an interrupt signal is being received. In one embodiment, an interrupt signal is provided by a secondary source **604** when the secondary source **604** desires to communicate with the wearer. If an interrupt signal is not being provided by a secondary source **604**, the method **620** returns to step **622**, and the wearable electronic interface **601** continues without interruption providing mp3 audio to the wearer via the audio output **612**.

However, if an incoming telephone call is being received by a secondary source **604** (e.g, the cellular telephone), the secondary source **604** sends an interrupt signal to the selector **610** of the wearable electronic interface **601**. The selector **610** receives the interrupt signal from the secondary source **604**, and determines that an incoming telephone call is being received. The method **620** then proceeds to step **626**.

At step **626**, the selector **610** compares a priority setting associated with the primary source **602** and secondary source **604**. If the selector **610** determines that the secondary source **604** does not have priority over the primary source **602**, the method **620** returns to step **622**, and the wearable electronic interface **601** continues providing mp3 audio to the wearer without interruption via the audio output **612**. However, if the selector **610** determines that the secondary source **604** has priority over the primary source **602**, the method **620** continues to step **628**.

In one embodiment, each possible primary source **602** and secondary source **604** has a priority setting associated with that source **602**, **604**. Priority settings for each source **602**, **604** may be described by a priority schedule, which may be saved within, or loaded into the wearable electronic interface **601** via any programming method known.

For example, in one embodiment, the wearer customizes operation by downloading settings from a computer to the wearable electronic interface **601**. In another embodiment, the wearable electronic interface **601** is customized by programming via a telephone keypad, voice to text software, BLACKBERRY, or by pressing buttons or selectors on the wearable electronic interface **601**.

At step **628**, the playback volume of the primary source **602** (e.g., the mp3 player) is reduced or the source placed on pause, as selected by the wearer of the wearable electronic interface **601**. During this step **628**, the wearer may optionally be provided an alarm signal and the opportunity to either accept the incoming call, or to reject it.

For example, at step **628**, the wearable electronic interface **601** may provide the wearer with caller identification information received from the secondary source **604**. The wearer may then decide, based upon the identity of the caller, whether or not to accept the incoming call. Thus, in one embodiment the user selects a music source as the primary source **602**, and may select a cellular telephone as the secondary source **604**, with an override capability to enable interruption of the music to reveal the source of the incoming phone call. During device configuration, such as in communication with a notebook or desktop computer, the user may be allowed to input the names associated with each of the key telephone numbers from which the user may anticipate receiving a call.

In use, the wearer may be listening to music from the primary source when an incoming phone call is received. If

the incoming call is from a number which has been preprogrammed into the system, the override function allows the name of the caller or other information associated with that incoming phone number to be presented audibly over the speakers. The wearer can then elect whether to accept the call, such as by pressing a button on the user interface, activating the phone by voice command, or other initiating mechanism. When the phone call has ended, the user may press a button or activate another control, disconnecting the telephone and resuming listening to data from the primary source.

Whether or not the wearer has the ability to prevent a priority, secondary source **604** from interrupting the primary source **602** may be configured based upon the user environment. For example, in a commercial or industrial environment, the primary source **602** may include an mp3 player, and the secondary source **604** may include a paging system, or telephone intercom system. In such embodiment, a wearer of a wearable electronic interface **601**, such as a production-line worker, security guard, office employee, etc., may use the wearable electronic interface **601** to listen to mp3 audio or other entertainment. However, when a caller, such as a supervisor, a customer, or other priority individual attempts to contact the wearer via the secondary source **604**, the wearable electronic interface **601** automatically accepts the incoming communication request, and allows the caller to communicate with the wearer as discussed herein.

At step **630**, the selector **610** changes the input to the wearable electronic interface **601** from the primary source **602** to the secondary source **604** to facilitate communication between the wearer of the wearable electronic interface **601** and the caller.

The method **620** then continues to step **632**, where the telephone call between the wearer and caller occurs. During this step **632**, the selector **610** provides audio received from the secondary source **604** (e.g., the cellular telephone) to the audio output **612** (e.g., speakers) of the wearable electronic interface **601**, and provides audio received from the audio input **616** (e.g., microphone) of the wearable electronic interface **601** to the secondary source **604**.

At step **634** the telephone call is terminated, and the method **620** returns to step **622**. At step **622**, the wearable electronic interface **601** resumes mp3 audio playback as was occurring prior to receiving the telephone call from the secondary source **604**.

With reference to FIGS. **10-12**, a modification of the audio device **10**C is illustrated therein and identified generally by the reference numeral **10**D. The components of the audio device **10**D which are the same as the components in the audio devices **10**, **10**A, **10**B, and **10**C are identified with the same reference numerals, except that a letter "D" has been added.

In the audio device **10**D, the microphone **124**D can be disposed in the frame **42**D. In particular, the microphone **124**D can be disposed in the bridge portion **52**D. Alternatively, the microphone **124**D can be disposed along a lower edge of the right orbital **50**D, this position being identified by the reference numeral **124**D'. Further, the microphone could be positioned in a lower edge of the left orbital **48**D, this position being identified by the reference numeral **124**D". Optionally, two microphones can be disposed on the frame **42**D at both the positions **124**D' and **124**D". Similarly to the microphone **75**, the microphones **124**D', **124**D" preferably are positioned so as to face toward the user. Thus, the microphones **124**D', **124**D" can be protected from wind and noise. The microphones **124**D, **124**D', **124**D" can also be constructed in accordance with any of the forms of the microphone **75** discussed above with reference to FIGS. **4**A, **4**B, **5**A, **5**B.

With reference to FIG. **12**, the interface device **110**D can be disposed in one of the ear stems **54**D, **56**D. Optionally, the components of the interface device **110**D can be divided with some of the components being in the ear stem **54**D and the remaining components in the ear stem **56**D, these components being identified by the reference numeral **110**D'. Preferably, the components are distributed between the ear stems **54**D, **56**D so as to provide balance to the device **10**D. This is particularly advantageous because imbalanced headwear can cause muscle pain and/or headaches. Thus, by distributing components of the interface device **110**D between the ear stems **54**D, **56**D, the device **10**D can be better balanced.

In one arrangement, the transceiver **114**, interface **116**, and the antenna **118** can be disposed in the left ear stem **54**D with the battery **112** being disposed in the right ear stem **56**D. This arrangement is advantageous because there are numerous standard battery sizes widely available. Thus, the devices within the ear stem **54**D can be balanced with the appropriate number and size of commercially available batteries disposed in the ear stem **56**D.

In another arrangement, the lenses **44**D, **46**D can include an electronic variable light attenuation feature, such as, for example, but without limitation, a dichroic dye guest-host device. Additionally, another user operable switch (not shown) can be disposed in the ear stem **56**D. Such a user operable switch can be used to control the orientation, and thus the light attenuation provided by, the dichroic dye.

Optionally, a further power source (not shown) for the dichroic dye guest-host device can also be disposed in the ear stem **56**D. For example, the rear portion **162** of ear stem **56**D can comprise a removable battery. Such a battery can provide a power source for controlling the orientation of the dichroic dye in the lenses **44**D, **46**D. In this modification, the additional user operable switch disposed in the ear stem **56**D can be used to control the power from the battery supplied to the lenses **44**D, **46**D.

The appropriate length for the antenna **118**D is determined by the working frequency range of the transceiver **114**. Typically, an antenna can be approximately 0.25 of the wave length of the signal being transmitted and/or received. In one illustrative non-limiting embodiment, such as in the BLUETOOTH™ standard, the frequency range is from about 2.0 gigahertz to 2.43 gigahertz. For such a frequency range, an antenna can be made with a length of approximately 0.25 of the wavelength. Thus, for this frequency range, the antenna can be approximately 1 inch long.

With reference to FIG. **12**, the antenna can be formed at a terminal end of one of the ear stems **54**D, **56**D. In the illustrated embodiment, the antenna **118**D is disposed at the terminal end of the left ear stem **54**D.

In this embodiment, approximately the last inch of the ear stem **54**D is used for the antenna **118**D. The antenna **118**D can be made of any appropriate metal. The antenna can be connected to the transceiver **114** with a direct electrical connection, an inductive connection, or a capacitive connection.

With reference to FIG. **13**, an inductive type connection is illustrated therein. As shown in FIG. **13**, the antenna **118**D comprises an inner conductive rod **140** and a coil **142** wrapped helically around the rod **140**. The coil **142** is connected to the transceiver **114** in a known manner.

The ear stems **54**D, **56**D can be made from a conductive metal material. Where metal is used, near the terminal end of the ear stem **54**D, the metal material is reduced relative to the outer surface of the stem **54**D. The coil member is wrapped

around the rod **140** and an insulative material **144** is disposed over the coil **142** so as to be substantially flush with the remainder of the ear stem **54**D. Thus, the smooth outer appearance of the ear stem **54**D is maintained, without comprising the efficiency of the antenna **118**D.

With reference to FIG. **14**, a modification of the antenna **118**D is illustrated therein and identified by the reference numeral **118**D'. Components of the antenna **118**D' which were the same as the antenna **118**D illustrated in FIG. **13**, have been given the same reference numeral, except that a "'" has been added.

The antenna **118**D' and the stem **54**D includes a thin outer layer **146** of a metal material. As known in the antenna arts, it is possible to dispose a thin layer of metal over an antenna without destroying the antenna's ability to transmit and receive signals. This design is advantageous because if the device **10**D is constructed of a metal material, including metal such as, for example, without limitation, sintered titanium or magnesium, the thin outer layer **146** can be formed of this material so that the appearance of the device **10**D is uniform.

Where the stem **54**D is made from a metal material, the antennas **118**D, **118**D' illustrated in FIGS. **13** and **14** provide an additional advantage in that electrons in the ear stem **54**D can be excited by the signal applied to the coil **142**. Thus, the ear stem **54**D itself becomes part of the antenna **118**D, **118**D', and thus can provide better range and/or efficiency for the transmission and reception of signals. Furthermore, if the ear stem **54**D is electrically coupled to the frame **42**D, the frame **42**D would also become excited in phase with the excitations of the antenna **118**D, **118**D'. Thus, the ear stem **54**D and the frame **42**D would effectively become part of the antenna, thereby allowing transmission and reception from two sides of the head of the user.

Optionally, the ear stem **56**D could also be electrically coupled to the frame **42**D. Thus, the stem **56**D would also become part of the antenna **118**D, **118**D', thereby allowing transmission and reception of signals on three sides of the user's head. Thus, where at least a portion of a frame of an eyeglass is used as the antenna for the wireless transceiver **114**, the audio device benefits from enhanced antenna efficiency.

Optionally, the antenna **118**D, **118**D' can be isolated from the remainder of the stem **54**D via an insulator **146**, thereby preventing interference between the antenna and other devices on the audio device **10**D. As such, the remainder of the device **10**D can be made from any material, such as, for example, but without limitation, a polymer.

Preferably, the audio device **10**D includes a user interface device **150** configured to transmit user input signals to the interface **116** and/or the transceiver **114**. In the illustrated embodiment, the user interface device **150** is in the form of a 3-way button. The 3-way button **152** is configured to have three modes of operation. Firstly, the button **152** is mounted to pivot about a rocker axis **154**. Thus, in one mode of operation, the button **152** can be depressed inwardly on a forward end **156** of the button **152**, thereby causing the button **152** to pivot or "rock" about the pivot axis **154**. Additionally, the button **152** can be pressed at a rearward end **158**, thereby causing the button **152** to pivot about the pivot axis **154** in the opposite direction. Additionally, the button **152** can be mounted so as to be translatable in the medial-lateral direction, identified by the reference numeral **160** (FIG. **11**). Appropriate springs can be provided beneath the button **152** to bias the button in an outward protruding and balanced position. Appropriate contacts can be mounted beneath the button **152** so as to be activated individually according to the modes of operation.

In one illustrative and non-limiting embodiment, the button **152** can be used to control volume. For example, by pressing on the forward portion **156**, a contact can be made causing the transceiver **114** or the interface **116** to increase the volume of the speakers **14**D, **16**D. Additionally, by pressing on the rearward portion **158** of the button **152**, the transceiver **114** or interface **116** could lower the volume of the speakers **14**D, **16**D.

In a further illustrative and non-limiting example, the medial-lateral movement of the button **152**, along the directions identified by the arrow **160**, can be used to choose different functions performed by the transceiver **114** or the interface **116**. For example, an inward movement of the button **152** could be used to answer an incoming phone call where the audio device **10**D is used as an audio interface for a cellular phone.

Optionally, the power source **112** can comprise portions of the ear stems **54**D, **56**D which have been formed into batteries. For example, the rear portions **160**, **162** of the ear stems **54**D, **56**D, respectively, can be in the form of custom made batteries, either disposable or rechargeable. Preferably, the rear portions **160**, **162** are removable from the forward portions of the ear stems **54**D, **56**D. This provides a particular advantage in terms of balance. As noted above, imbalanced loads on the head can cause muscular pain and/or headaches. In particular, excessive pressure on the nose can cause severe headaches. Additionally, batteries can have a significantly higher mass density than plastic and lightweight metals, such as sintered titanium or magnesium. Thus, by constructing the rearward portions **160**, **162** of the ear stems **54**D, **56**D of batteries, the weight of these batteries can improve forward-rearward balance of the audio device **10**D in that the weight of the interface device **110** can be offset by the batteries. In another embodiment, the ear stems **54**D, **56**D can define a housing for removable batteries.

The audio device **10**D can also include power contacts **164** for recharging any rechargeable batteries connected thereto. For example, the power contacts **164** can be disposed on a lower edge of the orbitals **48**D, **50**D. Thus, with an appropriate recharging cradle (not shown), the audio device **10**D can be laid on the cradle, thereby making contact between the power contacts **164** and corresponding contacts in the cradle (not shown). Alternatively, power contacts can be provided in numerous other locations as desired. For example, the power contacts **164** can be disposed at the ends of the ear stems **54**D, **56**D. A corresponding cradle can include two vertically oriented holes into which the ear stems are inserted for recharging. In this configuration, the lens within the orbitals **48**D, **50**D would face directly upwardly.

In another alternative, the power contacts **164** are disposed on the upper edges of the orbitals **48**D, **50**D. In this configuration, the audio device **10**D is laid in a cradle in an inverted position, such that the contacts **164** make electrical contact with corresponding contacts in the cradle. This position is advantageous because it prevents weight from being applied to the supports **28**D, **30**D. This prevents misalignment of the speakers **14**D, **16**D.

With reference to FIGS. **8**, **9**A, and **9**B, in another embodiment, the audio device **10**C is advantageously adapted to support any of a variety of portable electronic circuitry or devices which have previously been difficult to incorporate into conventional headsets due to bulk, weight or other considerations. For example, but without limitation, the electronics are digital or other storage devices and retrieval circuitry such as for retrieving music or other information from MP3 format memory or other memory devices. The audio device **10**C can carry any of a variety of receivers and/or transmitters,

such as transceiver **114**. For example, but without limitation, the audio device **10**C can carry receivers and/or transmitters for music or for global positioning. In another example, the audio device **10**C can carry receivers and/or transmitters for telecommunications (e.g., telecommunications devices). As used herein, the term "telecommunications devices" is intended to include telephone components as well as devices for communicating with a telephone. For example, "telecommunications devices" can include one or more transceivers for transmitting an audio signal to a cellular phone to be transmitted by the cellular phone as the speaker's voice, and/or for receiving an audio signal from a cellular phone representing a caller's voice. Of course, other audio, video, or data signals can be transmitted between the audio device **10** C and such a cellular phone through such transceivers.

In other embodiments, drivers and other electronics for driving heads-up displays, such as liquid crystal displays or other miniature display technology can also be carried by the audio device **10**C. The power source **112** can be carried by the audio device **10**C. For example, without limitation, the power source **112** can advantageously be replaceable or rechargeable. Other electronics or mechanical components can additionally be carried by the audio device **10**C. In other embodiments, the audio device **10**C can also be utilized solely to support any of the foregoing or other electronics components or systems, without also supporting one or more lenses in the wearer's field of view. Thus, in any of the embodiments of the audio devices disclosed herein, the lenses and/or lens orbitals can be omitted as will be apparent to those of skill in the art in view of the disclosure herein.

In another embodiment, a further modification of the audio devices **10**, **10**A, **10**B, **10**C, and **10**D is provided wherein the audio devices include at least two banks of microphones, with one bank acting as a speaker of received and one bank providing an ambient noise-cancellation function. The microphone banks can be positioned at any suitable location or combination of locations (e.g., on the audio device, within the audio device, opposing sides of the audio device, or the like). In one embodiment, automatic switching of the speaking-microphone and noise-canceling-microphone banks' functions advantageously enhances ease of use. In a further embodiment, the microphone banks can be arranged in an array to be used in conjunction with algorithms to discern, reduce, and/or eliminate noise for the purpose of voice recognition. For example, in one embodiment, such microphone banks can include ASIC-based noise-canceling technology, such as is available in chips from Andrea Electronics Corporation (AEC), to enable voice recognition in ambient noise up to about 130 Db or more. In another embodiment, microphone banks can be arranged in any suitable combination of linear or non-linear arrays to be used in conjunction with algorithms to discern, reduce, and/or eliminate noise in any suitable manner. In another embodiment, audio/proximity sensors can advantageously trigger the appropriate functionality in a specific bank. In another embodiment, a noise-canceling microphone can be provided in connection with a cord or other microphones described above. For example, without limitation, a series of miniature microphones can be supported down a cord from the audio device, separated by desired distances, and aimed in different directions. In another implementation, one or more of the microphones can be for verbal input from the user, and one or more others of the microphones, or the same microphone, can also be for noise-cancellation purposes.

With reference to FIGS. **8**, **9**A, and **9**B, in another embodiment, the transceiver **114** is adapted to employ a wide variety of technologies, including wireless communication such as RF, IR, ultrasonic, laser or optical, as well as wired and other communications technologies. In one embodiment, a body-LAN radio is employed. Other embodiments can employ a flexible-circuit design. Many commercially available devices can be used as transceiver **114**. For example, without limitation, Texas Instruments, National Semiconductor, Motorola manufacture and develop single RF transceiver chips, which can use, for example, 0.18 micron, 1.8 V power technologies and 2.4 GHz transmission capabilities. Of course, a variety of transceiver specifications are available and usable, depending on the particular embodiment envisioned. In another implementation, other commercially available products operating at 900 MHz to 1.9 GHz or more can be used. Data rates for information transfer to wearable or other type computing devices will vary with each possible design. In a preferred implementation, a data rate is sufficient for text display. RF products, and other products, ultimately will be capable of updating a full-color display and have additional capabilities as well. Thus, heads-up displays, such as liquid crystal displays or other miniature display technology described above can be employed.

In another embodiment, a further modification of the audio devices **10**, **10**A, **10**B, **10**C, and **10**D is provided wherein the audio devices can include and/or communicate with a variety of sensors, including but not limited to motion, radar, heat, light, smoke, air-quality, oxygen, CO and distance. Medical monitoring sensors are also contemplated. Sensors can be directed inwardly toward the user's body, or outwardly away from the body (e.g., sensing the surrounding environment). Sensors in communication with the audio devices also can be strategically positioned or left behind to facilitate the communication of sensed information. For example, a firefighter entering a burning building can position sensor to communicate the smoke and heat conditions to that firefighter and to others at the sensor-drop location. Remote sensors can also be relatively fixed in position, as in the case of a maintenance worker wearing an audio device that receives various signals from sensors located in machines or other equipment for which the worker is responsible. A blind wearer of audio device can employ a distance sensor to determine distance to surrounding objects, for example, or a GPS unit for direction-finding. Other exemplary sensing capabilities are disclosed on one or more of the following, all of which are incorporated by reference herein: U.S. Pat. No. 5,285,398 to Janik, issued Feb. 9, 1994; U.S. Pat. No. 5,491,651 to Janik, issued Feb. 13, 1996; U.S. Pat. No. 5,798,907 to Janik, issued Aug. 25, 1998; U.S. Pat. No. 5,581,492 to Janik, issued Dec. 3, 1996; U.S. Pat. No. 5,555,490 to Carroll, issued Sep. 10, 1996; and U.S. Pat. No. 5,572,401 to Carroll, issued Nov. 5, 1996.

With reference to FIGS. **15** and **16**, a further modification of the audio devices **10**, **10**A, **10**B, **10**C, and **10**D, is illustrated therein and identified generally by the reference numeral **10**E. Components that are similar or the same as the components of the audio devices **10**, **10**A, **10**B, **10**C, and **10**D, have been given the same reference numerals, except that a "E" has been added thereto.

The audio device **10**E includes a microphone boom **180** extending downwardly from the lower end of the support arm **100**E. The microphone **124**E is disposed at the lower end of the microphone boom **180**.

In the illustrated embodiment, the audio device **10**E can include the interface device **110**E at an upper portion of the stem **96**E. In particular, the interface device **110**E can be disposed at the point at which the support arm **100**E connects to the stem **96**E. Optionally, certain components of the inter-

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face device **110**E can be disposed at a rear portion of the stem **96**E, this position being identified by the reference numeral **110**E'.

In this embodiment, the antenna **118**E can be disposed in the frame **82**E, the stem **96**E, the support arm **100**E, or the microphone boom **180**E. However, as noted above, it is preferable that at least a portion of the support **12**E is used as the antenna. More preferably, the support **12**E is made from a metal material, such that at least a portion of the support **12**E is excited by the antenna and thereby forms part of the antenna.

The transceiver **114** can be in the form of a digital wireless transceiver for one-way or two-way communication. For example, the transceiver **114** can be configured to receive a signal from another transmitter and provide audio output to the speakers **14**, **14**A, **14**B, **14**C, **14**D, **14**E, **16**, **16**A, **16**B, **16**C, **16**D, **16**E. Alternatively, the transceiver **114** can be configured to receive an analog audio signal from microphone **75**, **124**, **124**D, **124**E, convert the signal to a digital signal, and transmit the signal to another audio device, such as, for example, but without limitation, a cell phone, a palm top computer, a laptop computer or an audio recording device.

The over-the-head configuration of the audio device **10**E advantageously allows distribution of the load across a wearer's head, as well as positioning of relatively bulky or heavy electronics along the length of (e.g., inside) the audio device **10**E or at the posterior aspect of the audio device **10**E such as at the occipital end of the audio device **10**E. This enables the audio device **10**E to carry electronic equipment in a streamlined fashion, out of the wearer's field of view, and in a manner which distributes the weight across the head of the wearer such that the eyewear tends not to shift under the load, and uncomfortable pressure is not placed upon the wearer's nose, ears or temple regions.

In this embodiment, additional functional attachments may be provided as desired anywhere along the length of the frame, lenses or orbitals of the audio device **10**E. For example, earphones may be directed towards the wearer's ear from one or two earphone supports extending rearwardly from the front of the eyeglass, down from the top of the audio device **10**E or forwardly from the rear of the audio device **10**E. Similarly, one or more microphones may be directed at the wearer's mouth from one or two microphone supports connected to the orbitals or other portion of the audio device **10**E.

With reference to FIGS. **17** and **18**, a communication protocol between the audio device S, B and the transceiver **114** is described. In this embodiment, the transceiver **114** is configured for one-way communication. The transceiver includes a receiver and decoder **202** and a digital-to-audio converter **204**.

As noted above with reference to FIG. **8**, the audio device S, B can be any one of a number of different audio devices. For example, but without limitation, the audio device S, B can be a personal audio player such as a tape player, a CD player, a DVD player, an MP3 player, and the like. Alternatively, where the transceiver **114** is configured only to transmit a signal, the audio device S, B can be, for example, but without limitation, an audio recording device, a palm top computer, a laptop computer, a cell phone, and the like.

For purposes of illustration, the audio device S, B will be configured only to transmit a signal to the transceiver **114**. Thus, in this embodiment, the audio device S, B includes an MP3 player **206** and an encoder and transmitter **208**. An antenna **210** is illustrated schematically and is connected to the encoder and transmitter **208**. As an illustrative example, the MP3 player **206** outputs a signal at 128 kbps (NRZ data). However, other data rates can be used. The encoder and transmitter **208** is configured to encode the 128 kbps signal from the MP3 player and to transmit it through the antenna **210**. For example, the encoder and transmitter **208** can be configured to transmit the encoded signal on a carrier signal centered on 49 MHz.

The receiver and decoder **202** can be configured to receive the carrier signal of 49 MHz through the antenna **118**, decode the digital signal, and transmit the digital signal to the digital-to-audio converter **204**. The digital-to-audio converter **204** can be connected to the speakers **14**,**16** and thereby provide an audio output that is audible to the user.

With reference to FIG. **18**, the 128 kbps signal from the MP3 player **206** is identified by the reference numeral **212**. In one embodiment, the encoder and transmitter **208** can be configured to encode the signal **212** from the MP3 player **206**. The encoded signal from the encoder and transmitter **208** is identified by reference numeral **216**.

The encoder and transmitter **208** can be configured to encode each pulse **214** of the signal **212** into a pattern of pulses, one pattern being identified by the reference numeral **218**.

In the lower portion of FIG. **18**, signal **220** represents an enlarged illustration of the portion of the signal **216** identified by a circle **222**. As shown in FIG. **18**, the pattern **218** is comprised of a series of 50 MHz and 48 MHz signals.

With reference to FIG. **19**, a more detailed illustration of the transceiver **114** is illustrated therein. As shown in FIG. **19**, the transceiver includes a preamplifier **230**, a band pass filter **232**, and an amplifier **234** connected in series. The preamplifier **230** and the amplifier **234** can be of any known type, as known to those of ordinary skill in the art. The band pass filter **232**, in the present embodiment, can be constructed as a band pass filter that allows signals having a frequency from 48 MHz to 50 MHz, inclusive, to pass therethrough. Alternatively, the band pass filter **232** can include three band pass filters configured to allow frequencies centered on 48 MHz, 49 MHz, and 50 MHz, respectively, pass therethrough.

The transceiver **114** also includes a signal detector **236** and a system clock circuit **238**. The signal detector **236** comprises three signal detectors, e.g., a 49 MHz detector **240**, a 48 MHz detector **242** and a 50 MHz detector **244**. The 49 MHz detector **240** is connected to a carrier detector **246**. As is schematically illustrated in FIG. **19**, when the signal detector **236** detects a 49 MHz signal, which corresponds to a state in which no audio signal is being transmitted from the MP3 player **206**, the carrier detector **246** causes the transceiver **114** to enter a sleep mode, schematically illustrated by the operation block **248**.

As the detectors **242**, **244** detect 48 MHz and 50 MHz detectors, respectively, they output signals to a spread spectrum pattern detector **250**. The spread spectrum pattern detector outputs a corresponding signal to a serial-to-parallel converter **252**. The output of the serial-to-parallel converter **252** is output to a digital-to-analog converter **204**. A "class D" audio amplifier (not shown), for example, but without limitation, can be connected to the output of the digital-to-audio converter **204** to thereby supply an audio signal to the speakers **14**, **14**A, **14**B, **14**C, **14**D, **14**E, **16**, **16**A, **16**B, **16**C, **16**D, **16**E. It is to be noted that the encoding performed by the encoder and transmitter **208** can be in accordance with known signal processing techniques, such as, for example, but without limitation, CDMA, TDMA, FDM, FM, FSK, PSK, BPSK, QPSK, M-ARYPSK, MSK, etc. In this embodiment, the transceiver **114** can operate with a single channel.

With reference to FIG. **20**, a dual channel transceiver **114***i* is schematically illustrated therein. In this modification, the

transceiver **114***i* is configured to simultaneously receive two signals, one signal centered on 46 MHz, and a second signal centered on 49 MHz. Thus, the transceiver **114***i* includes four band-pass filters. The first filter **253** is configured to allow a signal at 45.9 MHz plus or minus 100 kHz to pass therethrough. A second filter **254** is configured to allow signals at 46.1 MHz plus or minus 100 kHz to pass therethrough. The third filter **255** is configured to allow signals at 48.9 MHz plus or minus 100 kHz to pass therethrough. A fourth filter **256** is configured to allow signals at 49.1 MHz plus or minus 100 kHz to pass therethrough. As such, the transceiver **114** can receive two simultaneous signals, as noted above, one being centered at 46 MHz and one being centered at 49 MHz. Thus, this modification can be used to receive two audio signals simultaneously, for example, left and right signals of the stereo audio signal.

Each of the transceivers **114**, **114***i*, illustrated in FIGS. **17-20**, can be configured to receive one pattern **218**, a plurality of different signals **218** or only one unique pattern **218**. Additionally, as known in the art, the transceiver **114** or **114***i* and the encoder **208** can include pseudo random generators which vary the pattern **218** according to a predetermined sequence. Thus, the receiver and decoder **202** can be configured to auto synchronize by recognizing a portion of the predetermined sequence.

In an application where the transceiver **114** operates according to the BLUETOOTH™ standards, the transceiver **114** communicates with the transmitter according to a spread spectrum protocol so as to establish communication in a short range wireless environment with the minimal risk of interference with other devices. For example, the transceiver **114** can communicate with a BLUETOOTH™ enabled MP3 player, or other audio device. The audio device **10**C can receive the output signal from the BLUETOOTH™ enabled MP3 player, and then output the audio signals to the interface **116**. Optionally, the signal can be a stereo signal. The interface **116** can then direct the left and right audio signals to the speakers **14**, **14**A, **14**B, **14**C, **14**D, **14**E, **16**, **16**A, **16**B, **16**C, **16**D, **16**E through the speaker lines **120**, **122**.

In accordance with the BLUETOOTH™ standard, for example, but without limitation, the transceiver **114** can operate in a half duplex mode in which signals are transmitted in only one direction. For example, at any one moment, the transceiver **114** can only either receive signals and direct them to the speakers **14**, **14**A, **14**B, **14**C, **14**D, **14**E, **16**, **16**A, **16**B, **16**C, **16**D, **16**E or transmit signals, for example, from the microphone **75**, **124**, **124**D, **124**E to another device through the antenna **118**, **118**D, **118**D'. Alternatively, the transceiver **114** can be configured to operate in a full duplex mode in which simultaneous of audio signals are received and transmitted to the speakers **14**, **14**A, **14**B, **14**C, **14**D, **14**E, **16**, **16**A, **16**B, **16**C, **16**D, **16**E and simultaneously audio signals from the microphone **75**, **124**, **124**D, **124**E are transmitted through the antenna **118**, **118**D, **118**D' to a cooperating wireless device.

Further, the interface **116** can include a processor and a memory for providing added functionality. For example, the interface **116** can be configured to allow a user to control the cooperating wireless device, such as a cell phone. In an illustrative, non-limiting embodiment, where the transceiver **114** is a BLUETOOTH™ device, the interface **116** can be configured to support a hands-free protocol, as set forth in the BLUETOOTH™ hands-free protocol published Oct. 22, 2001, the entire contents of which is hereby expressly incorporated by reference. Optionally, the interface **116** can be configured to comply with other protocols such as, for example, but without limitation, general access profile, service discovery application profile, cordless telephony profile, intercom profile, serial port profile, headset profile, dialup networking profile, fax profile, land access profile, generic object exchange profile, object push profile, file transfer profile, and synchronization profile, published Oct. 22, 2001, the entire contents of each of which being hereby expressly incorporated by reference. Additionally, the "Specification of the Bluetooth System, Core", version 1.1, published Feb. 22, 2001 is hereby expressly incorporated by reference.

The headset profile is designed to be used for interfacing a headset having one earphone, a microphone, and a transceiver worn by the wearer, for example, on a belt clip, with a cordless phone through a wireless connection. According to the headset profile, certain commands can be issued from a headset, such as the audio devices **10**, **10**A, **10**A', **10**B, **10**C, **10**D, and **10**E, using an AT command protocol. In such a protocol, text commands must be input to the BLUETOOTH™ device, which the BLUETOOTH™ device then transmits wirelessly to a synchronized BLUETOOTH™ enabled device. Such commands include, for example, but without limitation, initiating a call, terminating a call, and redialing a previously dialed number.

With reference to FIG. **9**A, the interface electronics **116** can include audio or aural menus that can be selected by user. For example, a user can initiate an audio menu by depressing the button **150** (FIGS. **10-12**). Upon initiation of the audio menus, the interface electronics **116** can send an audio signal to the speakers **14**, **14**A, **14**B, **14**C, **14**D, **14**E, **16**, **16**A, **16**B, **16**C, **16**D, **16**E including a humanoid voice. The voice signal can indicate that a first menu option is available. For example, but without limitation, the first menu choice can be to initiate a call. Thus, when the user pushes the button **150** the first time, the user will hear the words "initiate a call," emanating from the speakers **14**, **14**A, **14**B, **14**C, **14**D, **14**E, **16**, **16**A, **16**B, **16**C, **16**D, **16**E. If the user wishes to initiate a call, the user can depress the button **150** again which will send the appropriate AT command to the transceiver **114** so as to transmit the proper AT code to the cellular phone source device S, B (FIG. **8**).

The user can be provided with further convenience if there are other menu choices available, for example, if the user does not wish to choose the first menu option, the user can depress either the forward or rearward portions **156**, **158** of the button **150** so as to "scroll" through other audio menu options. For example, other audio menu options can include, for example, but without limitation, phonebook, email, clock, voice commands, and other menu options typically available on cellular phones and/or personal audio devices such as MP3 players.

As an illustrative, but non-limiting example, if a user wishes to access the phonebook, the user can depress the button **150** to initiate the audio menu, then "scroll" to the phonebook by depressing the portions **156** or **158** until the user hears the word "phonebook" in the speakers **14**, **14**A, **14**B, **14**C, **14**D, **14**E, **16**, **16**A, **16**B, **16**C, **16**D, **16**E. Once the user hears the word "phonebook," the user can depress the button **150** again to enter the phonebook. Thereafter, the user can depress the portions **156**, **158** to "scroll" through phonebook entries. As the user scrolls through the phonebook entries, the interface **116** can be configured to cause the cellular phone to scroll through the phonebook and thereby transmit an audio signal of a humanoid voice indicating entries in the phonebook. When the user hears the name of the person or entity which the user desires to call, the user can again push the button **150** to initiate a call to that entity.

In this embodiment, the cell phone can be configured with a text-to-voice speech engine which generates a humanoid

voice corresponding to entries of the phonebook. Such speech engines are known in the art and are not described further herein.

A text-to-speech engine can provide further convenient uses for a user. For example, if the cell phone or other source device is configured to receive email, the device can be configured to signal the user with an audio signal that an email has been received. The user can send a signal to the source device so as to open the email. The text-to-speech engine can be configured to read the email to the user. Thus, a user can "listen" to email through the audio device **10**, **10**A, **10**A', **10**B, **10**C, **10**D, **10**E, without manually operating the source device.

A further option is to allow a user to respond to such an email. For example, the user could record an audio file, such as, for example, but without limitation a .WAV, .MP3 file as an attachment to a reply email. For such a feature, the interface **116** can be configured to automatically provide a user with options at the end of an email that is read to the user. For example, after the text-to-speech engine finishes "reading" the email to the user, the interface device **116** can enter another audio menu. Such an audio menu can include a reply option, a forward option, or other options. If a user wishes to reply, the user can "scroll" until the user hears the word "reply." Once the user hears the word "reply" the user can depress the button **150** to enter a reply mode. As noted above, these types of commands can be issued using an AT command protocol, to which the source device will also be configured to respond. As noted above, one audio menu option can include voice command. For example, when a user chooses the voice command option, the interface electronic **116** can reconfigure to send an AT command to the source device, such as a cellular phone, to accept voice commands directly from the transceiver **114**. Thus, as the user speaks, the audio signal is directed to the source device, which in turn is configured to issue audio indicators back to the user, through the speakers **14**, **14**A, **14**B, **14**C, **14**D, **14**E, **16**, **16**A, **16**B, **16**C, **16**D, **16**E, to guide the user through such a voice command.

For example, if a user chooses a voice command option, the user could issue commands such as, for example, but without limitation, "phonebook" or "call alpha." With a source device such as a cellular phone, that has a speech recognition engine and that is properly trained to recognize the voice of the user, the user can automatically enter the phonebook mode or directly call the phonebook listing "alpha," of course, as is apparent to one of ordinary skill in the art, such a voice command protocol could be used to issue other commands as well.

In another alternative, the interface electronics **116** can include a speech recognition engine and audio menus. In this alternative, the interface electronics **116** can recognize speech from the user, convert the speech to AT commands, and control this source device using a standard AT command protocol.

For example, but without limitation, the source device B can be in the form of a palm-top or hand-held computer known as a BLACKBERRY™. The presently marketed BLACKBERRY™ devices can communicate with a variety of wireless networks for receiving email, phone calls, and/or internet browsing. One aspect of at least one of the present inventions includes the realization that such a hand-held computer can include a text-to-speech engine. Thus, such a hand-held computer can be used in conjunction with any of the audio devices **10**, **10**A, **10**A', **10**B to allow a user to "hear" emails, or other text documents without the need to hold or look at the device B. Preferably, the hand-held computer includes a further wireless transceiver compatible with at least one of the transceivers **114**, **114***i*. As such, a user can use any of the audio devices **10**C, **10**D, **10**E to "hear" emails, or other text documents without the need to hold or look at the device B. Thus, a presently preferred hand-held computer, as a non-limiting example, includes a BLACKBERRY™ hand-held device including long range wireless network hardware for email and internet browsing capability, a BLUETOOTH™ transceiver for two-way short range audio and/or data audio communication, and a text-to-speech engine.

Preferably, the transceiver **114** is configured to transmit signals at about 100 mW. More preferably, the transceiver **114** is configured to transmit signals at no more than 100 mW. As such, the transceiver **114** uses less power. This is particularly advantageous because the power source **112** can be made smaller and thus lighter while providing a practicable duration of power between charges or replacement of the power source **112**.

An audio network **300** in accordance with another embodiment of the present invention is illustrated in FIG. **21**. Audio network **300** includes a content source **302** coupled to an audio device **304** via communications link **306**. The content source **302** is any of a variety of information sources, including, but not limited to, radio stations and/or signals, a satellite radio source, a computer, a network, a storage device, such as a hard drive, a memory card, or a USB (Universal Serial Bus) drive, an audio component (e.g., a stereo receiver, a CD player, a tuner, an MP3 player, a digital audio player, etc.), a database, and/or a communications-enabled device, such as a telephone (including a BLUETOOTH enabled telephone), a PDA, a BLACKBERRY, the Internet, or the like. The content provided by the content source **302** may be any of a variety of information, including but not limited to, audio files, entertainment, news, media, music, photos, videos, advertising, etc.

The audio device **304** may be any of the audio devices described above with respect to FIGS. **1**-**19**, or may include any of the audio devices described below. In one embodiment, audio device **304** is electronically enabled eyewear, as discussed herein. Audio device **304** is coupled to content source **302** via communications link **306**. Communications link **306** may be any of a variety of information conduits known to those of skill in the art, including: a cable, a wire, a conductor, a bus, an RF signal, a radio signal, a satellite signal, a BLUETOOTH signal, etc. In one embodiment, the communications link **306** includes a USB, mini-USB, USB-to-mini-USB, FIREWIRE, IEEE 1394, RS232, SCSI, or any other cable. In one embodiment, the communications link **306** is temporarily attached to the audio device **304** for the transfer of content from the content source **302** to the audio device **304**. In another embodiment, the communications link **306** is a retractable cable mounted at least partially inside of the audio device **304**.

In one embodiment, the audio network **300** is configured for the downloading of music from the content source **302** (e.g., a user's computer) to the audio device **304**. In another embodiment, the audio network **300** is configured for the uploading of content stored within the audio device **304** to the content source **302**.

One embodiment of the audio device **304** is illustrated in FIG. **22**. Audio device **304** generally includes a data port **308**, data interface **310**, processor **312**, digital-to-analog converter **314**, speaker drivers **316**, and speakers **318**. In addition, audio device **304** generally also includes a control interface **320**, user controls **322**, display/indicator drivers **324**, display/indicators **326**, power module **328**, and memory module **330**; however, any one or more of these components may be combined. For example, in one embodiment, data interface **310**,

control interface **320**, display/indicator drivers **324**, digital-to-analog converter **314**, and speaker drivers **316** are combined with processor **312** into a single component.

Data port **308** is any of a variety of ports, connectors, jacks, interfaces, or receivers for wireless or wire-based coupling of audio device **304** with communications link **306**. For example, in one embodiment, data port **308** is a mini-USB connector. In other embodiments, the data port **308** may be, by way of example, a USB connector, a FIREWIRE connector, an IEEE 1394 cable connector, an RS232 connector, a JTAB connector, an antenna, a wireless receiver, a radio, an RF receiver, a BLUETOOTH receiver, or the like. Data port **308** generally includes an optional protective door (not illustrated) to protect the data port **308** from dirt, moisture, water, snow, etc., when the audio device **304** is disconnected from the communications link **306**.

In one embodiment, content is loaded from the content source **302** to the audio device **304** via the data port **308** at a data transfer rate. The data transfer rate will generally vary depending upon several factors, including the data port **308** selected, the content source **302**, and the communications link **306**. In one embodiment, the data transfer rate is about 1.5 Mbps (e.g., 10^6 bits per second). In other embodiments, the data transfer rate may be, by way of example, at least about 12 Mbps, 100 Mbps, 200 Mbps, 400 Mbps, 480 Mbps, or the like. In yet another embodiment, the data transfer rate is greater than about 100 Mbps, 200 Mbps, 400 Mbps, or 1000 Mbps. In another embodiment, the data transfer rate is less than about 100 Mbps, or 50 Mbps.

Data interface **310** couples data port **308** with processor **312**. In one embodiment, data interface **310** is a memory buffer for storing information or content received via data port **308** until it is processed by processor **312**. Processor **312** controls the overall function and operation of audio device **304**, and couples directly or indirectly to the various electronic components of the audio device **304**, as described herein. In one embodiment, processor **312** is a digital signal processor (DSP), firmware, microprocessor, microcontroller, field-programmable gate array (FPGA), and/or an application-specific integrated circuit (ASIC). Processor **312** may also be upgradeable. For example, in one embodiment, processor **312** is firmware, and software executable by the processor **312** may be changed, uploaded, downloaded, deleted, and/or modified.

In one embodiment the processor **312** is adapted to function as a digitized audio coder/decoder (CODEC). For example, the processor **312** may be a decoder, such as the STA013, STMP34xx, STMP35xx, or STMP13xx manufactured by SigmaTel. The processor **312** is generally capable of decoding variable bit rate, constant bit rate, or any other bit rate format of compressed digital audio files. In one embodiment, processor **312** is a 75 MHz DSP with an 18-bit sigma-delta digital-to-analog converter.

In other embodiments, processor **312** may process any of a variety of compressed and non-compressed digital audio formats, including but not limited to: Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Adaptive Differential Pulse Code Modulation (ADPCM), Advanced Audio Coding (AAC), RAW, Delta Modulation (DM), Resource Interchange File Format (RIFF), Waveform Audio (WAV), Broadcast Wave Format (BWF), Audio Interface/Interchange File Format (AIFF), Sun Audio (AU), SND, Compact Disc Audio (CDA), Moving Pictures Experts Group (MPEG), including MPEG-1, MPEG-2, MPEG-2.5, MPEG-4, MPEG-J, MPEG 2-ACC, and layers 1, 2, and 3 (e.g., MP3), MP3Pro, Audio Compression/Expansion (ACE), Macintosh Audio Compression/Expansion (MACE), including MACE-3 and MACE-6, Audio Code Number 3 (AC-3), Adaptive Transform Acoustic Coding (ATRAC), ATRAC3, Enhanced Perceptual Audio Coder (EPAC), Transform-Domain Weighted Interleave Vector Quantization (Twin VQ or VQF), Windows Media Audio (WMA), WMA with DRM, Digital Theatre Systems (DTS), DVD Audio, Super Audio Compact Disc (SACD), Transparent Audio Compression (TAC), SHN, OGG (including Ogg Vorbis, Ogg Tarkin, and Ogg Theora), Advanced Streaming Format (ASF), Liquid Audio (LQT), QDesign Music Codec (QDMC), A2b, Real Audio (including the .ra, .rm, and Real Audio G2 and RMX formats), Fairplay, Quicktime, Shockwave (SWF), Perfect Clarity Audio (PCA), or the like. Processor **312** may also be adapted to process not only existing digital audio formats, but also digital audio formats that may be developed in the future.

The processor **312** is generally able to process encoded, digitized audio data that has been encoded at a particular data encoding rate. For example, in one embodiment, the processor **312** decodes encoded audio data that has been encoded at a data encoding rate of about 8 kilobits per second (e.g., "kbps"). In other embodiments, processor **312** decodes encoded audio data that has been encoded at a data encoding rate of, by way of example, at least about 128 kbps, 160 kbps, 192 kbps, 256 kbps, or the like. In other embodiments, the processor **312** decodes encoded audio data that has been encoded at a data encoding rate of less than about 128 kbps, 160 kbps, 192 kbps, 256 kbps, or the like. In yet another embodiment, the processor **312** decodes encoded audio data that has been encoded at a data encoding rate of more than about 256 kbps.

In another embodiment, the processor **312** decodes encoded data at a decoding rate of about 8 kilobits per second ("kbps"). In other embodiments, the processor **312** decodes encoded data at a decoding rate of, by way of example, at least about 128 kbps, 160 kbps, 192 kbps, 256 kbps, or the like. In another embodiment, the processor **312** decodes encoded audio data at a decoding rate of less than about 128 kbps. In yet another embodiment, the processor **312** decodes encoded audio data at a decoding rate of more than about 256 kbps.

The digital-to-analog converter **314** is generally adapted to output an analog signal based upon an input digital signal. In one embodiment, the digital-to-analog converter **314** is an 8-bit digital-to-analog converter. In other embodiments, digital-to-analog converter **314** is, by way of example, a 16-bit, 24-bit, 32-bit, 64-bit digital-to-analog converter, or the like, although any number of bits may be used. In one embodiment, the digital-to-analog converter **314** is an 18-bit, sigma-delta digital-to-analog converter. The digital-to-analog converter **314** may be integrated with the processor **312**, or may be discrete from the processor **312**.

Speaker drivers **316** are generally amplifiers that amplify an analog signal received from the digital-to-analog converter **314** and send the amplified signal to the speakers **318**. Speakers **318** convert the signal received from the speaker drivers **316** to an audible signal that may be sensed by the user of the audio device **304**. In one embodiment, the speakers **318** are made from Mylar, but may be made from other materials, including: polypropylene, aluminum-coated polypropylene, aramid, graphite-injected polypropylene, honeycomb-laminate, kapton, kaladex, polybenzoxozole, polycarbonate, polyetherimide, pulp paper, silk, silver film, thermalum, urethane, and/or any other material familiar to those of skill in the art.

In one embodiment, the speakers **318** have an input impedance of about 16 Ohms. In other embodiments the speakers **318** have an input impedance of no greater than about 2, 4, 8, or 32 Ohms. In one embodiment, the input impedance is less

than about 16 Ohms, and in another embodiment it is greater than about 8 Ohms. In another embodiment, the input impedance is no less than about 100, 200, 400 or 600 Ohms. In one embodiment, the input impedance is about 300 Ohms or about 600 Ohms.

The control interface **320** generally includes a buffer, register, pre-processor, transistor, resistor and/or other electronic circuit to enable the processor **312** to receive commands from a user via the user controls **322**. In one embodiment, the control interface **320** is integrated with the processor **312**.

In one embodiment, the user controls **322** include a button, dial, switch, lever, sensor, touchpad, microphone, and/or any other input device that may be used by a user to control the audio device **304**. In one embodiment, the user controls **322** include a microphone that receives a voice command. The user controls **322** may be responsive to any biometric provided by a user to control the audio device **304**. For example, in one embodiment, the audio device **304** may monitor eye movement, and control the audio device **304** based upon blinking of the user's eyes.

In other embodiments, user controls **322** are used to perform any one or a combination of various functions with respect to an audio data file. For example, user controls **322** may be used to fast-forward, skip, cue, play, pause, turn power on or off, rewind, review, adjust volume, balance, tone, bass, or treble, randomize file selection, load a playlist, set a playlist, delete a playlist, repeat playback of all audio files, selected audio files, or a playlist, or perform any other function related to an audio data file.

The display/indicator drivers **324** are generally amplifiers or other drivers known to those of skill in the art, useful for driving or activating display/indicators **326**. In one embodiment, the display/indicator drivers **324** receive signals from the processor **312** and generate drive signals to turn on or off display elements of the display/indicators **326**. In one embodiment, the display/indicators **326** include an LED, LCD, light, tone, sound, beep, vibration, or other such display or indicator, or other indicators known to those of skill in the art. In one embodiment, the display/indicators **326** indicate a song selection, a power level, a volume, a remaining battery life, an artist, a song title, a time remaining during the playback of an audio file, a duration of an audio file's playback, or any other data related to an audio data file.

In one embodiment, the audio device **304** also includes a power module **328**, which provides power to the audio device **304**. The power module **328** is generally any device adapted to provide power, such as: a battery, a capacitor, a solar cell, solar paint, a fuel cell, and/or any other such device known to those of skill in the art. In one embodiment, the power module **328** distributes power to the various components of the audio device **304** via a conductor **332**, either directly or indirectly. In one embodiment, the power module **328** is a rechargeable battery, such as a lithium-ion polymer battery.

In one embodiment, the power module **328** is recharged via the data port **308**, and/or via an external charger (not shown). In one embodiment, the power module **328** has an input power rating of 5 Vdc at 150 mA, and a lifetime of 6 hours, although other input power ratings and lifetimes are possible. In one embodiment, the audio device **304** is able to play audio data files for at least about 4, 6, 8, 10, 12 hours, or more before the power module **328** is recharged. In one embodiment, the audio device **304** is able to play audio files for greater than about 6 hours before the power module **328** is recharged. In one embodiment, the power module **328** is able to be recharged in no more than about 3 hours, and reaches at least about 80% recharge in no more than about 1 hour. In one embodiment, the audio device **304** includes a power save function to conserve power consumption from the power module **328**. For example, in one embodiment, when the audio device **304** has not been activated by the user for a period of time, the audio device **304** enters a sleep state, or automatically turns itself off. In one embodiment, the audio device **304** turns itself off after about 5, 10, 20, or 40 minutes of non-use.

The audio device **304** may also include a memory module **330**, which in one embodiment stores audio data files. The memory module **330** may include any of a variety of electronic memory devices, including but not limited to, a hard drive, flash memory, RAM, ROM, EPROM, EEPROM, or PROM. In one embodiment, the memory module **330** includes NAND flash memory. In one embodiment, the memory module **330** includes at least about 128 MB. In other embodiments, the memory module **330** includes, by way of example, at least about 256 MB, 512 MB, or 1 GB of memory.

The memory module **330** may be permanently contained within the audio device **304**, or may be removable. For example, in one embodiment, the memory module **330** includes an SD memory card, a compact flash memory card, a USB drive, a MEMORYSTICK, SMARTSTICK, and/or any other removable memory device as is well known to those of skill in the art.

Conductors **332** generally provide direct or indirect electrical communication between the various components of the audio device **304**. In one embodiment, the conductors **332** include a data bus, power distribution network or a combination thereof. In one embodiment, the conductors **332** include a flexible printed circuit board (PCB), a conductive paint or coating, an Aricon fiber, or a Kevlar fiber. The PCB may be a multi-conductor PCB, and in one embodiment includes multiple conductors. In one embodiment, the PCB includes five conductors. In another embodiment, the conductors **332** include fiber dipped in or otherwise coated with a highly-conductive material, such as, for example, an aramid yarn or Kevlar fiber containing silver, or any other conductor known to those of skill in the art.

The conductors **332** may be embedded within the frame of the audio device **304** or applied to a surface of the audio device **304**. In another embodiment, the audio device **304** includes both embedded and surface-applied conductors **332**. In one embodiment, conductors **332** include conduits, such as conduits **73***ai*, **73***bi*, **274***i*, and **14**Ai', as illustrated above in FIG. **3**M. The conductors **332** may be embedded within the frame of the audio device **304** by extending through a channel, such as channel **316** illustrated in FIG. **3**M. In other embodiments, the conductors **332** are applied to a surface of the audio device **304**. In one embodiment, conductors **332** are applied to the surface of the audio device **304** such as the frame and/or lens and include conductive metals or paint. Conductive paints and coatings are well known to those of skill in the art, and include, for example, the ELECTRODAG series of products manufactured by Acheson industries in Port Huron, Mich.

In one embodiment, the conductors **332** include conductive paints of one or more colors. By using conductors **332** having colors, the conductors **332** function as electrical conductors and provide design and aesthetic enhancement of the audio device **304**.

In one embodiment, the audio device **304** includes dual automatic equalization. The audio device **304** may also include static and/or noise correction, and/or active or passive noise cancellation. The audio device **304** has a total harmonic distortion of less than about 1.0% and, in one embodiment,

less than about 0.1%. The signal-to-noise ratio is generally greater than about 80 dB, and in one embodiment, at least about 90 dB.

In one embodiment, the audio device **304** receives a wireless signal, such as an FM or satellite radio, or wireless network, infrared, Bluetooth signal, or the like. The audio device **304** identifies audio signal information in the wireless signal, such as the performer of a song corresponding to the wireless signal.

The audio device **304** compares the audio signal information to stored preference information to determine whether to receive and store the wireless signal corresponding to a particular song. For example, in one embodiment, a user provides the audio device **304** with a list of preferred information, which includes preferred song names, artist names, or show or program titles. The audio device **304** monitors wireless signals to determine if preferred information is or will be broadcast. If the audio device **304** determines that preferred information is or will be broadcast, the audio device **304** receives the preferred information and saves it in the memory module **330**. In one embodiment, the audio device **304** receives the preferred information and compresses it according to any of the compression or de-compression schemes described in greater detail above. Once compressed, the preferred information is saved in the memory module **330**.

In another embodiment, a user provides the audio device **304** with a list of preferred information, which includes preferred song names, artist names, or show or program titles. The audio device **304** also receives a program guide, which generally indicates the schedule of transmission of songs, programs, or other content from a content source **302**, such as the content source **302** shown in FIG. **21**. The audio device **304** determines when preferred information will be available by comparing the preferred information to the program guide. The audio device **304** receives and stores the preferred information based upon the comparison.

In one embodiment, the audio device **304** is generally light-weight, and able to be worn comfortably by a user for an extended period of time. In one embodiment, the audio device **304** weighs less than about 75 g, less than about 50 g, or less than about 30 g. In one embodiment, the audio device **304** weights about 52 g.

One embodiment of a method of audio playback **350** is illustrated in FIG. **23**. An audio file is received at block **352**. The audio file may be any of the compressed or non-compressed digital file formats described above with respect to FIGS. **21** and **22**, or may be any other audio file. The audio file may be any content described above with respect to FIG. **21**. In one embodiment, the audio file is an MP3 formatted audio file.

The audio file is stored in the audio device **304** at block **354**. At block **356**, the method **350** determines whether the user has instructed the audio device **304** to play back the audio file. If not, the method **350** continues to block **358**, where the method **350** determines whether the user has instructed the audio device **304** to load an audio file into the audio device **304**. If not, the method **350** returns to block **356**. If the user has instructed the audio device **304** to load an audio file, the method **350** returns to block **352**.

If at block **356** the user has instructed the audio device **304** to play back an audio file, the method **350** continues to block **360**. At block **360** the method processes an audio file. In one embodiment, block **360** includes any one or a combination functions that may be performed with respect to an audio file. For example, at block **360** the audio file may be selected, the playback volume may be adjusted, the tone, balance, bass, treble, or other audio parameter may be adjusted, and/or any other processing function may occur.

At block **362** the audio file is played back, which in one embodiment includes decompressing an audio file, converting it to an analog signal, and sending a signal to speakers so that the audio file may be heard by a user. After block **362** the method **350** returns to block **358**.

FIG. **24** illustrates an audio device **304** in accordance with another embodiment of the present invention. The audio device **304** of FIG. **24** may be the same as and/or include any or all of the features of any of the audio devices described above with respect to FIGS. **1-23**. The audio device **304** of FIG. **24** includes a frame **380**, which includes an ear stem **382**, an electronic housing **384**, a coupling **386**, and orbitals **388**. The embodiment of audio device **304** illustrated in FIG. **24** is adapted to be worn on the head of a user as a pair of eyeglasses, although other configurations for the support of audio device **304** may be employed.

In one embodiment, the electronic housing **384** is a hollow cavity formed within the audio device **304** frame **380**. Electronic components of the audio device **304**, for example, any one or all of the components described above with respect to FIG. **22** and elsewhere herein, are at least partially enclosed within electronic housing **384**. In one embodiment, the audio device **304** includes at least three buttons **390**, which extend from the electronic housing **384**, and allow user control over operation of the audio device **304**. The orbitals **388** of the audio device **304** at least partially enclose and/or support a lens **392**. Additional details regarding the lens **392** of the audio device **304** are provided in greater detail below with respect to FIGS. **26-28**.

In one embodiment, the frame **380** of the audio device **304** includes two ear stems **382**. The right ear stem **382** may include an electronic housing **384**, and the left ear stem **382** may include a housing (not shown) to carry a power source **328** (not shown), for example, an AAAA battery, a rechargeable battery, or any other power source described above. Power from the power source **328** is provided to the electronic components of the audio device **304** within the electronic housing **384** via conductors **332** (not shown). In such configuration, the weight of the audio device **304** may be substantially evenly distributed across the user's head, as described in greater detail above.

In one embodiment, power is provided from one ear stem **382** to the other ear stem **382** across the upper orbital and nose bridge portion **442** (as shown in FIG. **27**) of the audio device **304** frame **380**. Analog signals that correspond to a selected compressed digital audio file are provided from the electronic housing **384** to the ear stem **382** that carries the electronic housing **384**, and across the nose bridge portion **442** to the other ear stem **382**. From the ear stems **382**, the analog signal is provided to right and left speakers **400** via the right and left couplings **386** and extensions **398**. In another embodiment, the analog signals are conducted at least partially through or upon the orbitals **388** of the audio device **304** frame **380**.

In another embodiment, electronics components are distributed along the frame **380** of the audio device **304**. In one embodiment, digital signals that correspond to a selected compressed digital audio file are provided through, within or upon the frame **380**. For example, in one embodiment, digital signals are provided across the nose bridge portion **442** of the audio device **304** frame **380**. In one embodiment, digital-to-analog converters **314** are included in the right and left speaker **400** housings, such that audible audio is generated by the speakers **400** based upon the digital signals.

In one embodiment, the coupling **386** of the audio device **304** includes a hollow chamber (not illustrated), into which a

boom **394** of a support arm **396** extends. The support arm **396** also includes an extension **398** and a speaker **400**. Speaker **400** is attached to the extension **398** at a speaker pivot **402**. Although one speaker pivot **402** is illustrated, each support arm **396** may include more than one speaker pivot **402** to provide additional adjustability of the speaker **400** with respect to a user's ear. In one embodiment, speaker pivot **402** includes a pin, hinge, cam, and/or ball joint. The boom **394** is configured to at least partially slide along and rotate about its longitudinal axis (illustrated as boom axis **404**) within the coupling **386**. In one embodiment, longitudinal translation of boom **394** with respect to coupling **386** along the boom axis **404** results in speaker **400** position adjustment in an anterior or posterior direction ("z-axis" adjustability, as described below) with respect to a user's ear.

In another embodiment, rotation of boom **394** about the boom axis **404** provides adjustment of the angular orientation of speaker **400** with respect to the user's ears. In one embodiment, boom **394** is configured to rotate about its longitudinal axis such that speaker **400** is directed inward, towards a user's ear. In another embodiment, boom **394** is configured to rotate such that speaker **400** is directed outward and upward, away from a user's ear by at least about 35 degrees and in some embodiments at least about 65 degrees from vertical. Such adjustability is particularly useful for allowing a user to use a telephone without requiring removal of audio device **304** from user's head.

Speaker pivot **402** allows speaker **400** to rotate through an arc about the rotational center of the pivot **402**, thereby providing additional superior-inferior as well as anterior-posterior speaker position adjustability. See FIG. **24**A. Rotation through an arc of at least about 45 degrees, and often at least about 90 degrees or 120 degrees is contemplated. In one embodiment, speaker pivot **402** additionally permits speaker **400** to rotate laterally with respect to a user's ear, as illustrated in FIG. **25**, and discussed in greater detail below with respect to FIGS. **28-30**. Sound emitted from speaker **400** is generally emitted along a sound propagation axis **406**, which is generally transverse a speaker face **408**. Inward and outward rotation of speaker **400** about speaker pivot **402** permits adjustment of the speaker face **408** and the sound propagation axis **406** with respect to a user's ear. In one embodiment, speaker **400** is adjustable over an adjustment range **410** of about 45°. In other embodiments, speaker **400** is adjustable over an adjustment range **410** of no more than about 5°, 10°, 15°, 25°, 30°, or 60°. In one embodiment, speaker is adjustable over an adjustment range of greater than about 25°. Additional discussion regarding speaker **400** adjustability is discussed in greater detail below.

Overall, in one embodiment, the audio device **304** provides speaker **400** adjustability in about four degrees-of-freedom with respect to a user's ear. In other embodiments, the audio device **304** provides speaker **400** adjustability in one, two, three or more than three degrees-of-freedom.

The lens **392** of the audio device **304** may be any of a variety of lenses described above, including but not limited to, sunglass lens, waterwhite lens, UV filtering lens, plano lens, magnifying lens, prescription lens, polarized lens, tinted lens, bifocal lens, trifocal lens, Polaroid lens, photochromic lens, protective lens, or the like. The lens **392** may be manufactured from a variety of materials, as described above, including plastic, polymers, or glass, or a combination thereof. Polycarbonate and CR-39 are suitable non-glass lens materials. In addition, the lens **392** may be fabricated by injection molding, coining, thermoforming, coating, or layering one or more materials together, as is well known to those of skill in the art. The lens **392** may be interchangeable so that a user can select the lens **392** attached to the audio device **304** depending upon the user's preference.

The term lens as used herein may refer either to a single lens in a unitary lens system, or a dual lens in a system having a separate lens for each of the left and right line of sight. The lens generally comprises a lens body, having a front surface, a rear surface, and a thickness therebetween. The front surface of the lens preferably conforms to a portion of the surface of a solid geometric shape, such as a portion of the surface of a first sphere having a first center. The rear surface of the lens preferably conforms substantially to a portion of the surface of a solid geometric shape, which may be the same or different than that conforming to the front surface. Preferably, the rear surface conforms substantially to a portion of the surface of a second sphere, having a second center.

The first and second centers are offset from one another to taper the lens thickness. Preferably, the lens is mounted in the frame such that a line drawn through the first and second centers is maintained substantially parallel with a wearer's reference line of sight. Often, the wearer's reference line of sight will be the wearer's straight ahead normal line of sight.

The lens may be cut from a lens blank, or formed directly into its final configuration such as by injection molding or other techniques known in the art. The lens may be oriented on the head of a wearer by the eyeglass frame such that the straight ahead normal line of sight crosses the posterior surface of the lens at an angle greater than about 95°, and often within the range of from about 100° to about 120°, while maintaining the optical center line of the lens in a substantially parallel relationship with the straight ahead normal line of sight of the wearer. The optical center line of the lens may or may not pass through the lens. Further aspects of the optically correct embodiment of the lens for use in the present invention are disclosed, for example, in U.S. Pat. No. 6,168,271 to Houston et al., entitled Decentered Noncorrective Lens for Eyewear, the disclosure of which is incorporated by reference in its entirety herein.

In one embodiment, as illustrated in FIGS. **26-28**, lens **392** is mounted to a lens mount **440**, which is adjustable with respect to frame **380**. For example, in one embodiment, lens mount **440** is coupled to a bridge portion **442** of frame **380** via a pivot or hinge (not shown). The pivot allows the lens mount **440** and the lens **392** attached thereto, to rotate up and out of the visual field of the wearer. Such adjustability of the lens **392** allows the user to remove the lens **392** from the user's visual field without requiring removal of the audio device **304** from the user's head. In one embodiment, where the lens **392** includes sunglass lens, flip-up functionality advantageously permits the user to wear the audio device **304** in bright environments with the sunglass lens flipped down, and in dark environments with the sunglass lens flipped up.

A secondary lens may be provided for each of the wearer's right and left lines of sight. The secondary lens may be secured to the frame **380** on the posterior side of the primary lens **392**, such that when the primary lens **392** is advanced from the first position as illustrated in FIG. **26** to a second position as illustrated in FIG. **27**, the secondary lens remains within the wearer's line of sight. The secondary lens may be a waterwhite lens, and may either be a prescription lens or a protective plano lens.

Any of a variety of mechanisms may be used to couple lens mount **440** to the frame **380** of the audio device **304**. Such mechanisms include pins, hinges, joints, including ball joints, and any other suitable mechanism, as are well known to those of skill in the art. In one embodiment, lens mount **440** is detachably coupled to frame **380** so that the user may remove

and exchange lenses **392** depending upon the user's requirements. For example, lenses **392** of different color, shape, size, prescription, tint darkness, polarization, filtering, or any other optical or aesthetic quality may be interchanged and used with the audio device **304**.

In one embodiment, the frame **380** includes a support ridge **444** formed within an edge of a frame orbital **388**. The support ridge **444** is generally designed to accommodate a contact edge **446** of the lens **392**, and to provide resistance and support for frontal impact against the lens **392**. In one embodiment, the support ridge **444** provides impact resistance at or in excess of that required by a national or international standard, such as ANSI Z87.1-2003.

The lens **392** may be pivotably connected to the frame **380** in any of a variety of ways. In the illustrated embodiment, a medial side **393** of lens **392** is connected to a lens mount **440**, which is pivotably connected to the frame **380**. Due to the bilateral symmetry of the disclosed embodiment, only a single lens **392** will be described herein.

The medial side **393** of the lens **392** is provided with structure for enabling a connection **395** to the lens mount **440**. In the illustrated embodiment, lens **392** is provided with at least a first alignment recess **397**, which may be molded or formed in the medial side **393** of the lens **392**. The first alignment recess **397** is positioned to receive a first alignment pin **399** which projects from the lens mount **440**. Optionally, a second alignment recess **401** may be positioned to receive a second alignment pin **403**, as illustrated in FIG. **27**.

A fastener **405**, such as a screw is advanced through an aperture in the lens **392** and into a threaded recess within lens mount **440**. The fastener **405**, in cooperation with the alignment recess and alignment pin configuration described above, enable a secure attachment of the lens **392** to the lens mount **440**, with minimal encroachment upon the field of view.

The fastener **405** may be provided with a knob, hexagonal recess, or other rotational engagement structure, to permit rotation of the fastener **405** by hand or with a tool, to enable exchange of the lens **392**. Alternatively, fastener **405** may comprise any of a variety of snap fit structures, to permit removal of the lens **392** and replacement with an alternative lens **392**.

The mechanical center of each lens is displaced from the axis of rotation of the lens mount **440** by sufficient distance to enable the lens **392** to be rotated in and out of engagement with the support ridge **444**, even with rake and wrap angles in excess of about 6° or 8° or 10°. In the illustrated embodiment, the axis of rotation of the lens mount **440** is displaced from the mechanical center of the lens by at least about 0.25", and, in some embodiments, at least about 0.5". In the illustrated embodiment, the axis of rotation of the lens mount **440** extends within about 0.125" of the upper edge of the lens **392** when the lens is in the first, lowered position, when viewed in a front elevational view.

The support ridge **444** may be provided with at least one recess **407**, for receiving the fastener **405**, to maximize the contact surface area between the lens **392** and the support ridge **444**. The lens mount **440** may be provided with a spring bias, such as a first surface spring biased against a second, cam surface to bias the lens **392** against the support ridge **440** when the lens is in the first position, and to bias the lens **392** away from the wearer's line of sight when the lens **392** is in the second position.

An embodiment of the audio device **304** is generally adapted to be worn at least partially upon the head **460** of a user. A top view of a user's head is generally illustrated in FIG. **29**. The head **460** includes two ears **462**. The external, visible portion of the ear **462** is generally referred to as the pinna **464** or auricle. A small, cartilaginous protrusion within the pinna **464** is known as the tragus **466**. The size and shape of the tragus **466** varies between individuals, but it generally extends posteriorly and sometimes slightly laterally with respect to the head **460**. A tragus-tragus line **466** extends laterally across the head **460**, between the posterior limit of each of the left and right tragus, and generally bisects the head **460**, as viewed from above. A lateral plane of symmetry **470** extends transverse the tragus-tragus line **466**, substantially bisecting both the user's head **460** and nose **472**.

FIG. **30** illustrates a top, horizontal cross-sectional view of the external portion of a user's left ear **462** where the speaker **400** (not shown) of an audio device **304** (not shown) is not positioned against, or partially within the ear **462**. The ear **462** includes a pinna **464** and tragus **466** as described above. The ear **462** also includes a concha **480**, outer ear canal **486**, and external auditory meatus **484** or opening of the outer ear canal **482**. The posterior aspect of the auditory meatus **486** partially separates the concha **480** and outer ear canal **482**. FIG. **29** also illustrates anterior **488** and posterior **490** directions with respect to the user's head **460**. Tragus line **468** lies on a tangent to the posterior limit of the tragus **466**.

A speaker **400** placed partially within the ear **462** of a user is illustrated in FIG. **31**. The face **408** of a speaker **400** lies generally in a speaker plane **494**, which intersects the tragus-tragus line **468** at an orientation angle **496** such that sound emitted from the speaker **400** along the sound propagation axis **406** is directed towards an anterior wall **498** of the outer ear canal **482**. By adjusting the orientation angle **496** of the speaker face **408** with respect to the tragus-tragus line **468**, sound quality and enjoyment may be enhanced.

In one embodiment, when the speaker **400** is placed within a user's ear **462**, the speaker **400** may contact the ear **462** at the tragus **466** and posterior aspect of auditory meatus **486**, as illustrated in FIG. **30**. The orientation angle **496** formed by such speaker **400** placement may be any of a variety of angles, preferably directing the sound propagation axis in an anteriorly inclined direction. In one embodiment, the orientation angle **496** is in the range of between about 15° and 85°, between about 20° and 50°, or between about 20° and 30°. In one embodiment, the orientation angle is about 25°.

An audio device **304** and a reference system **500** are shown in FIGS. **32-35**. Referring first to FIG. **32**, audio device **304** generally includes two speakers **400**, each having a speaker face **408**, as described in greater detail above. The speaker face **408** has a centerpoint **409**, which in one embodiment is the mechanical center of the planar surface substantially parallel to the speaker face **408** and bounded by a speaker perimeter **411**.

In one embodiment, reference system **500** includes three axes **502**, **504**, **506** that may be used to describe the position, orientation, and degrees of freedom of movement and rotation of the speakers **400**, the speaker faces **408**, and speaker face centers **409** with respect to the audio device **304**. The reference system **500** includes an x-axis **502**, a y-axis **504**, and a z-axis **506**. In one embodiment, the x-axis **502** is parallel to a reference axis x', as shown in FIG. **33**, which is tangential to the ends **508** of the ear stems **382** which, in a typical, symmetrical eyeglass, have approximately the same length. In the illustrated embodiment, the x-axis **502** lies on a plane that bisects the anterior-posterior dimensions of the audio device **304**. The x-axis **502** generally extends laterally, or from side-to-side with respect to a wearer's head when the audio device **304** is worn.

A z-axis **506** bisects the eyeglass along its typical plane of symmetry and is perpendicular to the x-axis as illustrated in

FIG. **33**. The z-axis **506** generally extends in a posterior-to-anterior direction with respect to a wearer's head when the audio device **304** is worn.

A y-axis **504** is perpendicular to the x-axis **502**, as illustrated in FIG. **34**. The y-axis **504** lies on a plane that bisects the audio device **304**. The y-axis **504** generally extends in an inferior-to-superior direction with respect to a wearer's head when the audio device **304** is worn. In one embodiment, the x-axis **502**, y-axis **504**, and z-axis **506** are substantially perpendicular to one another.

The axes **502**, **504**, **506** of the reference system **500** define multiple planes, which may also be used to describe the position, orientation, and degrees of freedom of movement and rotation of the speakers **400**, the speaker faces **408**, and speaker face centers **409** with respect to the audio device **304**. For example, in one embodiment, the x-axis **502** and z-axis **506** define an xz-plane, the x-axis **502** and y-axis **504** define an xy-plane, and the y-axis **504** and z-axis **506** define a yz-plane, as illustrated in FIGS. **33-35** respectively. The term "substantially parallel" as used herein is intended to include deviations from parallel that are induced by reasonable manufacturing tolerances and normal anatomical variations as the context may require. In addition, a term such as "the yz-plane" is intended to include the yz-plane and all planes parallel to the yz-plane unless indicated otherwise either expressly or by context. Motion along, for example, the x-axis refers also to motion along any parallel to the x-axis.

Referring back to FIG. **32**, in the illustrated configuration, the speaker faces **408** of the speakers **400** lie on a plane that is substantially parallel to the yz-plane. The speaker **400**, speaker face **408**, and centerpoint **409** may be moved linearly anteriorly or posteriorly in the z-axis **506** by employing any of a variety of devices, speaker mounts, joints and couplings, as described in greater detail above. For example, by coupling speaker **400** to a boom **394** that slides within a coupling **386**, speaker **400** may be linearly translated in a direction substantially parallel to the z-axis **506**, as illustrated in FIG. **3**F and elsewhere herein.

In one embodiment, the linear z-axis translation distance will vary depending upon the particular design of the boom **394** and coupling **386**. Preferably, a z-axis range of at least about 0.25 inches will normally be used. For example, by using a longer boom **394** and coupling **386**, z-direction linear translation may be increased. In addition, by using a telescoping boom **394**, z-direction linear translation may also be increased. In one embodiment, a telescoping boom **394** includes at least two substantially concentric structures (e.g., tubes), that slide with respect to one another, and allow the boom **394** to be manipulated from a first, compacted configuration to a second, extended configuration. Other nested or slider and track structures may be utilized, as will be appreciated by those of skill in the art. For example, any of a variety of axially elongate rails may be aligned in the z-axis, to serve as the coupling **386**. The extension **398** may be provided with any of a variety of complementary clamps or retainers for traveling axially along the rail, thereby providing z-axis adjustability of the speaker.

In one embodiment, a locking or dampening mechanism (not shown) is used to secure the boom **394**, and to fix the position of the speaker **400** from or provide resistance to further movement in the z-axis **506**. For example, in one embodiment, a compression ring or collar is used to apply friction between the boom **394** and the coupling **386**, or between nested, concentric structures of a telescoping boom **394**. This enables a wearer to adjust the z-axis position of the speaker by overcoming the friction, but the friction will retain the position selected by the wearer. Locking structures, including pins, levers, clasps, switches, knobs, and latches may also be utilized.

During movement of the speaker **400** in the z-axis **506** by axial movement of the boom **394** speaker face **408** may either also be adjusted or may remain substantially parallel to the yz-plane. Speaker **400** may be moved in certain embodiments in a direction substantially parallel to the z-axis **506** while speaker face **408** remains positioned at a preset angle with respect to the yz-plane. For example, referring to FIGS. **25** and **32-35**, speaker **400** may be inclined at an angle with respect to the yz-plane that is within an adjustment range **410**. While, before, or after the speaker **400** is positioned at the selected angle, the speaker's **400** position along an axis substantially parallel to the z-axis **506** may be adjusted, as described above.

Similarly, in another embodiment, the speaker **400** may be moved in a direction substantially parallel to either or both of the x-axis **502** or y-axis **504**. For example, in one embodiment, the speaker face **408** remains substantially fixed with respect to the yz-plane while the speaker face **408** is laterally or medially displaced along an axis substantially parallel to the x-axis **502**. Such movement may be achieved by utilizing any of a variety of x-axis telescoping or track and slider mechanisms well known to those of skill in the art. For example, in one embodiment, the speaker **400** is coupled to the audio device **304** with a slider. The slider moves within a guide extending along the x-axis and provides lateral movement of the speakers **400** along the x-axis. Alternatively, a pivotable joint can be provided at each end of the extension **398**.

In another embodiment, the speaker **400** includes a threaded portion that mates with a threaded counterpart on the speaker support. Lateral displacement along a direction substantially parallel to the x-axis **502** is achieved by rotating the speaker **400** with respect to its threaded counterpart. In one embodiment, the speaker's threaded portion includes male threads, and the threaded counterpart includes female threads. In another embodiment, the speaker's threaded portion includes female threads, and the threaded counterpart includes male threads. In addition, in other embodiments, the speaker **400** moves laterally at an angle offset from the x-axis **502**.

Speaker **400** movement in any direction may be de-coupled from movement in other directions. For example, linear translation of the speaker **400** along the z-axis **506** (or an axis substantially parallel thereto) does not necessarily result in translation or movement of the speaker **400** along either the x-axis **502** or y-axis **504**. However, in other embodiments, speaker **400** movement in one direction may be coupled to movement in one or more other directions as well. Such coupled movements are described in greater detail below.

In one embodiment, the speakers **400** of the audio device **304** may be rotated within one or more planes. The term "rotation" is intended to include both rotation of an object about an axis extending through the object, as well as movement of an object through an arcuate path about a center of rotation separated by an offset distance from the object.

Referring again to FIG. **32**, speaker **400** is coupled to extension **398** with a speaker pivot **402**. In one embodiment, speaker **400** rotates about speaker pivot **402**, and an axis that extends through the speaker pivot **402**, and which is substantially parallel to the x-axis **502**. During such rotation, in one embodiment, the speaker face **408** remains substantially parallel to a yz-plane (or a reference plane that is located at an offset angle with respect to the yz-plane), while the speaker **400** centerpoint **409** moves in an arcuate path within the

yz-plane (or within a reference plane that is located at an offset angle with respect to the yz-plane). Although the speaker pivot **402** is illustrated as located at the connection between the speaker and the extension **398**, it could alternatively be located at the connection between the extension **398** and the boom or other attachment point to the eyeglasses, or along the length of the extension **398**. At least two pivots may also be provided, such as one at each end of the extension **398**, depending upon the desired performance.

Rotation of speaker **400** about the speaker pivot **402** provides arcuate movement of the speaker **400** in the yz-plane. Such movement allows superior-inferior (e.g., y-axis) adjustment of speaker **400** position with respect to a user's ear without adjusting the rest of the frame **380** of the audio device **304**. Y-axis adjustability of the speaker center **409** of at least about 0.25 inches, often at least about 0.45 inches and in some embodiments at least about 0.75 inches is contemplated. By adjusting the speaker **400** position, the speaker's sound propagation axis may be oriented with respect to a user's ear without adjusting the frame **380** of the audio device **304**.

Any of a variety of structures may be used as the speaker pivot **402**, as described in greater detail above. For example, the speaker pivot **402** may include a ball and socket joint, concentric tubes, a pin and channel, a joint, a hinge, a lever, or any other structure that provides rotation coupling, as is known to those of skill in the art.

In another embodiment, speaker **400** may be rotated laterally about a boom axis **404** (as illustrated in FIGS. **3**H and **24**) to provided further rotational adjustability of the speaker **400** in the x-axis. In one embodiment, rotation of speaker **400** about a boom axis **404** results in arcuate movement of the speaker **400** from a first, listening position, in which the speaker face **408** is substantially parallel to the yz-plane (or to a reference plane that is offset from the yz-plane by a first offset angle), to a second position in which the speaker face **408** may be substantially parallel to the xz-plane (or to a reference plane that is offset from the xz-plane by a second offset angle). The offset between the speaker and the center of rotation (boom axis **404**) defines the radius of arcuate movement of the speaker within the xy-plane. An x-axis offset (when the speaker is in the second position) of at least about 0.25 inches, often at least about 0.5 inches, and in some embodiments at least about 1.0 inches, is contemplated.

In such embodiment, the speaker **400** and its centerpoint **409** move within a plane that is substantially parallel to the xy-plane from the first position along an arcuate path in a lateral, superior direction to the second position. The speaker **400** may be moved back to the first position by traveling along the arcuate path in a medial, inferior direction from the second position. A speaker **400** shown in one embodiment of a first position is illustrated in FIGS. **32-35**. In another embodiment, the speaker **400** is configured to rotate from a first position in which the speaker face **408** is substantially parallel to the yz-plane to a second position in which the speaker **400** is inclined at an angle with respect to the yz-plane.

In one embodiment, this movement of the speaker **400** and its centerpoint **409** within the xy-plane allows the wearer to raise the speaker **400** from adjacent the wearer's ear without moving or adjusting the remaining portion of the frame **380** of the audio device **304**. Such movement allows the wearer to receive a telephone call if the eyeglass is not equipped with an internal cellular phone and place the speaker of a hand held telephone adjacent the wearer's ear without requiring the removal of the audio device **304** from the wearer's head.

In another embodiment, speaker **400** may be rotated about a reference axis that extends in a direction substantially parallel to the y-axis **504**. One example of such adjustability is illustrated in FIG. **25**, and is discussed in greater detail above. In one embodiment, such adjustability allows the movement of the speaker **400** from a first position in which the speaker face **408** is substantially perpendicular to tragus-tragus line **468**, the ear canal axis **492** and/or an axis substantially parallel to the x-axis **502**, to a second position in which the speaker face **408** is offset from the tragus-tragus line **468**, the ear canal axis **492** and/or an axis substantially parallel to the x-axis **502** by an offset angle **496**. One example of such offset angle is described in greater detail above with respect to FIG. **31**.

Any of a variety of structures may be used to provide rotational movement as described above. For example, the speaker **400** may be coupled to the frame **380** of the audio device **304** with a ball and socket joint, concentric tubes, a pin and channel, a joint, a hinge, a lever, or any other structure that provides rotation coupling, as is known to those of skill in the art.

Thus, the speakers **400** of the audio device **304** may be moved linearly within along directions substantially parallel to one or more of the x-axis **502**, y-axis **504**, z-axis **506**, and/or any direction offset from any one or more of the x-axis **502**, y-axis **504**, or z-axis **506** by a fixed or adjustable offset angle. In addition, in certain embodiments, the speaker **400** of the audio device **304** may be moved typically through an arc residing within the xy-plane, the yz-plane, the xz-plane, and/or any preselected plane offset from any one or more of the xy-plane, the yz-plane, or the xz-plane by a fixed or adjustable offset angle.

In addition, in one embodiment, such multi-dimensional adjustability may be performed by moving the speaker **400** with respect to the audio device **304** without requiring sliding or rotational adjustment of the frame **380**. For example, in one embodiment, the speaker **400** is coupled to the audio device **304** frame **380** with a support which comprises flexible tube, or conduit, such as a gooseneck tube, wire bundle, or hollow wire. Such flexible tubing allows independent, three-dimensional positioning of a speaker **400** along any axis, and within any plane, without requiring adjustment of the position of the frame **380**. The support retains the position of the speaker selected by the wearer until adjusted again to a different position.

Of course, the foregoing description is that of a preferred construction having certain features, aspects and advantages in accordance with the present invention. Accordingly, various changes and modifications may be made to the above-described arrangements without departing from the spirit and scope of the invention, as defined by the appended claims.

What is claimed is:

1. A wearable electronically enabled interface system for providing audio and or video input to the wearer from at least two sources, comprising:

a wearable support, for carrying at least a portion of the interface, said wearable support comprising an eyeglass frame, at least one support arm, and at least one speaker supported by the eyeglass frame with the support arm, wherein the support arm comprises a first segment attached to the eyeglass frame at a first coupling and a second segment attached to the speaker at a second coupling, wherein the first coupling permits the support arm to be rotated to move the speaker away from the eyeglass frame, wherein the second coupling permits the speaker to be rotated with respect to the support arm about at least first and second axes, said first axis being perpendicular to said second axis, and wherein a distance between the first and second couplings is adjust-

able by the wearer by moving the first segment with respect to the first coupling;

at least one data port carried by the support and configured to receive data from at least a first and a second source, the data port having an output and configured to provide a signal corresponding to the data received from one of said first and second sources;

a memory configured to store a user-configurable prioritization schedule, said user-configurable prioritization schedule comprising first and second priority settings associated with said first and second sources, respectively; and

a selector configured to provide an alarm signal to the wearer while data from the first source is directed to the data output, when data from the second source is detected and when said second priority setting indicates greater priority than said first priority setting, wherein the selector is further configured to enable the wearer to manually select and direct data from a desired one of the first and second sources to the interface via the data port in response to the alarm signal.

2. A wearable electronically enabled interface system as in claim **1**, wherein the data port comprises a radio frequency receiver.

3. A wearable electronically enabled interface system as in claim **1**, wherein the interface comprises at least one speaker.

4. A wearable electronically enabled interface system as in claim **1**, wherein the interface comprises two speakers.

5. A wearable electronically enabled interface system as in claim **1**, wherein the interface comprises at least one microphone.

6. A wearable electronically enabled interface system as in claim **1**, wherein the interface comprises a video display.

7. A wearable electronically enabled interface system as in claim **1**, wherein the selector comprises a wearer actuatable control.

8. A wearable electronically enabled interface system as in claim **1**, further comprising a second data port.

9. A wearable electronically enabled interface system as in claim **1**, wherein the data port comprises a wireless transceiver.

10. A wearable electronically enabled interface system as in claim **1**, wherein the first source comprises an MP3 player and the second source comprises a telephone.

11. The wearable electronically enabled interface system of claim **1**, wherein the first source and the second source are carried by the wearable electronic interface.

12. The wearable electronically enabled interface system of claim **1**, wherein the second source comprises a sensor.

13. The wearable electronically enabled interface system of claim **12**, wherein the sensor comprises a biometric sensor.

14. The wearable electronically enabled interface system of claim **12**, wherein the sensor comprises a global positioning system (GPS) receiver and a clock.

15. A wearable cell phone and music system, comprising:

a wearable support, said wearable support comprising an eyeglass frame, said eyeglass frame comprising a data port, at least one support arm, and at least one speaker supported by the eyeglass frame with the support arm, wherein the support arm comprises a first segment attached to the eyeglass frame at a first coupling and a second segment attached to the speaker at a second coupling, wherein the first coupling permits the support arm to be rotated to move the speaker away from the eyeglass frame, wherein the second coupling permits the speaker to be rotated with respect to the support arm about at least first and second axes, said first axis being perpendicular to said second axis, and wherein a distance between the first and second couplings is adjustable by the wearer by manipulating the support arm with respect to the first coupling;

a cell phone in communication with the support via the data port;

a music source in communication with the support via the data port;

an electronic interface carried by the support and in communication with the data port, the data port having an output and configured to provide a signal corresponding to data received from one of the cell phone and the music source, the electronic interface further comprising a memory configured to store a user-configurable prioritization schedule, said user-configurable prioritization schedule indicating priority of said cell phone and said music sources, said electronic interface further configured to provide an alarm signal to a wearer when data from the cell phone and music source are detected, and based at least in part on said prioritization schedule; and

a selector configured to enable the wearer to manually select and regulate the transmission of data from at least one of the cell phone and the music source to the interface in response to the alarm signal.

16. A wearable cell phone and music system as in claim **15**, wherein the data port comprises radio frequency electronics for wireless communication between the cell phone and the support.

17. A wearable cell phone and music system as in claim **16**, wherein the data port further comprises radio frequency electronics for wireless communication between the music source and the support.

18. A wearable cell phone and music system as in claim **16**, wherein the music source is carried by the support.

19. A wearable cell phone and music system as in claim **18**, wherein the music source comprises an MP3 player.

20. A wearable cell phone and music system as in claim **15**, wherein the music source comprises an MP3 player.

21. A wearable cell phone and music system as in claim **15**, wherein the data port comprises a wireless transceiver.

22. A method of managing multiple signal sources configured to provide signals to a single wearable interface, comprising the steps of:

enabling data from a first source to reach a wearer through a data port supported by the interface, said interface comprising at least one support arm, and at least one speaker supported by the interface with the support arm, wherein the support arm comprises a first segment attached to the interface at a first coupling and a second segment attached to the speaker at a second coupling, wherein the first coupling permits the support arm to be rotated to move the speaker away from the interface, wherein the second coupling permits the speaker to be rotated with respect to the support arm about at least first and second axes, said first axis being perpendicular to said second axis and wherein a distance between the first and second couplings is adjustable by the wearer while said speaker is attached to said support arm;

automatically detecting when data becomes available from a second source;

comparing a priority setting of said second source to a priority setting of said first source, said first and second priority settings stored in a user-configurable prioritization schedule;

providing an alarm signal to the wearer in response to the automatic detecting and the comparing priority settings;

receiving a control signal from the wearer in response to the alarm signal;

enabling data from the second source to reach the wearer through the data port supported by the interface in response to said control signal; and

automatically resuming delivery of data from the first source to the wearer through the data port supported by the interface upon deactivation of data delivery from the second source to the data port.

23. A method of managing multiple signal sources as in claim **22**, wherein the first source comprises a source of music.

24. A method of managing multiple signal sources as in claim **23**, wherein the second source comprises a telephone.

25. A method of managing multiple signal sources as in claim **22**, wherein data from the first source is no longer provided to the interface in response to activation of the control.

26. A method of managing multiple signal sources as in claim **22**, wherein the data port comprises a wireless transceiver.

* * * * *

Appendix CCC

US006349001B1

(12) **United States Patent**
Spitzer

(10) **Patent No.: US 6,349,001 B1**
(45) **Date of Patent: *Feb. 19, 2002**

(54) **EYEGLASS INTERFACE SYSTEM**

(75) Inventor: **Mark B. Spitzer**, Sharon, MA (US)

(73) Assignee: **The Microoptical Corporation**, Boston, MA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/481,195**

(22) Filed: **Jan. 11, 2000**

Related U.S. Application Data

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(60) Provisional application No. 60/064,430, filed on Oct. 30, 1997.

(51) **Int. Cl.**[7] **G02B 27/10**

(52) **U.S. Cl.** **359/618**; 359/630; 351/50; 351/123; 351/158; 345/8

(58) **Field of Search** 359/618, 630, 359/409, 475; 351/50, 123, 158; 345/6, 8, 7

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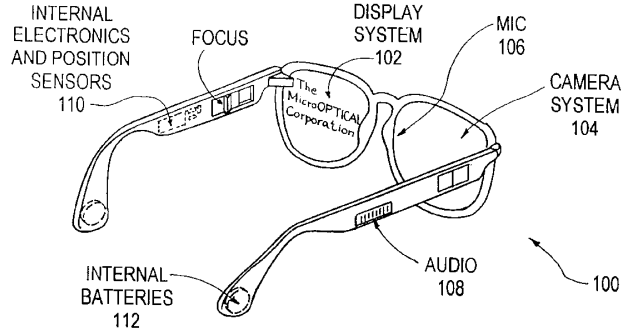
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(57) **ABSTRACT**

An eyeglass interface system is provided which integrates interface systems within eyewear. The system includes a display assembly and one or more audio and/or video assemblies mounted to an eyeglass frame. The display assembly is mounted to one temple and provides an image which can be viewed by the user. The audio or video assembly is mounted to the other temple and is in communication with the display assembly. The audio or video assembly may comprise a camera assembly and/or an audio input or output assembly, such as a microphone and/or speakers. The camera assembly is placed on the temple to record the visual field observed by the user. A head-tracking assembly may be provided to track the position of the user's head. A number of applications can be provided with the present system, such as a telephone system, pager system, or surveillance system. The present eyeglass interface system is compact, offers the user hands-free operation, and provides an attractive appearance due to concealment of the assemblies within the eyeglass frame and lenses.

16 Claims, 10 Drawing Sheets



Motorola v. Stellar
Motorola Exhibit 1063
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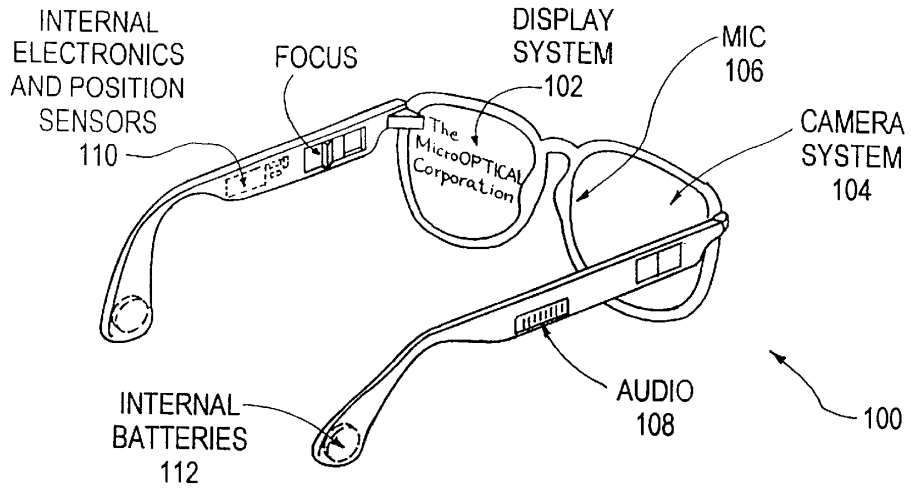

INTERNAL ELECTRONICS AND POSITION SENSORS 110
FOCUS
DISPLAY SYSTEM 102
MIC 106
CAMERA SYSTEM 104
The MicroOPTICAL Corporation
INTERNAL BATTERIES 112
AUDIO 108
100

FIG. 1

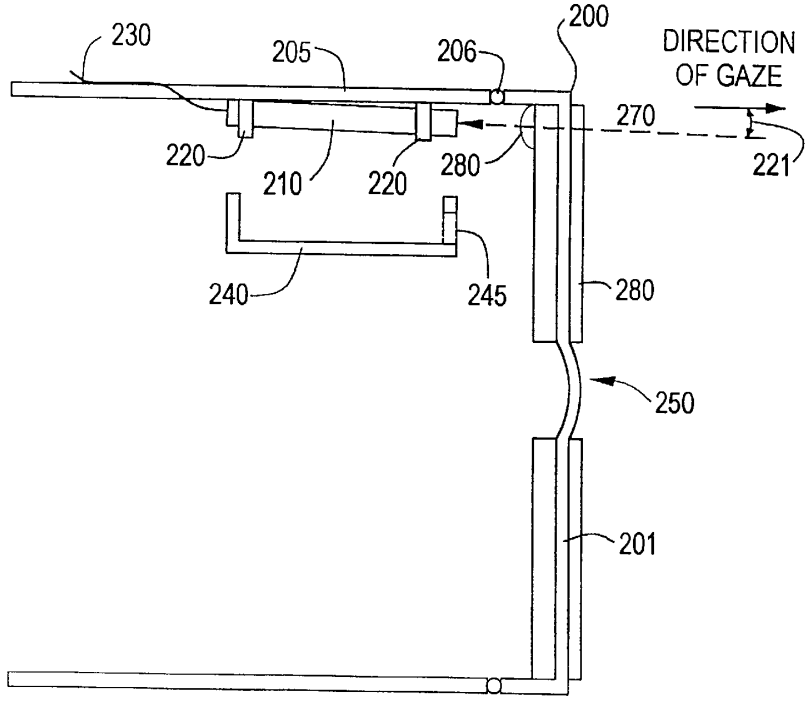

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DIRECTION OF GAZE
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FIG. 2

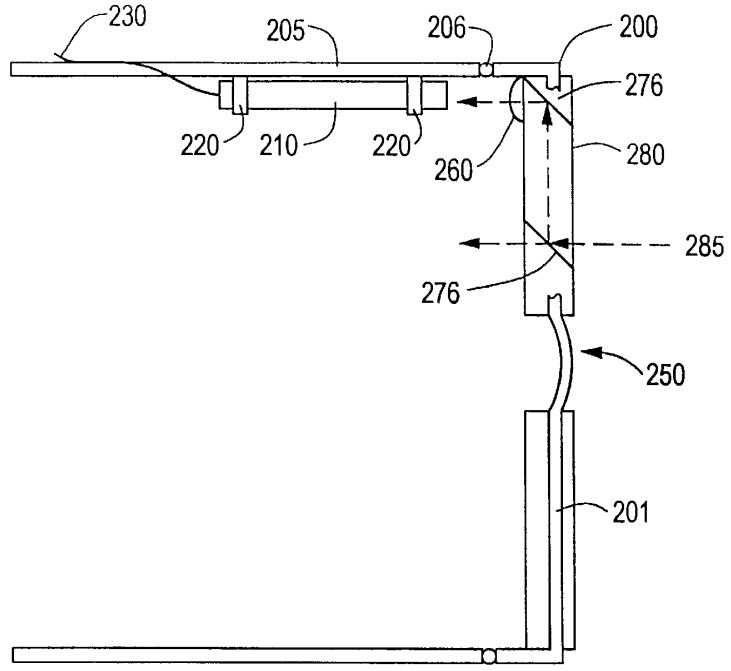

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FIG. 3

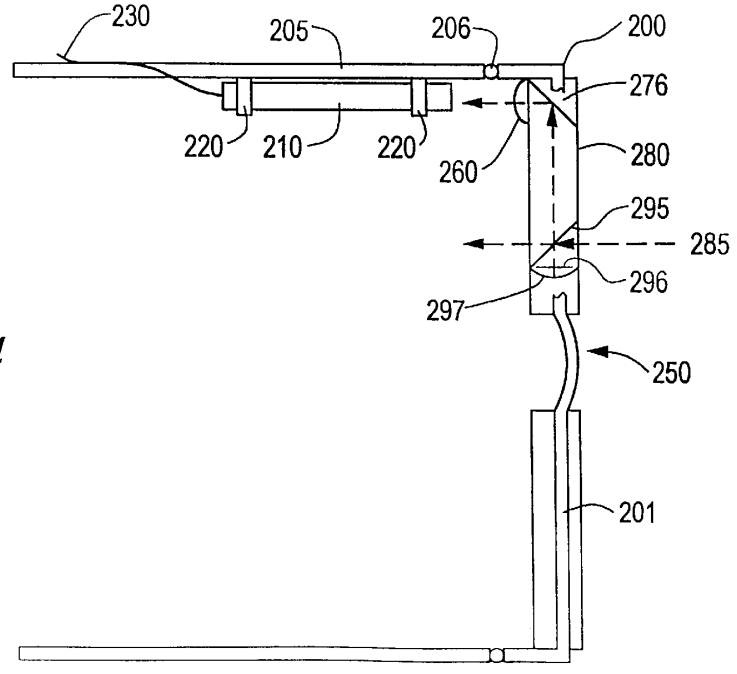

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FIG. 4

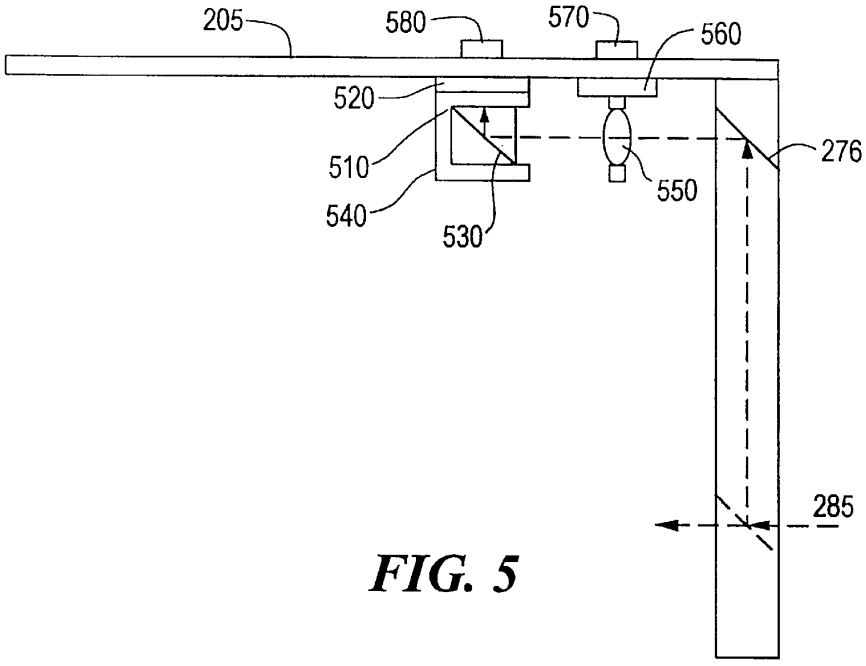

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FIG. 5

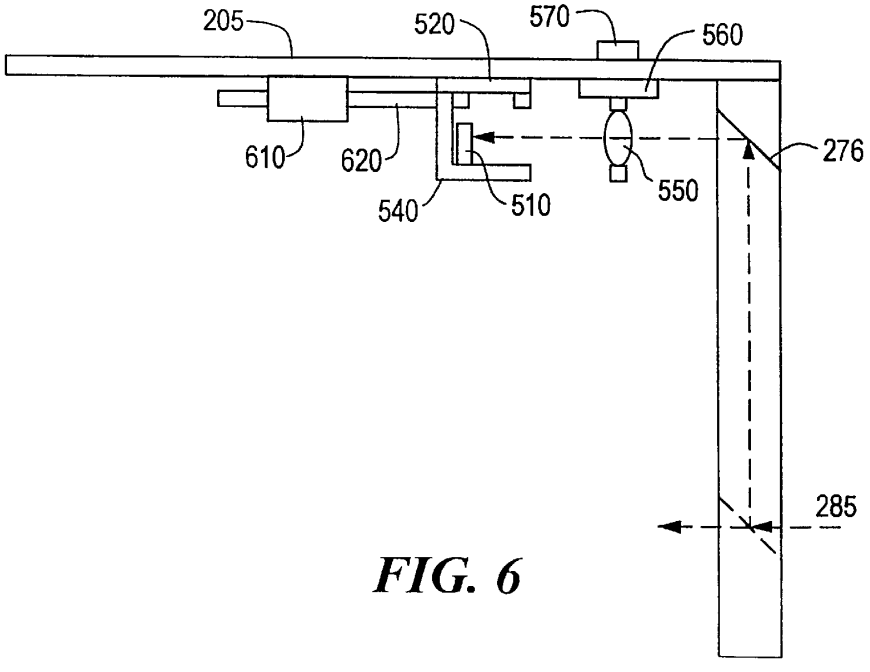

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FIG. 6

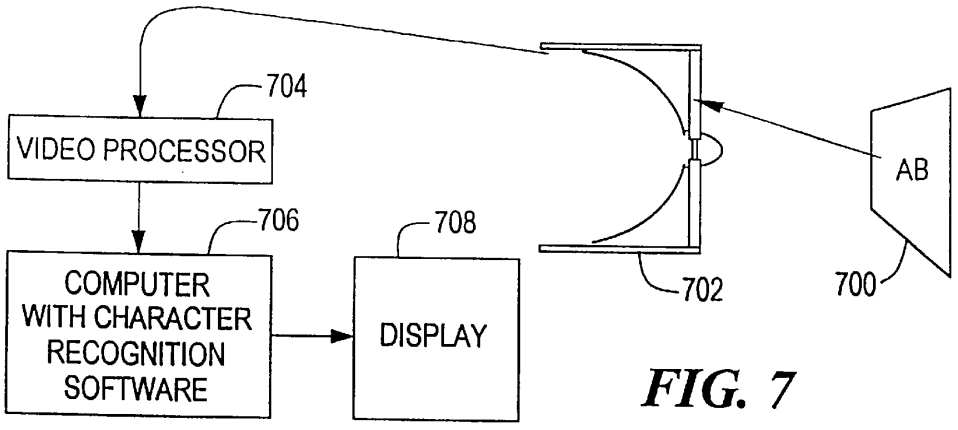

704
VIDEO PROCESSOR
706
708
COMPUTER WITH CHARACTER RECOGNITION SOFTWARE
DISPLAY
AB
702
700

FIG. 7

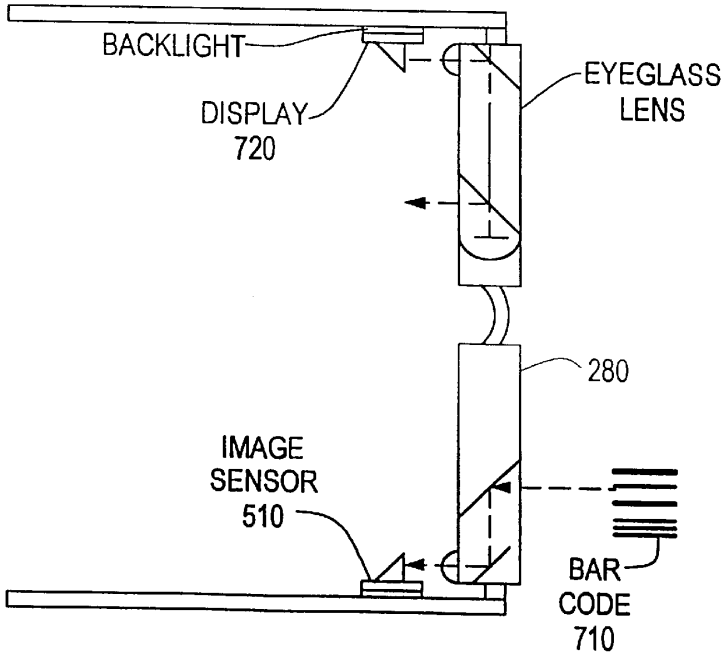

BACKLIGHT
DISPLAY
720
EYEGLASS LENS
280
IMAGE SENSOR
510
BAR CODE
710

FIG. 8

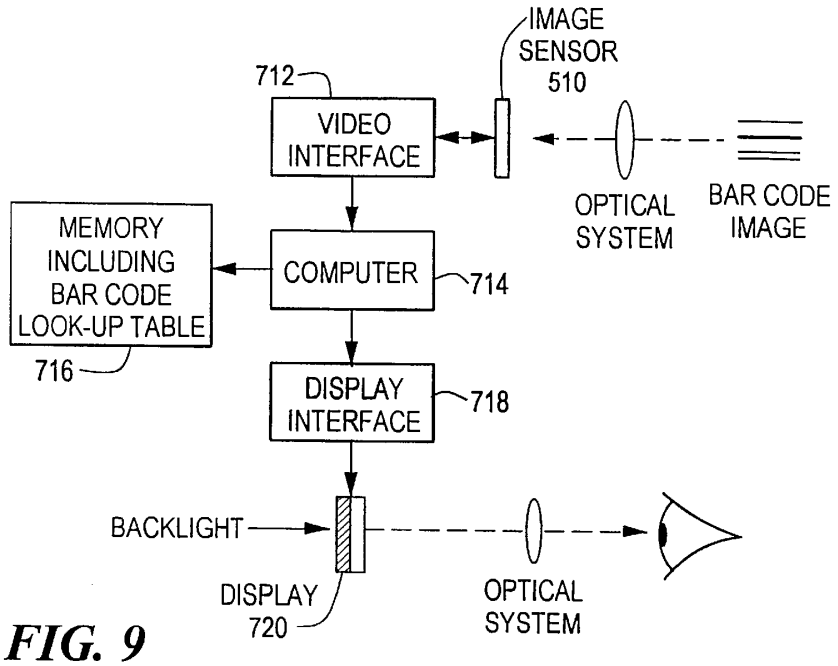

IMAGE SENSOR 510
712
VIDEO INTERFACE
OPTICAL SYSTEM
BAR CODE IMAGE
MEMORY INCLUDING BAR CODE LOOK-UP TABLE
716
COMPUTER
714
DISPLAY INTERFACE
718
BACKLIGHT
DISPLAY 720
OPTICAL SYSTEM

FIG. 9

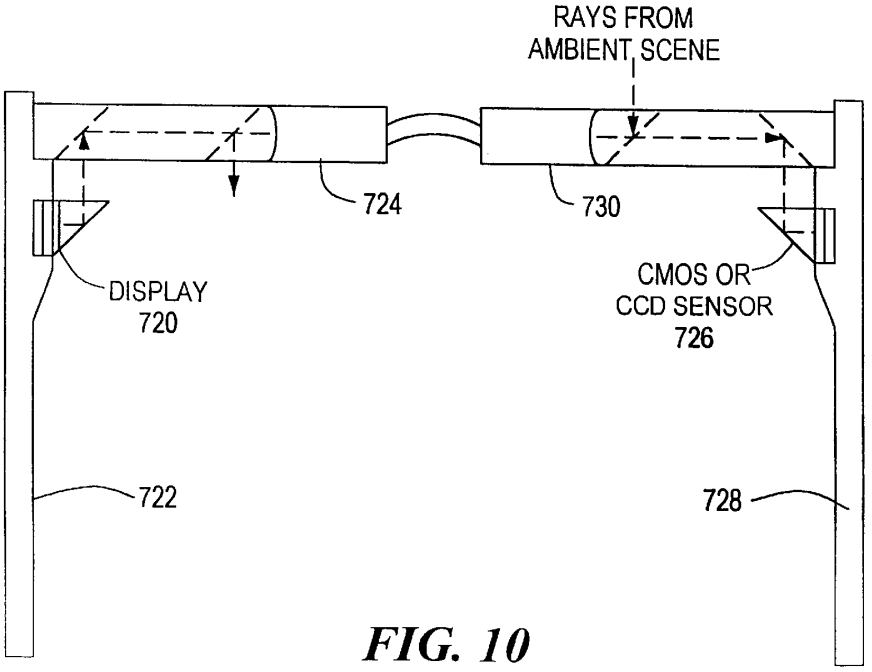

RAYS FROM AMBIENT SCENE
724
730
DISPLAY 720
CMOS OR CCD SENSOR 726
722
728

FIG. 10

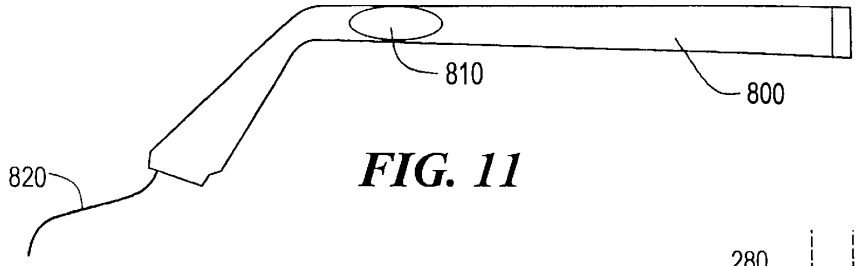


FIG. 11

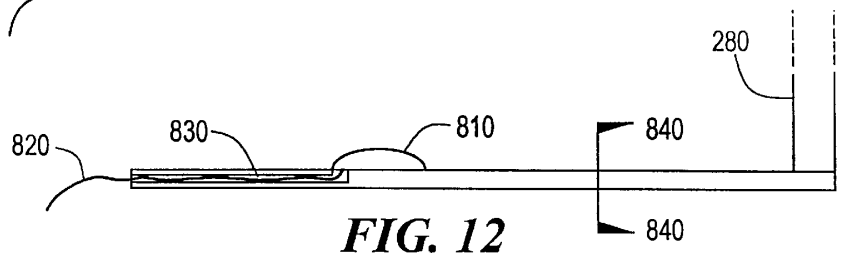


FIG. 12

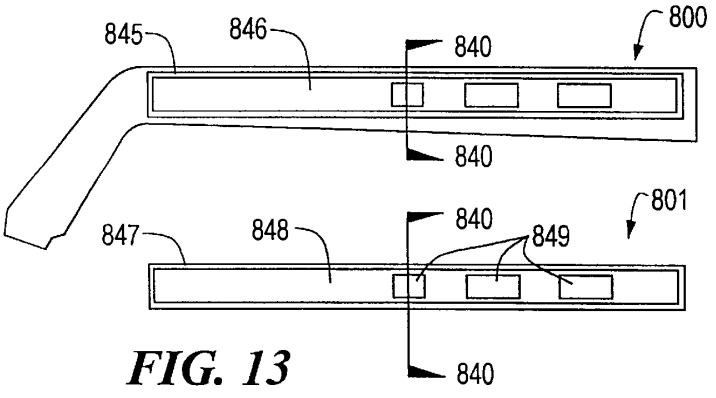


FIG. 13

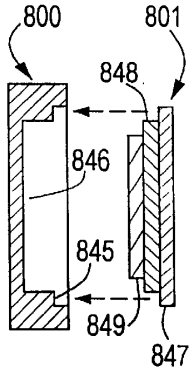


FIG. 14

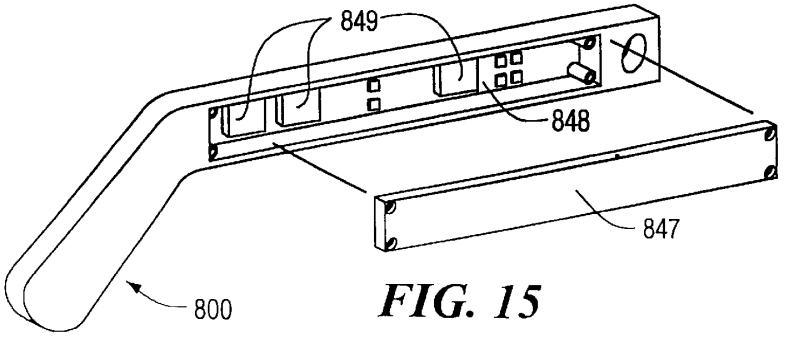


FIG. 15

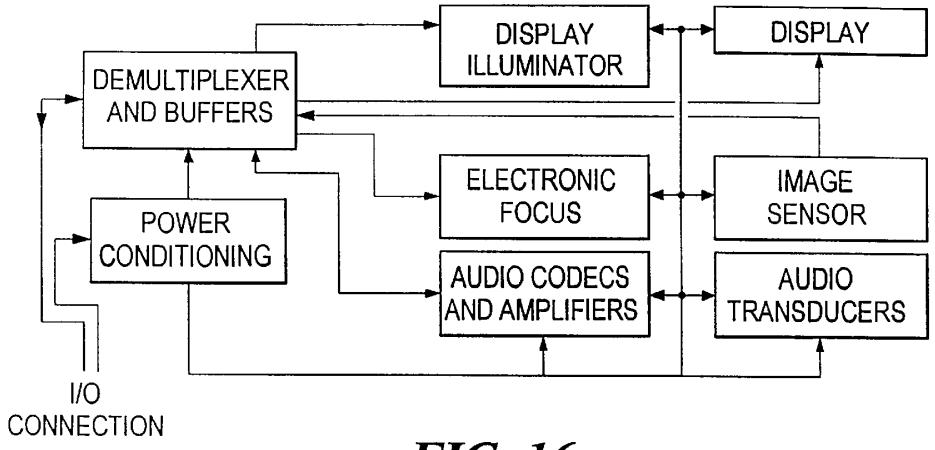


FIG. 16

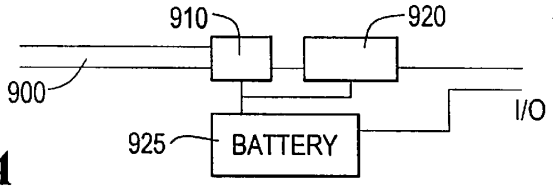


FIG. 17A

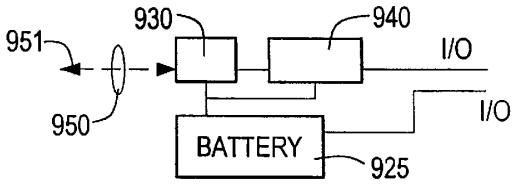


FIG. 17B

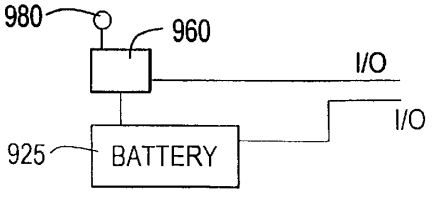


FIG. 17C

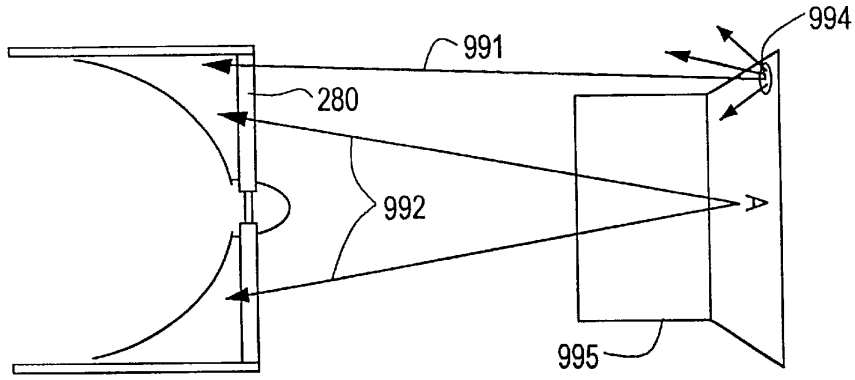


FIG. 18

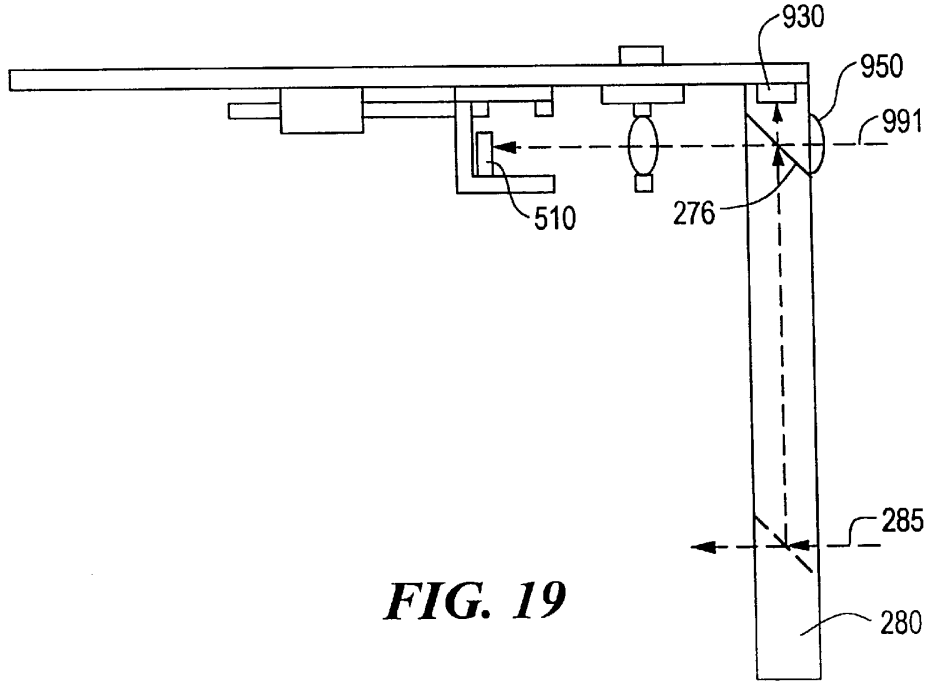


FIG. 19

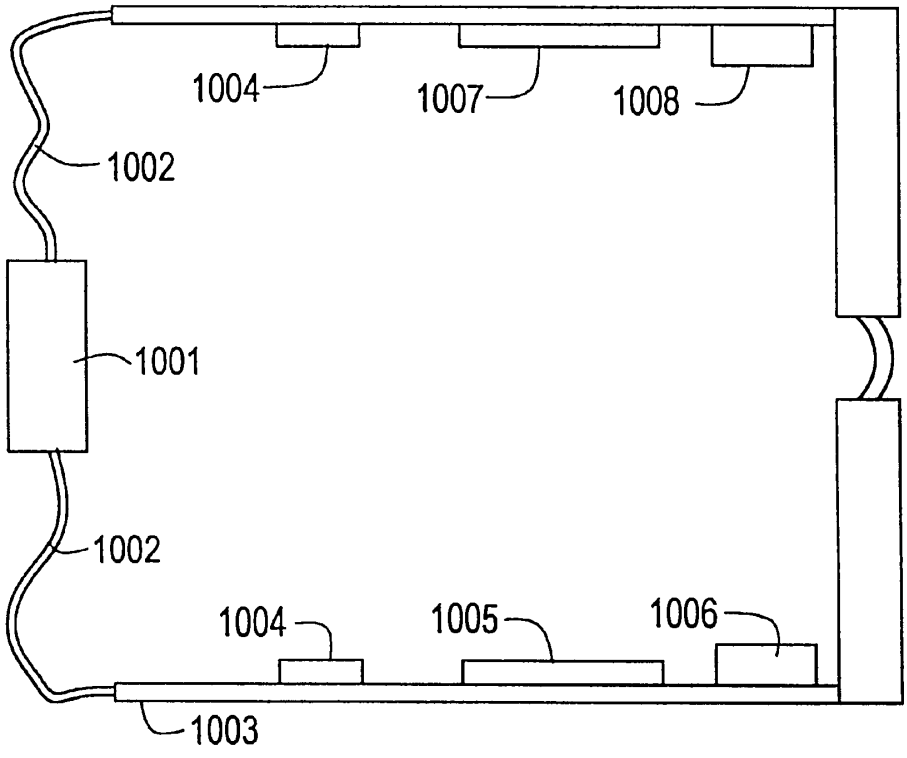


FIG. 20

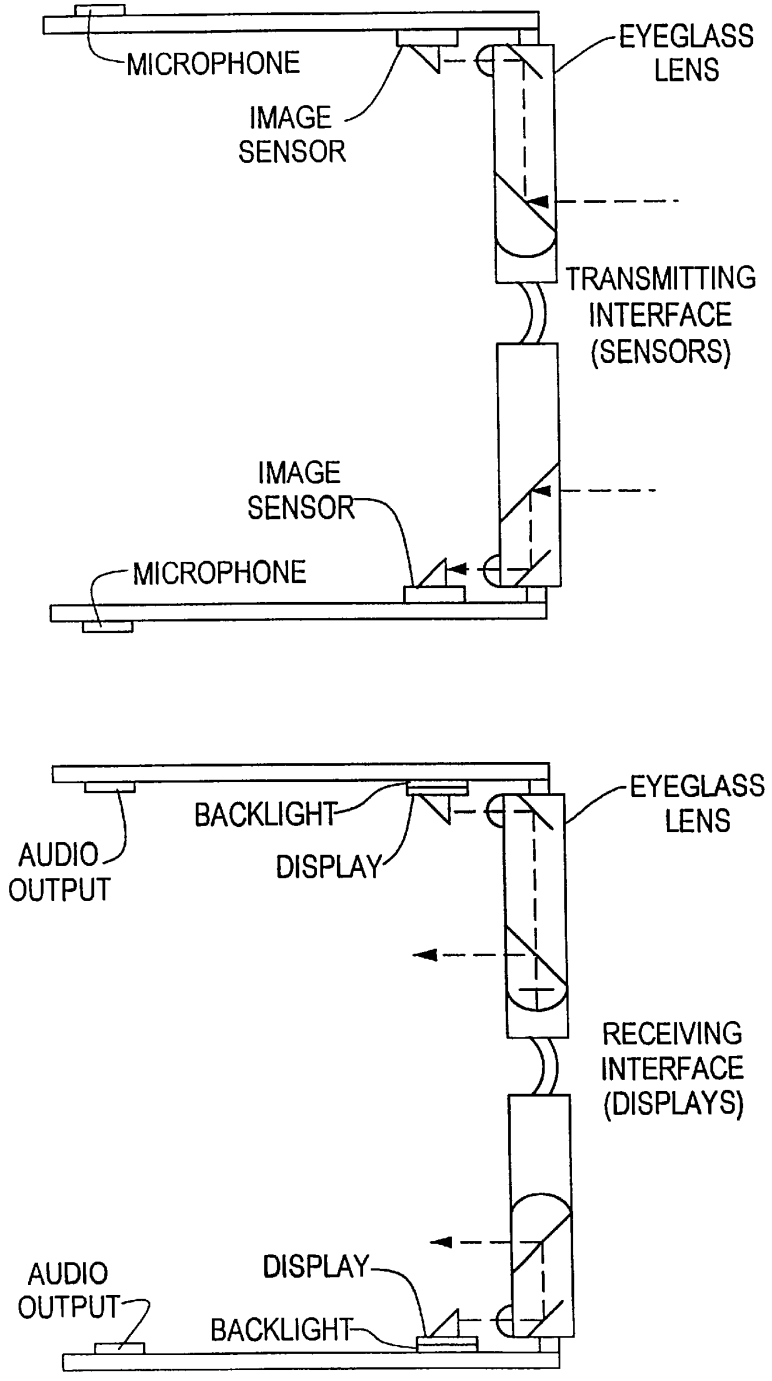

MICROPHONE
IMAGE SENSOR
EYEGLASS LENS
TRANSMITTING INTERFACE (SENSORS)
IMAGE SENSOR
MICROPHONE
AUDIO OUTPUT
BACKLIGHT
DISPLAY
EYEGLASS LENS
RECEIVING INTERFACE (DISPLAYS)
AUDIO OUTPUT
DISPLAY
BACKLIGHT

FIG. 21

EYEGLASS INTERFACE SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit under 35 U.S.C. §119 (e) of U.S. Provisional Application No. 60/064,430, filed Oct. 30, 1997, the disclosure of which is incorporated by reference herein; and a continuation under 35 U.S.C. §120 of prior application Ser. No. 09/182,609, filed Oct. 29, 1998 now U.S. Pat. No. 6,091,546.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

N/A

BACKGROUND OF THE INVENTION

Information storage and processing, electronic recording of sound and images, electronic communications, and electronic entertainment systems have become widespread, and portable applications of these technologies are growing rapidly. The integration of a camera with a head-mounted display was disclosed by Hawthorne in U.S. Pat. No. 4,672,436 for use in camcorder systems. In this case, only the display is placed on the head and the camera is held in the operator's hand. U.S. Pat. No. 5,491,510 discloses a system for superimposing an image of an object. The camera described in this patent is separate from the user, requiring significant processing to correct for the large parallax angle between the camera and user's view.

In U.S. Pat. No. 5,129,716, Holakovsky discloses a head mounted stereoscopic vision system for the purpose of providing television audio and video information to the user. U.S. Pat. No. 5,717,479 discloses safety glasses comprising audio speakers, a microphone, and a heads-up display. The speakers are placed in protective ear inserts in order to attenuate external noise. U.S. Pat. No. 5,606,743 to Vogt discloses a radio receiver and speakers mounted in an eyeglass frame, but includes no provision for audio input or for video input or output. U.S. Pat. No. 5,367,345 to daSilva discloses an audio system enclosed in an eyeglass retainer that is substantially separate from any eyeglass system to which it may be attached. Hearing aid audio components have been mounted in eyewear.

Ritchey, in U.S. Pat. Nos. 5,130,794 and 5,495,576, discloses a panoramic display and its use in an audiovisual virtual reality/telepresence system. This system is designed specifically to allow immersive interaction with a remote or virtual object. An electronic camera in the nose frame of eyewear has been offered for sale by one organization that provides covert surveillance devices.

BRIEF SUMMARY OF THE INVENTION

Full portability for many of these interface systems requires reduction to the portable scale of the user interface. For most applications, it is desirable to have an audio/video interface which is compact and allows hands-free or nearly hands-free operation. In addition, it is desirable that such an interface be unobtrusive and not detract from the appearance of the user. The eyeglass interface system of present invention addresses the need for such an interface, by integrating the complete audio/video interface within eyewear.

The eyeglass interface system uses an eyeglass optical system or display assembly such as that in accordance with U.S. patent application Ser. No. 08/844,098, filed on Apr. 18, 1997, now U.S. Pat. No. 5,886,822, the disclosure of which is incorporated by reference herein. More particularly, the eyeglass interface system of the present invention comprises an eyeglass frame having first and second lens holders and first and second temples configured to be supported on a user's head. The display assembly used in the eyeglass interface system comprises an image source supported by the first temple, an optical pathway disposed internally within the first lens to receive light from the image source, and an insert in the first lens to redirect light on the optical pathway to the user's eye, as described more particularly in U.S. patent application Ser. No. 08/844,098. An audio and/or video assembly is mounted to the second temple, preferably in communication with the display assembly. The audio and/or video assembly is operative to receive or transmit audio and/or video signals. Interface circuitry is provided in communication with the display assembly and the audio and/or video assembly.

In a typical configuration according to the present invention, the display assembly is mounted within one half of the eyeglasses. The audio and/or video assembly comprises a camera assembly mounted within the other half. The system may also include audio transducers (microphone and/or speakers) which provide audio data and/or which collect sound for recording, digital signal processing and analysis. In this way, the microphone may also provide voice activated commands to the system. Additionally, the eyeglass system may include batteries and an RF or infrared communication system to eliminate the need for a cable to the glasses. Various types of systems may be formed using one or more of the subsystems. In its most complete form, the present eyeglass interface system includes the following subsystems or assemblies: an audio input assembly for collecting speech input from the user, a display assembly, an audio output assembly, a camera assembly, and a head-tracking assembly to provide a computer with the position of the user's head. Thus, the eyeglass interface system includes audio, video, tracking and power modules.

The eyeglass interface system of the present invention provides computer input and output in highly compact forms, preferably entirely within eyeglasses, which look to the casual observer like ordinary eyewear. In some embodiments of the invention, the subsystems or assemblies are entirely concealed within the eyeglass frame and lenses. The invention comprises not only the integration of the hardware subsystems within an eyeglass frame, but also the integration of the subsystems with hardware and software intended for specific functions.

The present invention is an improvement over devices in the prior art owing to the complete integration of the camera assembly within the eyeglass frame and lens system of the eyeglasses. The mechanical aspects of the camera, including focusing mechanisms, are integrated within the eyeglass temple, as are the electronics in the form of a multi-chip module integrated in the temple. Additionally, lenses and optical surfaces of the camera assembly are integrated in the temple and even in the eyeglass lens itself. In this way, the camera assembly may attain its most compact form, may be made light in weight, and may attain a greater degree of concealment and functionality than prior art devices. In addition, the present invention places the field of view of the camera in proximity to or convergent with the operator's field of view, so that the camera records the visual field observed by the user. The present invention allows the camera to have the same line of sight as the user's eye, without parallax error.

The present invention also includes the use of the camera assembly to control a computer. While in prior art camera

systems, the camera merely collects data for the computer, in the present invention, the camera assembly also collects input commands. These commands may be in the form of written symbols, hand signals, bar codes, or other forms that cause the computer to execute instructions.

The integration of the camera and display within eyewear according to the present invention provides eyewear that is more compact and therefore easier to wear than prior art devices, and is more aesthetically appealing, because it looks like eyeglasses. The present invention uses optics embedded in the eyeglass lens rather than suspending them in a mount, making the system more durable. The present invention incorporates audio and video inputs as well as outputs. The audio assembly may be integrated into the eyeglass frame. Details of the visual display are not used in conjunction with normal hearing, and therefore one embodiment of the present system integrating an audio assembly seeks to avoid attenuating external sounds. The current system allows the user to interact with computer generated or other electronically relayed information without requiring the occlusion of the actual surroundings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The invention will be more fully understood from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. **1** is an isometric view of an eyeglass interface system according to the present invention;

FIG. **2** is a top plan view of an eyeglass interface system incorporating a camera system;

FIG. **3** is a top plan view of a further embodiment incorporating a camera system;

FIG. **4** is a top plan view of a still further embodiment incorporating a camera system;

FIG. **5** is a top plan view of a still further embodiment incorporating a camera system;

FIG. **6** is a top plan view of a still further embodiment incorporating a camera system;

FIG. **7** is a schematic view of an eyeglass interface system operable with optical character recognition;

FIG. **8** is a top plan view of an embodiment incorporating a bar code reading system;

FIG. **9** is a schematic view of an eyeglass interface system operable with bar code recognition;

FIG. **10** is a top plan view of an eyeglass interface system incorporating a camera and a display;

FIG. **11** is a side view of an eyeglass temple incorporating an audio system;

FIG. **12** is a partial top plan view of the eyeglass system of FIG. **11**;

FIG. **13** is an exploded view of a temple of an eyeglass interface system incorporating integrated circuits in a multi-chip module;

FIG. **14** is a cross-sectional view taken along line **840**—**840** in FIG. **13**;

FIG. **15** is an exploded view of a further embodiment of a temple of an eyeglass interface system incorporating integrated circuits and flexible interconnect circuitry;

FIG. **16** is a block diagram illustrating subsystems that may be mounted within the eyeglass interface system and circuitry for connection to an external device;

FIGS. **17**A–C are block diagrams illustrating connections to external devices;

FIG. **18** is a top plan view of an eyeglass interface system incorporating an infrared connection to an external device;

FIG. **19** is a partial top plan view of the eyeglass interface of FIG. **18**;

FIG. **20** is a top plan view of an eyeglass interface system with plug-in module; and

FIG. **21** is a top plan view of a telepresence system according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** illustrates an eyeglass interface system **100** according to the present invention. Within one half of the eyeglass system is mounted a display assembly **102**, and within the other half is mounted a camera assembly **104**. The display assembly, as well as some aspects of a camera assembly, are described in U.S. Pat. No. 5,886,822. Additional subsystems or assemblies include an audio output subsystem **108**, an audio input subsystem **106** such as a microphone, an interconnection subsystem **110**, and a power subsystem **112**, such as internal batteries. Any number or all of these subsystems may be integrated to form an eyeglass interface system according to the present invention.

The integration of a camera assembly within eyewear is important for a number of applications, including image acquisition, data input by character recognition, bar code scanning, face recognition, and the like. The key factors which must be addressed in order to integrate a camera within eyewear are (i) portability, and (ii) making the camera adjustable so that it is aimed precisely where the user is looking with his or her eyes. This second factor is key for data input by character recognition. For example, if one is looking at a notepad and writing characters, the camera can be positioned within the eyewear so that the notepad is within the field of view of the camera. The characters written by the user can then be photographed by the camera and fed to a character recognition processor. Such a system can replace the keyboard as the data input device for portable applications. Currently, such functions are provided by touch sensitive screens, such as on the Palm Pilot and other pen-based data entry devices. A camera has the distinct advantage that it can work with ordinary pencil and paper. A scanner may also be built from a camera mounted within eyewear. Text that the user reads can be automatically fed to the computer, recognized, and stored.

FIG. **2** illustrates a design based on concealment of the camera **210** within the temple **205** of eyeglasses **250**. The camera may comprise, for example, ELMO Model QN42H, which includes optional focusing lenses within the camera. The camera is mounted within a plurality of supports **220** and adjusted in angle **221** so that the field viewed by the camera overlaps the field viewed by the user. In FIG. **2**, the viewing direction to the center of the field is indicated by ray **270**. For a wide field of view camera or for uses at large distances, angle **221** may be zero. Shroud **240** with aperture **245** may be attached to the temple to conceal the camera. A lens **260** may be used to change the focal length of the camera's lens system. In such a case, the focus of the camera may be adjusted by frictionally sliding the camera **210** within the mounts **220** to adjust the distance between the camera **210** and the lens **260**. An adjustment handle for this purpose may extend through the shroud **240** or the temple **205**. A cable **230** may supply the signal generated by the camera to external electronics, or may connect to circuitry within the eyeglass temple.

The camera's field of view is obtained through the lens **280** held within frame front **200**. This facilitates conceal-

ment of the camera. Further concealment may be obtained by tinting the lens, or by using polarization coatings, or by other means known in the art. If concealment is not desired, the camera may be mounted on the outside of the temple. It should also be recognized that the camera may be mounted on either the left side (as shown in FIG. **2**), or the right side. Alternatively, cameras may be mounted on both sides of the eyeglasses.

An eyeglass system in which the camera is more nearly aligned to the user's direction of gaze is shown in FIG. **3**. Rays represented by ray **285** which propagate to the user's eye are split at beam splitter coating **275**, embedded within the lens **280**, one half propagating to the eye and one half propagating to the camera by reflection at mirror coating **276**. Optical power can be added near the user's eye without interference with the user's vision as shown in FIG. **4**, by using a polarization beam splitting coating **295**. Rays **285** are partially reflected or transmitted by coating **295** and for the typical case of unpolarized incident light, split with 50% propagating in each direction. One half of the light therefore propagates to the eye while the other half is reflected toward curved mirror **297**. The rays first pass through quarter wave plate **296** and undergo a rotation of polarization, then propagate to mirror **297** and are focused and reflected back through quarter wave plate **296**. Upon the second pass through plate **296** the waves have been rotated sufficiently to pass efficiently through the beam splitter coating to mirror **276** and from there through optional lens **260** and then to the camera.

A camera system may be integrated within the eyeglass temple in a further manner, as shown in FIG. **5**. A charge coupled device (CCD) or complementary metal oxide semiconductor (CMOS) image sensor **510** is mounted to a sliding base **520** in contact, or partially within, or even fully within, eyeglass temple **205**. The sliding base is in contact with handle **580** through a slot in the temple (not shown) so that the user may slide **580** a short distance (between about 3 to 10 mm) for the purposes of focusing. The sliding base **520** is machined with keys or tracks in temple **205** to maintain alignment in a manner known in the art. A mirror **530** is positioned to receive light represented by rays **285** from the lens system, and is housed within shroud **540**. A focusing lens **550** is mounted on a sliding base **560** which is in contact with handle **570** through temple **205** in the same manner as for base **520** and handle **580**. The lens may be moved closer to or more distant from the imaging element **510** to adjust the focus. Preferably, only one base (either **520** or **560**) needs to be moveable for adjustment purposes, and either may be chosen, although both could be adjustable if desired. Additional optical elements may be added to the camera system, any one or all of which may be positioned on a sliding base for adjustment. In this way, both focus and zoom adjustment may be accommodated. Alternatively, lens **550** may be mounted directly to or formed integrally with the main eyeglass lens **280**, as shown in FIG. **3**.

Another embodiment which includes an auto focus mechanism is shown in FIG. **6**. Imager **510** is mounted against shroud **540** upon the sliding base **520**. A miniature stepper motor **610** is fixed to the temple **205** and is in contact with shroud **540** through lead screw **620**. The stepper motor is in communication with remote electronics which can command the motor to run the lead screw in either direction in precise angular increments. Rotation of the lead screw in this way causes the shroud and sliding base to move toward or away from the motor, affecting the focus. The motor may be controlled through software which analyzes the image and issues focus commands to the motor, or which is in communication with a distance sensor to derive a focus signal. Such control systems are well known in the camcorder industry.

FIG. **7** illustrates a data input system based on optical character recognition. A user wearing the eyeglasses with camera, as described above, views a written object **700**. The camera provides the raw video data to a video processor **704** (also known as a frame grabber) which stores in the memory of a computer **706** an image of the scene taken by the camera. The image is processed by the character recognition code in the computer **706** to determine the nature of the information and may be output to a display **708**. In the same manner as text input is derived from a keyboard, the characters are stored in a buffer until the code detects a control character (the equivalent of a carriage return). The instruction is then executed. In a similar manner, the device may operate as a scanner. Images are stored in memory and a code is executed to construct a large image from the sequential frames. Another application involves the collection of video imagery. The video is collected by the camera and provided to the video processor which compresses the video stream and stores it within memory.

A bar code reading system may be built using the integrated system. It comprises eyeglass optics, display and camera as shown in FIG. **8**. The image of the bar code is centered in the eyepiece of the right lens **280** so that the bar code stripes **710** are relayed to the image sensor **510**. The camera system may be provided with autofocus as previously described. As shown in FIG. **9**, the image from the sensor is provided electronically via video interface **712** to a computer **714** that employs character or pattern recognition to decode the stripes. The computer can be programmed with look-up tables **716** for universal price codes or any other bar codes, so that the output of the computer is then the decoded information in alpha-numeric characters, symbols or graphics. These characters are relayed electronically from the computer **714** via a display interface **718** to the display **720** mounted within. the eyeglasses, so that the user sees the decoded information in the display.

Another application of a similar nature involves face recognition, wherein the bar code shown in FIGS. **8** and **9** are replaced by a face and the software is replaced by face recognition software. In this embodiment, the user looks at the face of another person and the camera records the image of that person's face. The software within the computer extracts the essential information and makes a comparison to a database. If the characteristics are matched in the database, the user is supplied with information about the person through the eyeglasses. A similar application comprises hand position recognition in which the position of the hands or a hand-held stylus is analyzed to create input or command signals to the computer.

In all of the above applications, it is necessary for the camera to record the view that the user has. The advantage of a camera mounted in eyewear is obtained, because the camera is aimed at the user's subject by virtue of its alignment within the eyeglasses.

As noted above, the subsystems may be integrated with displays. FIG. **10** illustrates an embodiment in which a display **720** is integrated within the left temple **722** and left lens **724**, and a camera **726** is integrated in the right temple **728** and lens **730**. It is also possible to feed the data directly from the camera to the display. For example, a number of commercial cameras, as well as CMOS and CCD image sensor integrated circuits, provide signals conforming to the National Television Systems Consortium (NTSC) specifica-

tion. This analog data can be supplied to most liquid crystal display drive electronics directly, without the use of a computer. One such display is the CyberDisplay offered by Kopin Corporation. In this way, the display can serve as a viewfinder or monitor for the camera.

Many important devices can be constructed with this simple arrangement. If the camera sensor comprises a long wavelength infrared focal plane array or other sensor, then the device allows the user to have vision in the long wavelength range which is well suited for vision through smoke. Firefighters use long wavelength sensors to find people in smoke-filled buildings in which the performance of ordinary vision is poor. Additionally, systems of this type can be configured for enhanced night vision by using infrared image sensors, or by using highly sensitive low-light image sensors. The system can also serve in surveillance applications in which imagery from one set of eyeglasses is transmitted to a second set. This allows a surveillance team to share images.

The eyeglass embodiment of the various camera systems comprises an improvement over the prior art alternatives owing to its light weight and compact nature, as well as owing to the automatic aiming of the camera by virtue of its mounting within eyewear, and its use of the eyeglass lens to align the camera to the user's pupil. Additionally, such systems can be used without employing the hands, making it possible to conduct other tasks while using the device.

The present invention also utilizes audio transducers integrated within eyeglasses as communication devices and as input/output devices for computers. In addition to the integration of audio with an eyeglass display and/or camera system, another embodiment contemplates the use of bone conductivity transducers to allow the transducers to be concealed within the eyeglass frames. Bone conductivity transducers are designed to transmit sound vibrations directly to solid media (bone) and not to develop a pressure wave in air. Accordingly, bone conductivity transducers are not generally audible unless in contact with the head. Additionally, bone conductivity transducers are not worn in the ear canal and accordingly do not block normal hearing and further do not require an audio microphone near the mouth. For this reason, bone conductivity transducers permit the concealment of the transducers within eyewear.

As shown in FIG. **11**, a bone conductivity transducer **810** serving as the speaker may be mounted to the temple **800** of an eyeglass frame so as to be in contact with the skull at a point approximately centered over the ear. The transducer may be mounted on a sliding mechanism in the manner of the camera sensor described earlier. The transducer is mounted on the inside of the temple for adequate contact to the head. The temples are provided with adequate tension so as to press the transducer comfortably to the skin. The sliding mechanism allows the user to adjust the position for best fit. The transducer is in communication with the rest of the system through leads **820** which may extend through a cavity **830** within the temples (FIG. **12**). The leads may be made from flexible stranded insulated wire, flexible coaxial cable, or flexible circuitry based on Kapton or other polymeric material. By using flexible material, the position of the transducer may be adjusted without strain to the leads.

One or more bone conduction microphones may be mounted within the eyeglass frame, including within the nose piece, to sense the vibration produced by the user's speech. Alternative positions for bone conduction microphones are along the temple or at the back of a temple behind the ear. In some cases the microphone may be mounted in an attached earpiece which may be inserted into the ear.

Alternatively a directional air conduction audio microphone may be used by placing it at the bottom of the eyeglass frame oriented so as to preferentially detect the sound of the user's speech. A plurality of microphones may be used in order to make possible the implementation of noise reduction techniques using analog or digital signal processing. For certain applications, it is desirable to sense ambient sound instead of or in addition to the user's speech. In that case, an air conduction microphone similar to ones used in hearing aids may be used in any convenient place along the eyeglass frame. For the particular application of assisting the hearing impaired, the microphone would be so oriented so that sound coming from the area in front of the user is preferentially detected, in alignment with the camera direction if one is used. Alternatively, an external microphone may be used for this application.

In order to accommodate the integrated circuits and flexible interconnect circuitry within the eyeglass temple, the eyeglass temple may be made hollow so as to house the circuits. Additionally, if the temple is made from metal or is metal coated, the circuits can be shielded so that the radio frequency interference from the internal circuits is minimized. Although flexible Kapton circuitry may be used as a substrate and interconnect for the internal electronics, alternatively it is possible to design a multichip module (MCM) and package using the eyeglass temple as a housing, as illustrated in FIG. **13**. The metal temple **800** is provided with a cavity **846** having a mounting edge **845** designed to fit with a second part **801** which has an edge **847** that mounts against edge **845**. The two parts **800** and **801** mounted together form a closed cavity. Part **801** forms the substrate for an MCM and is coated with multi-layer ceramic and conductive patterned layers **848** as is known in the art which provide the interconnection paths to the integrated circuits **849** that are mounted in die form upon the layer **848**. FIG. **14** shows a cross section taken along line **840** which shows the enclosure formed when temple **800** is joined to the MCM substrate **801**. The MCM may be connected electrically to the other subsystems by wires or flexible interconnect which are not shown in the figures.

FIG. **15** shows an alternative arrangement in which the MCM and its component layers **848** and integrated circuits **849** may be formed within the temple **800**. Substrate **801** may contain additional circuits and/or may serve as a cover.

The interconnection of the subsystems to external electronics may be made by individual wires; however, an improved method comprises multiplexing and demultiplexing of the signals in digital or mixed signal form. FIG. **16** illustrates a block diagram of the subsystems that may be mounted within the eyeglass system and a multiplexing/demultiplexing circuit intended to simplify connection to the external electronic device. The multiplexer/demultiplexer and buffer circuitry interprets data originating at an external device and which is provided by an input/output (I/O) connection. The circuit identifies the data and stores it in a buffer. The data are then provided to the appropriate subsystem within the eyeglasses. The multiplexer component also collects audio data from the microphone and imagery from the camera and multiplexes it for return along the I/O path to the external device. Such circuits may be formed in integrated fashion and may be mounted within the temples as previously described. In such a case, this multiplexer integrated circuit can be mounted on Kapton flexible circuitry which can connect to the other circuits in the eyeglasses, or it may be part of an MCM. Additionally, a second integrated circuit can be employed to accept power from the I/O connection and condition it so as to provide the

supply voltage needed by the various subsystems. The various circuits may be distributed between the left and right temples. There are numerous interconnection and data formatting methods consistent with this approach, including the IEEE 1394 family of standards and the like.

The subsystems described above are connected to remote electronics either by wire as noted above, or by infrared link, radio frequency methods, or by fiber optical cable. FIGS. **17**A–C illustrate the three methods. In FIG. **17**A, a fiber optical cable **900** provides signals to an integrated laser and detector **910** mounted within the temple of the glasses. The electrical signals are passed to and from a driver and amplifier circuit **920** which is in communication with the I/O line to the demultiplexer in FIG. **16**. A second arrangement, shown in FIG. **17**B, comprises reception and transmission of data by infrared (IR) link. Infrared radiation illustrated by ray **951** is received and transmitted through lens **950** which directs the light to and from an integrated detector and IR LED pair **930**. The integrated detector and LED pair are amplified and driven respectively by circuit **940** which is in communication with the I/O data stream. A further alternative arrangement, shown in FIG. **17**C, comprises an RF link in which signals are transmitted and received by antenna **980**. These signals are passed to and from transceiver circuit **960**, which is in communication with the I/O data stream.

In each of the above embodiments, a battery **925** may also be installed in the eyeglasses which powers the interface circuits and all other devices in the eyewear. The battery may be located within the temple behind the ear or remote from the eyeglass frame and in communication with the eyeglasses by wire.

The use of an IR system is illustrated in FIG. **18**. A notebook computer or other device **995** is viewed by a user along lines of sight **992** or other similar lines of sight to the device, resulting in a general orientation of the head toward the screen or keyboard of device **995**. An LED and detector pair **994** which sends and receives IR signals is positioned on the device **995** so as to be near or within the field of view of the device **995**, as shown in FIG. **18**. Ray **991** is incident upon a light receiving area of the eyeglasses, defined for example by lens **950** in FIG. **19**. The light **991** collected by lens **950** enters the main lens **280** and reflects from the back side of mirror **276** toward IR LED and detector pair **930**. Other optical configurations are possible, including locating the pair **930** in the other main lens, and/or configured without the need for mirror **276** or lens **950**. Additionally, if the camera is provided with an IR sensor, the detection of the signal may be made directly at the camera sensor **510**.

The integration of microphones, speakers, camera and display within or upon the eyeglass frames makes possible a wide range of communication and recording devices, in addition to computer input and output devices. A multimedia interface module, comprising one, several, or all of the audio and video subsystems, has numerous applications when combined with the appropriate circuitry. FIG. **20** illustrates a system with a plug-in module **1001** located on a strap **1002** behind the head. The strap may contain within it batteries, electronic circuits, and wires and may also be fitted to hold the glasses in position in the conventional manner. The strap may be flat if it contains Kapton flex circuitry, or it may have a rectangular or other cross section. The glasses may be fitted with audio transducers **1004**, electronics **1005** to drive a flat panel display **1006**, a camera sensor **1008** and related electronic and mechanical parts **1007** as previously described herein. Alternatively, the internal circuitry of the plug-in module **1001** may be permanently mounted within the eyeglass frame **1003**. If the circuitry is too large for integration in the eyeglass frame, and is also too large for head mounting, the strap **1002** may be lengthened so that the plug-in module **1001** can be placed in a pocket or worn on a belt.

An application of a display system using audio within the glasses is in a hands-free telephone interface. In such an application, the eyeglass system is connected to telephone circuitry, such as a cellular or cordless telephone, provided in the module **1001**. A keypad is unnecessary if voice recognition is employed. In such a case, the user speaks the command normally input by keypad, such as the number to dial, the send command, and so forth. The display within the interface module shows the number to be called for verification, just as the display on a cell phone would show the number, and after the appropriate send command is spoken, the call is placed. The user speaks and listens through the audio capability of the eyeglass system. This is an improvement over the standard cell phone interface because the user's hands are free, and the user does not have to look away from his current field of view in order to verify the number to be called.

An electronic hands-free pager may be incorporated within the eyewear interface system by interconnecting the system to a pager receiver by wire within strap **1002** to module **1001**. Alternatively, the pager receiver or transceiver circuit may be incorporated within the eyeglass frame itself.

The interface system may be provided with a timepiece module within the eyeglass frame so that the time is displayed in the user's field of view by the display. In addition to providing the time in a hands-free manner, a further improvement over wristwatches and wall clocks is that the user may check the time in a non-obvious way thereby avoiding giving offense to others with which the user is conversing.

The interface system may be connected to an information sending unit or may be fitted with an RF receiver for reception of critical information, located within module **1001**. This information system may be, but is not limited to, a general function computer such as a notebook computer. For example, a receiver may be mounted in the eyeglass frame to display simple alpha-numeric characters. A transmitter in communication with this receiver may be provided with a blood pressure or other vital sign monitoring device, so that a surgeon may be provided with vital sign data for a patient. In this way the data is available to the surgeon in a hands-free manner and without the need for the surgeon to look away from the incision.

Many other similar information systems are possible. For example, an electronics engineer may be provided with a display of the output of an oscilloscope or network analyzer. In this way, the engineer can see the output of the measurement device without the need to look away from the device under test.

The camera and microphone within the glasses allow the system to perform many of the functions of a camcorder or still camera. Audio and video may be recorded in electronic memory and then may be transmitted to tape or disk storage media. The advantages over current camcorders are that the interface system, including the camera, is largely hands-free. The only requirement is that the user activate the recorder either by spoken command or by the use of buttons on the recording device. A head tracking position sensor can be used to stabilize the image. In such a device, the recording device (for example, tape recorder, recordable digital video disk system, recordable compact disk system) are located in module **1001**.

The camera system comprises standard CCD or CMOS image sensors that are commercially available from Texas Instruments, Kodak, and other sources. These sensors are used in camcorders and electronic cameras. The image sensors are combined with the eyeglass optics so that the camera has a view of the world as seen by the user's eye. The camera may be mounted in the same optical system as the display, or as shown in FIG. **1**, the camera system optics may be mounted for use in the right eye, and the display system optics for use in the left eye.

The head tracking module is useful for augmented reality applications in which information displayed by the interface system is superimposed on the user's field of view by the optical system. For example, computers are used to calculate position from global positioning satellites to provide navigation information to a user. If the system also has information on the direction of gaze of the user, by virtue of a head-tracker sensor, symbols may be provided that are registered to the field of view, such as street names. When the user looks toward a side street, the computer may calculate the position of the intersection of the streets and present the name of the crossing street to the user. Many other applications of augmented reality are possible.

The tracking sensors may comprise either magnetic and gravity sensors that determine position from the earth's magnetic and gravitational fields, or from other artificial magnetic fields. Sensors may be mounted in module **1001** if it is held against the head or alternatively within the eyeglass frame. The magnetic sensor may be based on the Hall effect or may use flux gate magnetometers. Any sensor that detects magnetic field strength and direction may be used in this application, provided the sensor is small enough to fit within an eyeglass frame or module. An alternative is to position magnetic sensors within module **1001** which is worn upon the shoulders of the user, and to place small magnets within the glasses frame. In this way the magnetic sensors can determine the user's head position. Many other types of sensors may be used for the head tracking system, including miniature gyroscopic or other inertial sensors, ultrasonic sensors, and even systems that use images from the camera system to detect head movement.

The eyeglass module can be used for video conferencing. In this application, the interface system comprises a display, camera, associated optics, and audio system in communication, either by wire or local RF, with a transceiver which is itself in communication with the video conferencing partner. Video conferencing systems with standard CRT video and microphone/speaker audio are known in the art. In the present invention, the user receives information in audio and video form through the system interface (display and audio subsystems) and transmits information from the system interface, this information being collected from the microphone and camera. In a video conference, the user transmits to the conference images he sees. Alternatively, the user may face a mirror to transmit his own image. The improvement over the prior art is the high degree of portability offered by this invention.

Many surveillance systems are possible using the interface system, including systems in which the surveillance is concealed by the eyeglass frame. The system may be used by law enforcement personnel to transmit audio and video between agents, in a manner similar to the video conferencing application. For example, an agent on the street may see an image collected by an agent on a roof top. Another application involves patient monitoring in hospital intensive care units. A third surveillance application comprises a baby monitor. The glasses may receive images and audio from a camera located in a nursery so that the parent may see and hear the baby from anywhere in the house.

The interface system may be applied in telepresence systems, in which the user receives visual and audio information from a remote source, as if he were present at the remote source. A transmitter at the remote source collects information from the environment and sends it to the receiver. As shown in FIG. **21**, the remote system is configured with two cameras, one in each eye as shown, and two microphones near the left and right ears. The receiving system comprises an interface module fitted with two displays and two audio transducers so that the resulting receiving system displays information as it is collected from the transmitting sensor. In this manner, the user has the sensation of presence at the remote location.

The invention is not to be limited by what has been particularly shown and described, except as indicated by the appended claims.

What is claimed is:

1. An eyeglass interface system comprising:

an eyeglass frame having a lens holder assembly configured to hold a pair of lenses and first and second temples configured to be supported on a user's head;

a cavity formed within the first temple;

an audio or video assembly mounted to one of the first and second temples, the audio or video assembly operative to receive or transmit audio or video signals;

interface circuitry in communication with the audio or video assembly, the interface circuitry comprising integrated circuits disposed within the cavity.

2. The eyeglass interface system of claim **1**, wherein the integrated circuits are interconnected in a multi-chip module.

3. The eyeglass interface system of claim **1**, wherein the integrated circuits are interconnected by a substrate comprising flexible Kapton circuitry.

4. The eyeglass interface system of claim **1**, wherein the integrated circuits are interconnected on a substrate comprising a hybrid circuit assembly.

5. The eyeglass interface system of claim **1**, wherein the integrated circuits include a cellular telephone transceiver.

6. The eyeglass interface system of claim **1**, wherein the integrated circuits include a circuit for reception of radio frequency transmissions of video information.

7. The eyeglass interface system of claim **1**, wherein the integrated circuits include a pager transceiver.

8. The eyeglass interface system of claim **1**, wherein the integrated circuits include an audio recorder.

9. The eyeglass interface system of claim **1**, wherein the integrated circuits include a clock.

10. The eyeglass interface system of claim **1**, wherein the integrated circuits are in communication with a general function computer.

11. The eyeglass interface system of claim **1**, wherein the integrated circuits include a video conferencing interface.

12. The eyeglass interface system of claim **1**, wherein the integrated circuits include a video recorder.

13. The eyeglass interface system of claim **1**, further comprising a second cavity formed within the second temple, and the interface circuits comprise integrated circuits disposed within the second cavity.

14. An eyeglass frame configured for an eyeglass interface system comprising:

a lens holder assembly configured to support a lens system and configured to be supported on a user's head;

first and second temples configured to be supported on said user's head; and

a cavity formed within the first temple and configured to house interface electronics.

15. The eyeglass frame of claim **14**, further comprising a lens system disposed in the lens holder assembly.

16. The eyeglass frame of claim **14**, further comprising interface circuits disposed within the cavity.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,349,001 B1
DATED : February 19, 2002
INVENTOR(S) : Mark B. Spitzer

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
Item [73], Assignee, "Boston, MA" should read -- Westwood, MA --.

Signed and Sealed this

Nineteenth Day of November, 2002

Attest:

Attesting Officer

JAMES E. ROGAN
Director of the United States Patent and Trademark Office

Appendix DDD

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(12) **United States Patent**
Howell et al.

(10) **Patent No.: US 7,806,525 B2**
(45) **Date of Patent: Oct. 5, 2010**

(54) **EYEGLASSES HAVING A CAMERA**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 384 days.

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Related U.S. Application Data

(63) Continuation-in-part of application No. 11/183,256, filed on Jul. 15, 2005, now Pat. No. 7,500,747, which is a continuation-in-part of application No. 10/964,011, filed on Oct. 12, 2004, now Pat. No. 7,192,136.

(60) Provisional application No. 60/509,631, filed on Oct. 9, 2003, provisional application No. 60/527,565, filed on Dec. 8, 2003, provisional application No. 60/562,798, filed on Apr. 15, 2004, provisional application No. 60/583,169, filed on Jun. 26, 2004, provisional application No. 60/592,045, filed on Jul. 28, 2004, provisional application No. 60/605,191, filed on Aug. 28, 2004, provisional application No. 60/618,107, filed on Oct. 12, 2004, provisional application No. 60/620,238, filed on Oct. 18, 2004, provisional application No. 60/647,836, filed on Jan. 31, 2005, provisional application No. 60/647,826, filed on Jan. 31, 2005, provisional application No. 60/725,896, filed on Oct. 11, 2005, provisional application No. 60/725,999, filed on Oct. 11, 2005, provisional application No. 60/787,850, filed on Apr. 1, 2006, provisional application No. 60/846,150, filed on Sep. 20, 2006.

(51) **Int. Cl.**
G02C 1/00 (2006.01)

(52) **U.S. Cl.** **351/158**

(58) **Field of Classification Search** 351/158, 351/121, 111, 119, 41, 156
See application file for complete search history.

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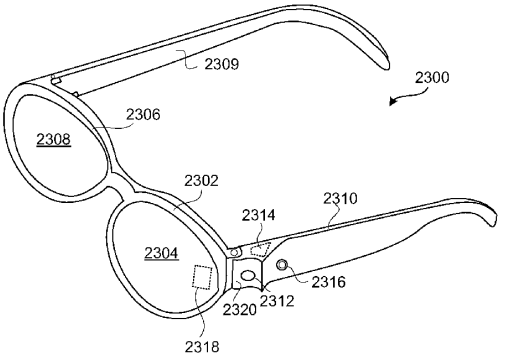
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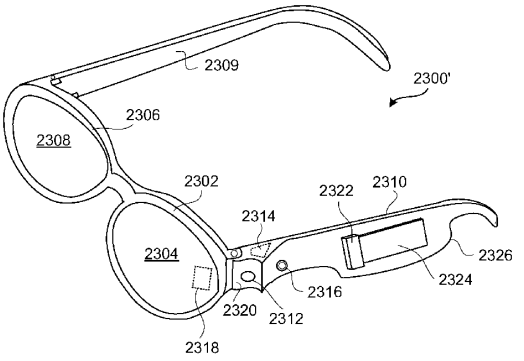
Primary Examiner—Hung X Dang

(57) **ABSTRACT**

One embodiment pertains to a pair of glasses with a camera. For example, the camera can be partially or fully embedded in the glasses. In another embodiment, the camera can be removably attached to the glasses, such as removably attached to a temple of the glasses. The glasses can also include one or more various other electrical components. These other electrical components can work separately or in conjunction with the camera.

30 Claims, 33 Drawing Sheets





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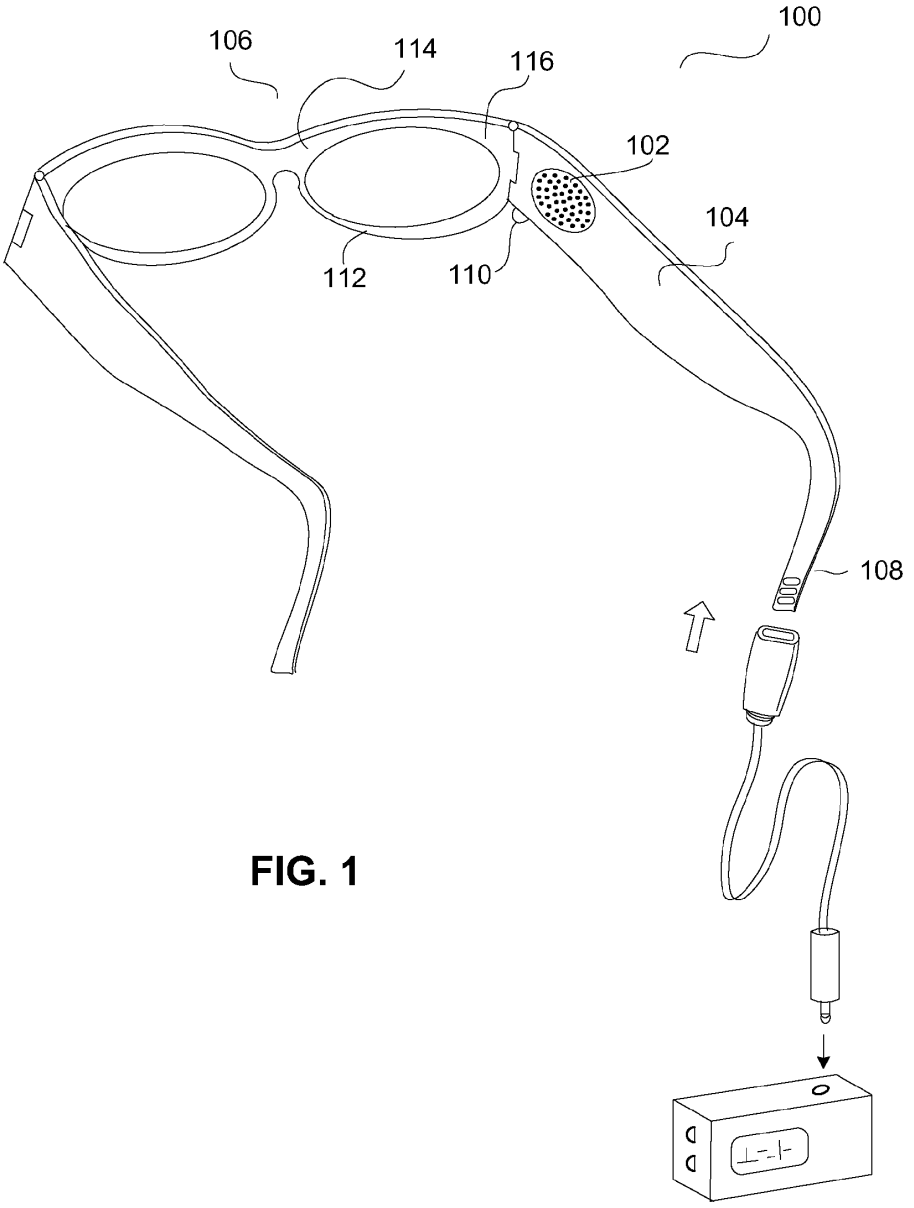


FIG. 1

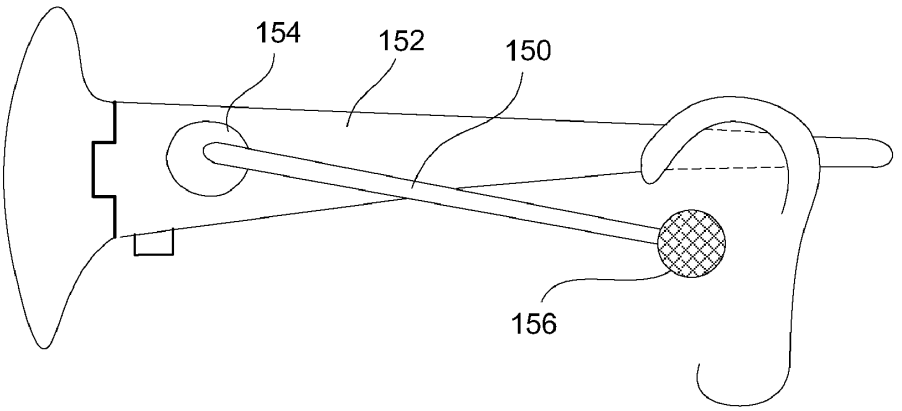


FIG. 2

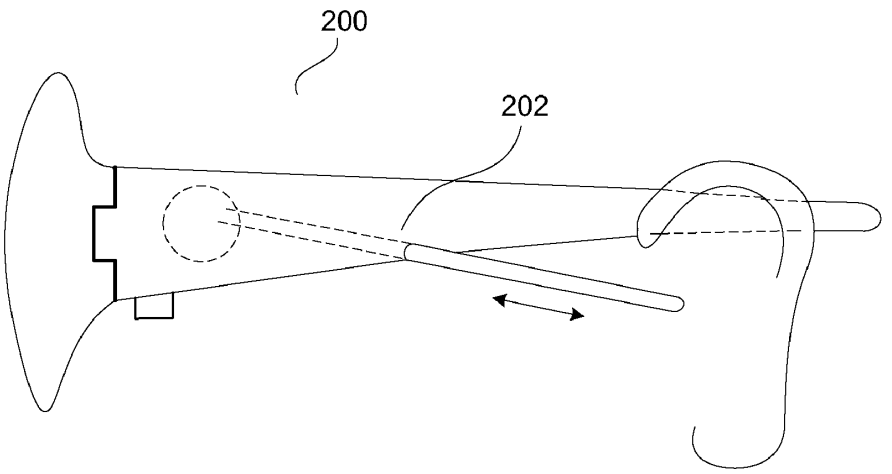


FIG. 3

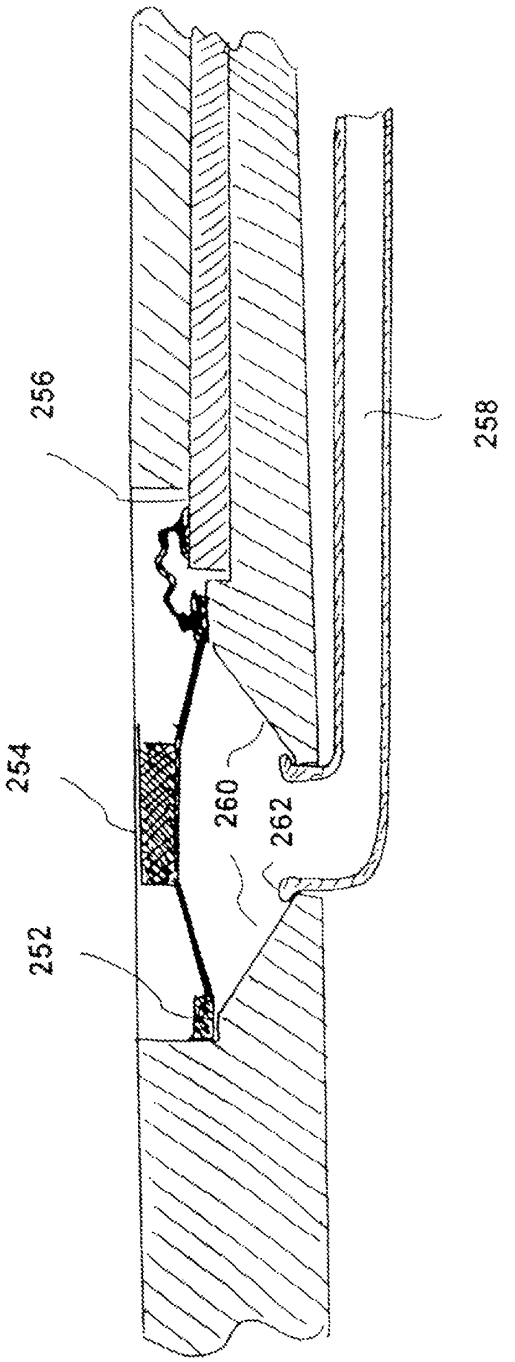


FIG. 4

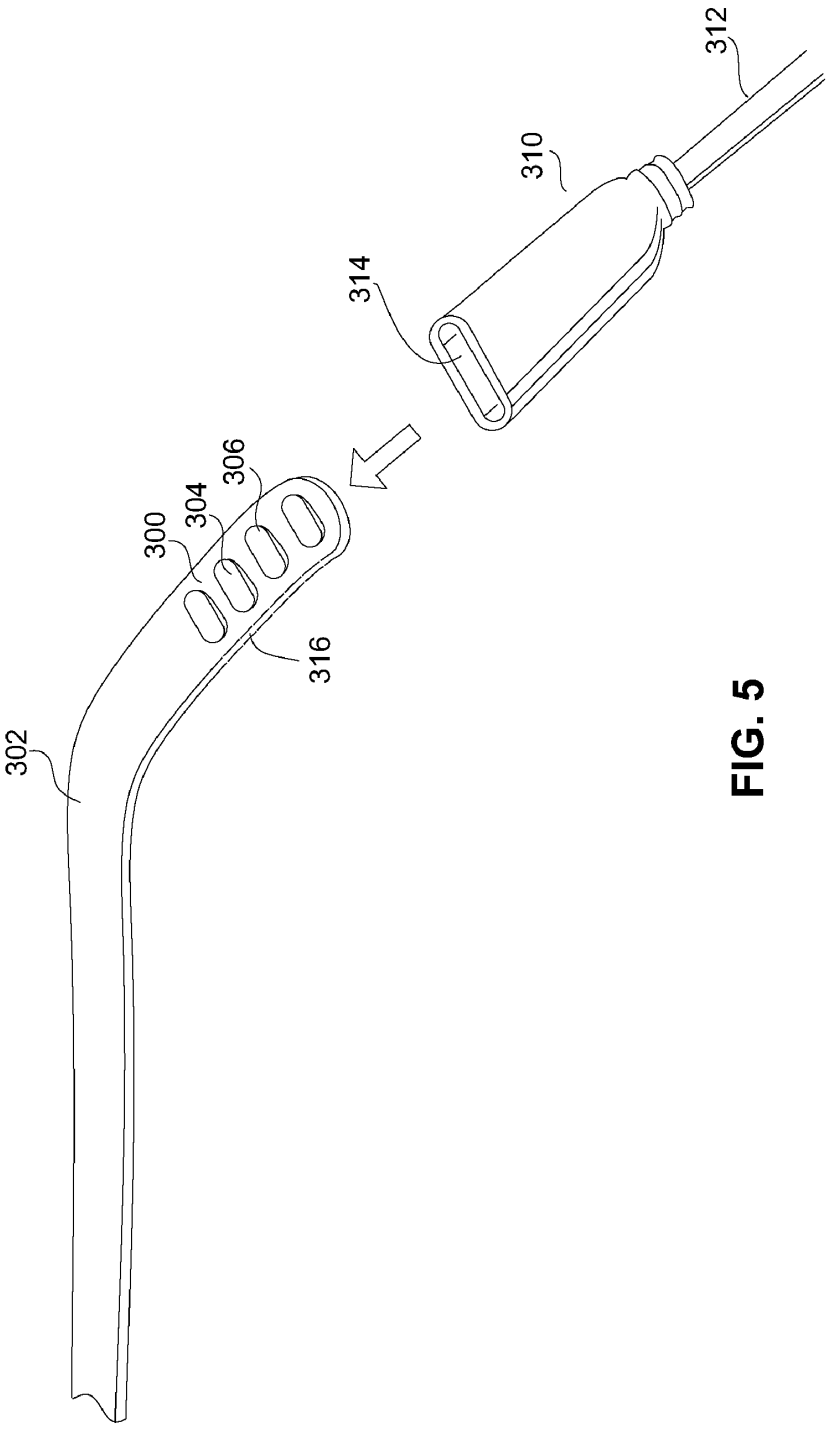


FIG. 5

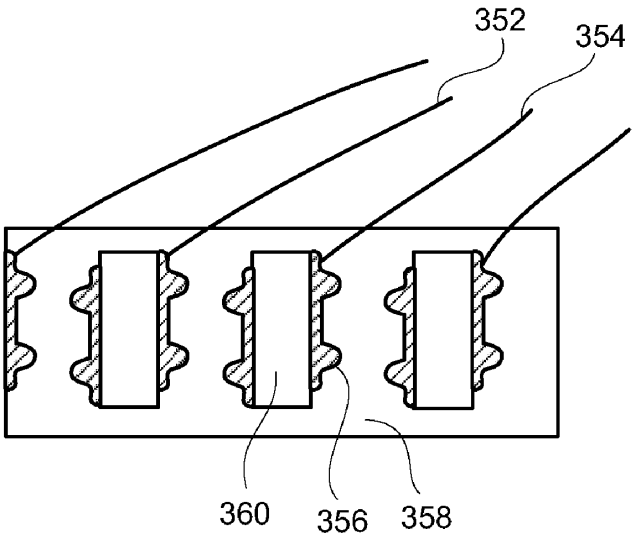


FIG. 6A

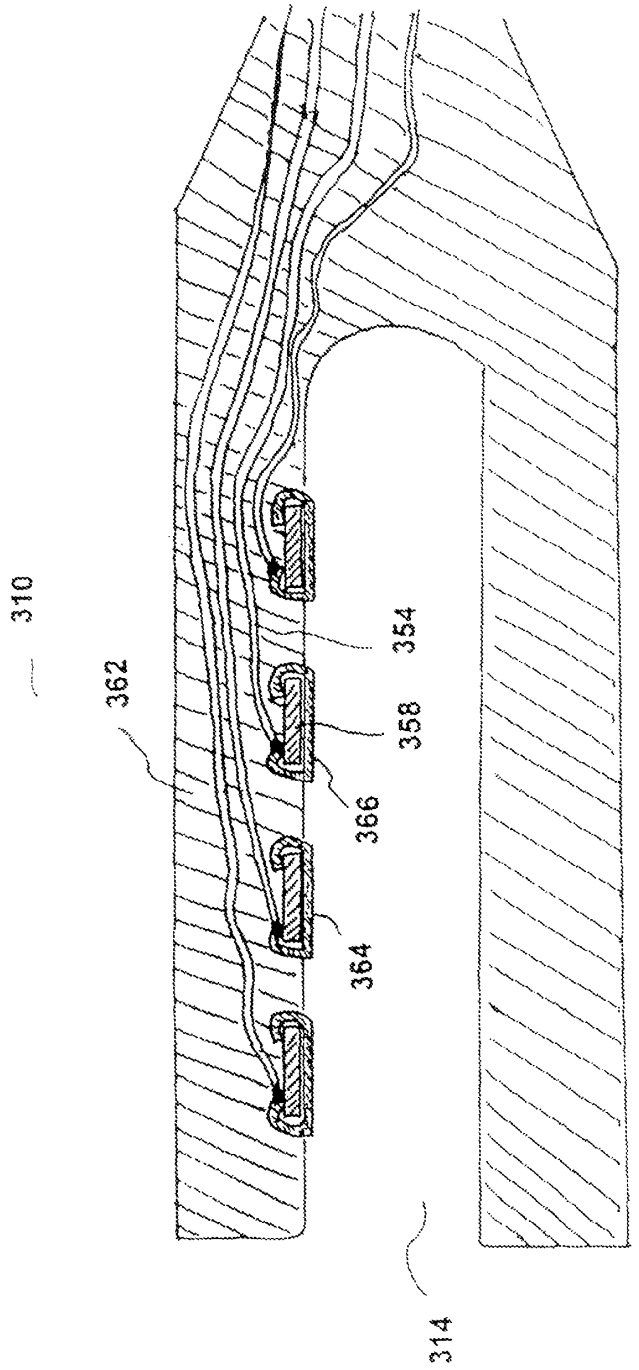


FIG. 6B

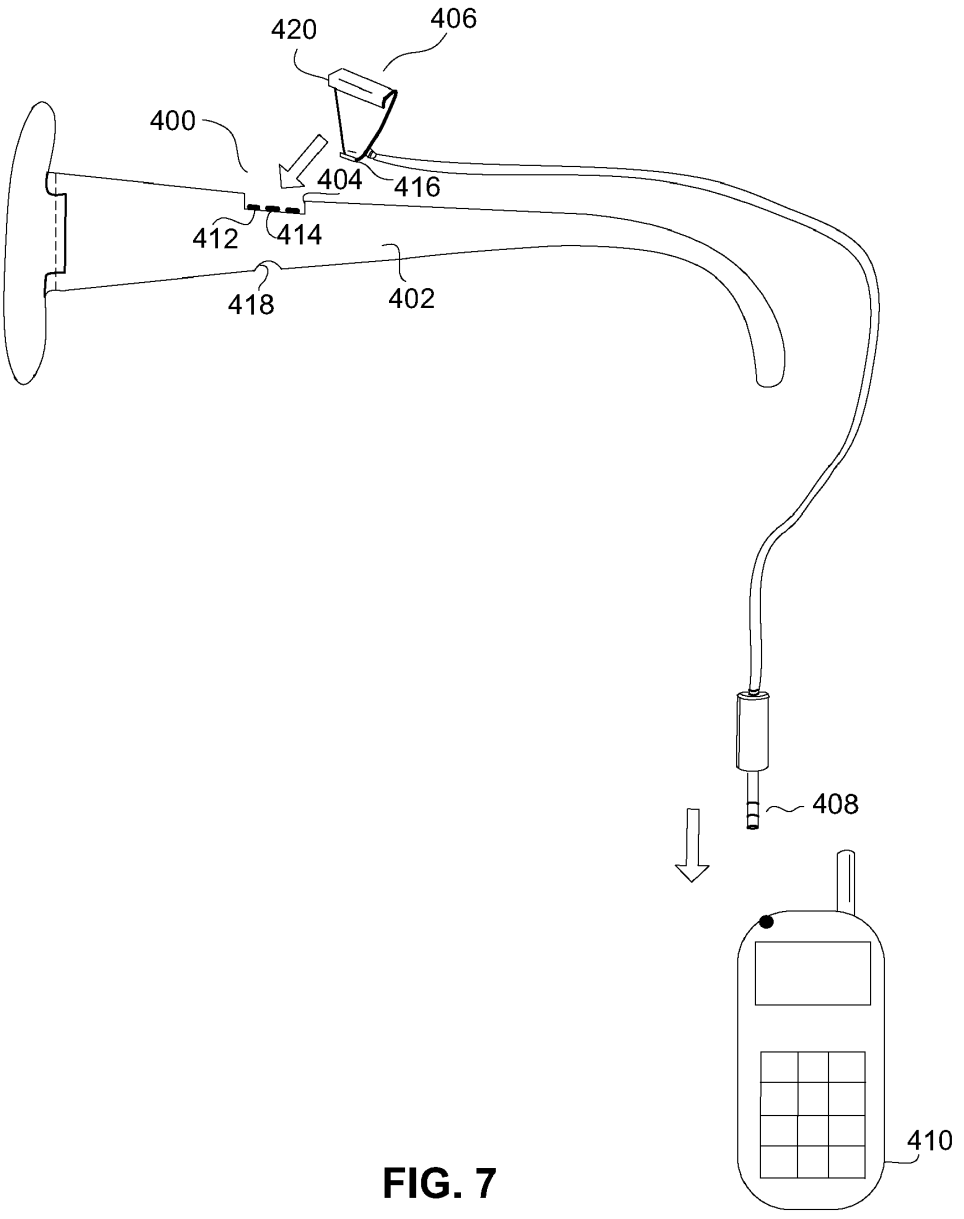


FIG. 7

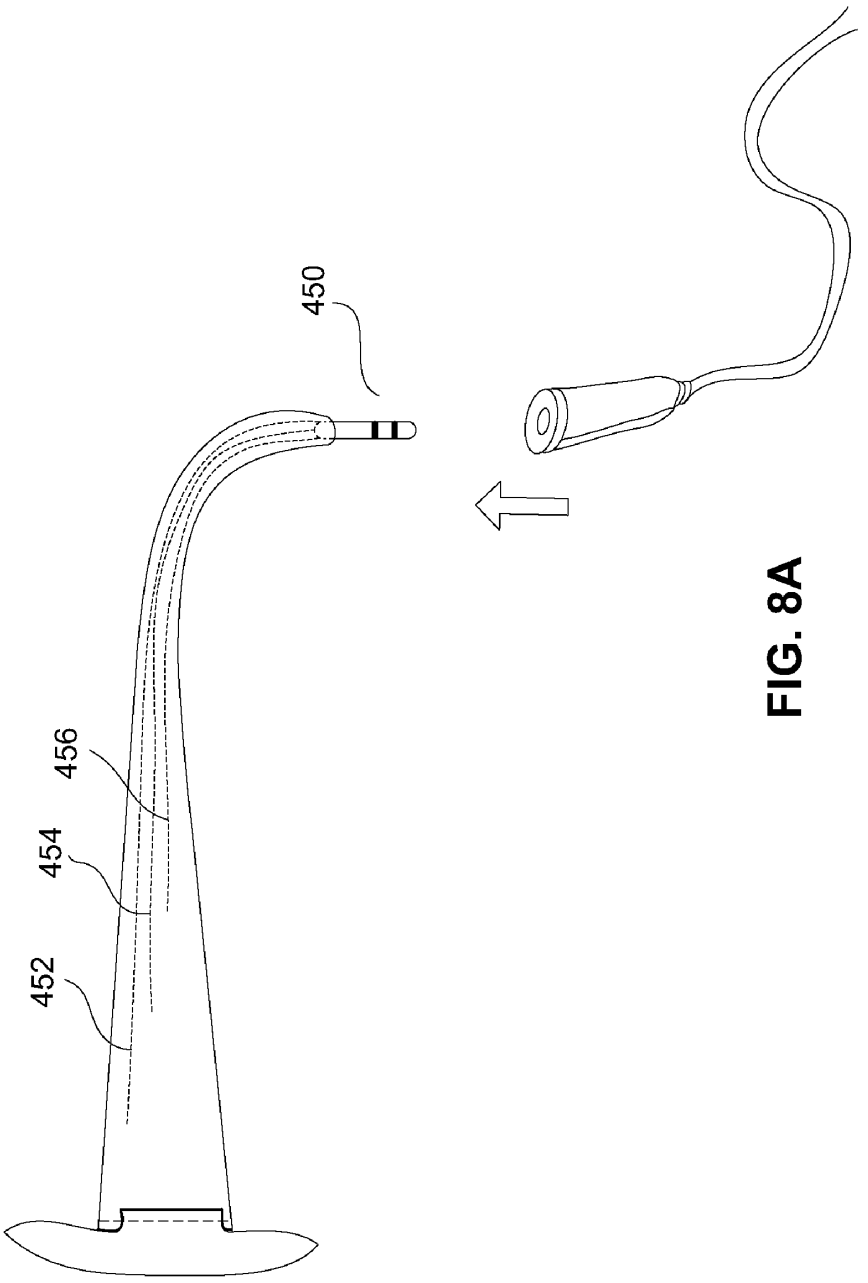


FIG. 8A

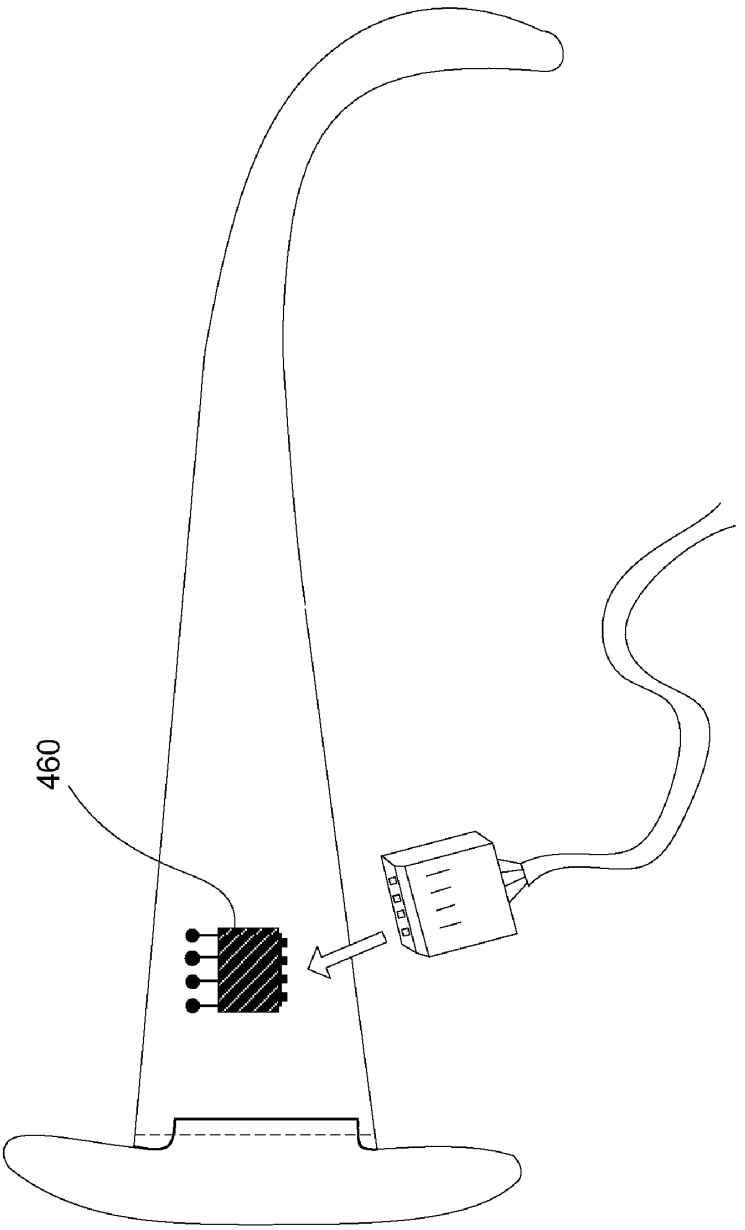


FIG. 8B

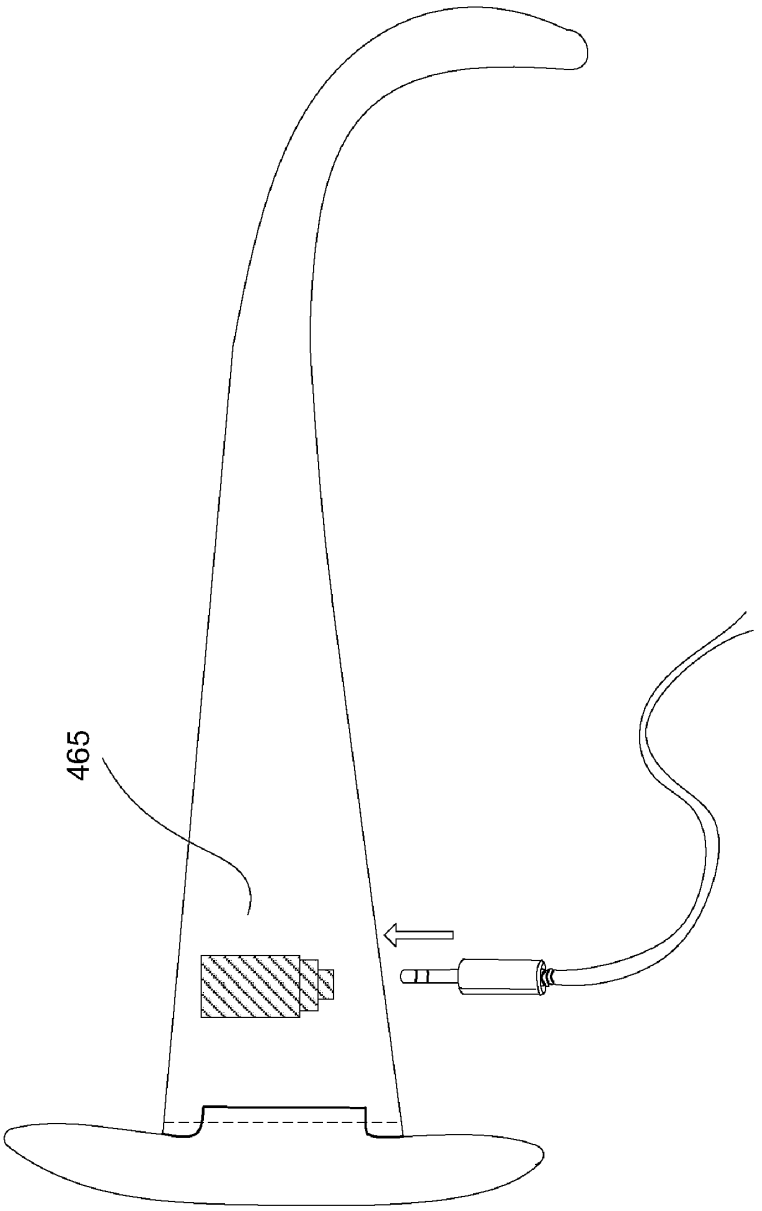


FIG. 8C

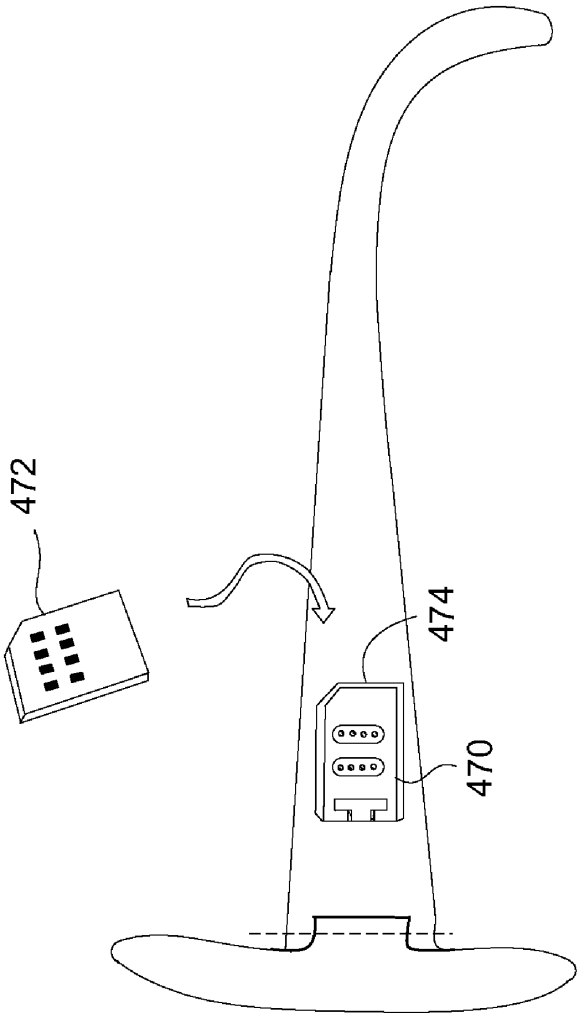


FIG. 8D

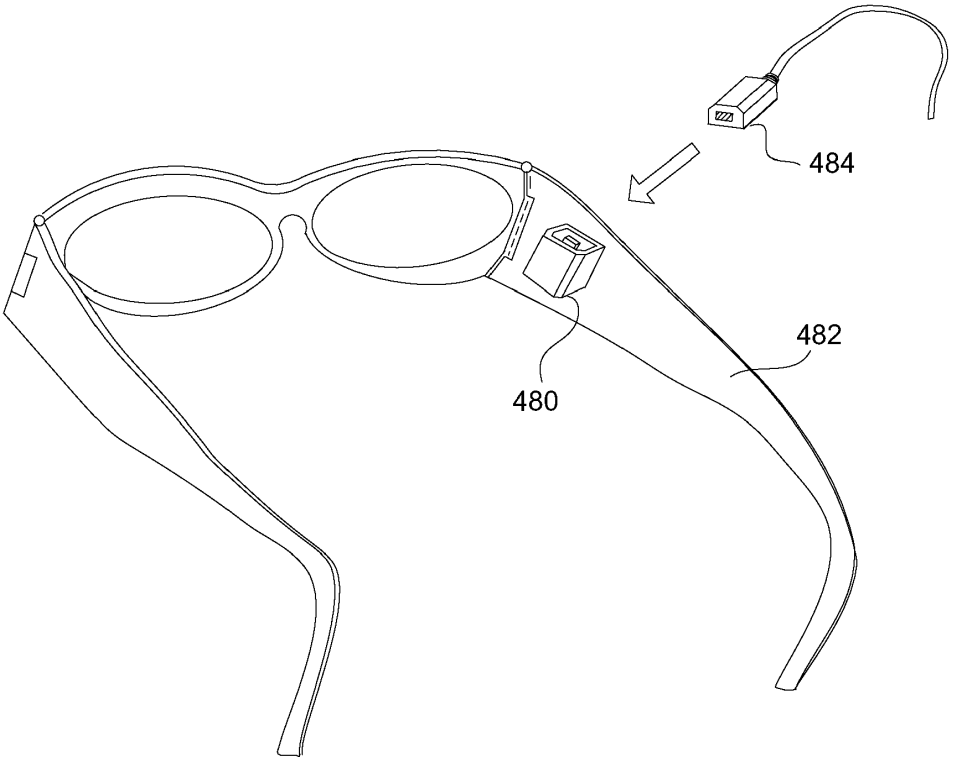


FIG. 8E

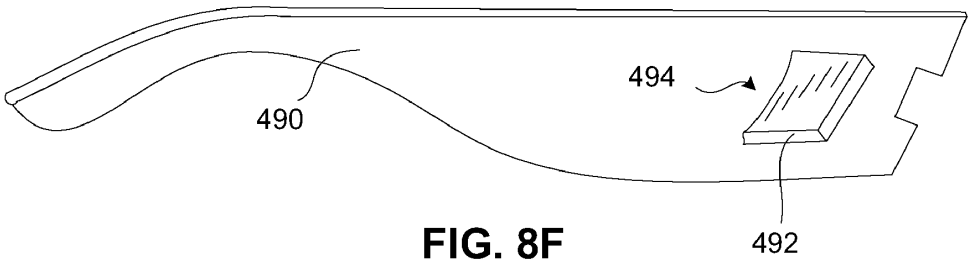


FIG. 8F

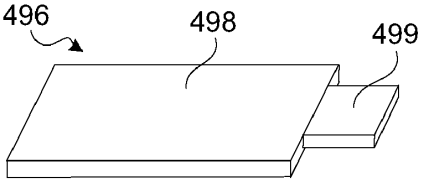


FIG. 8G

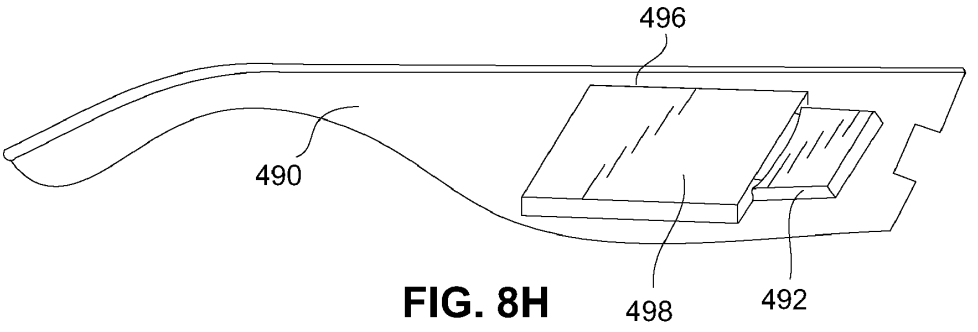


FIG. 8H

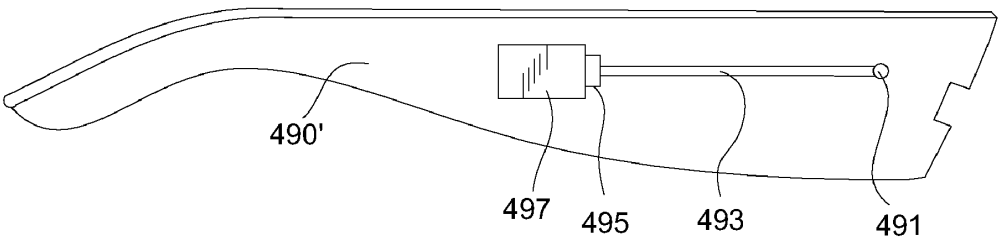


FIG. 8I

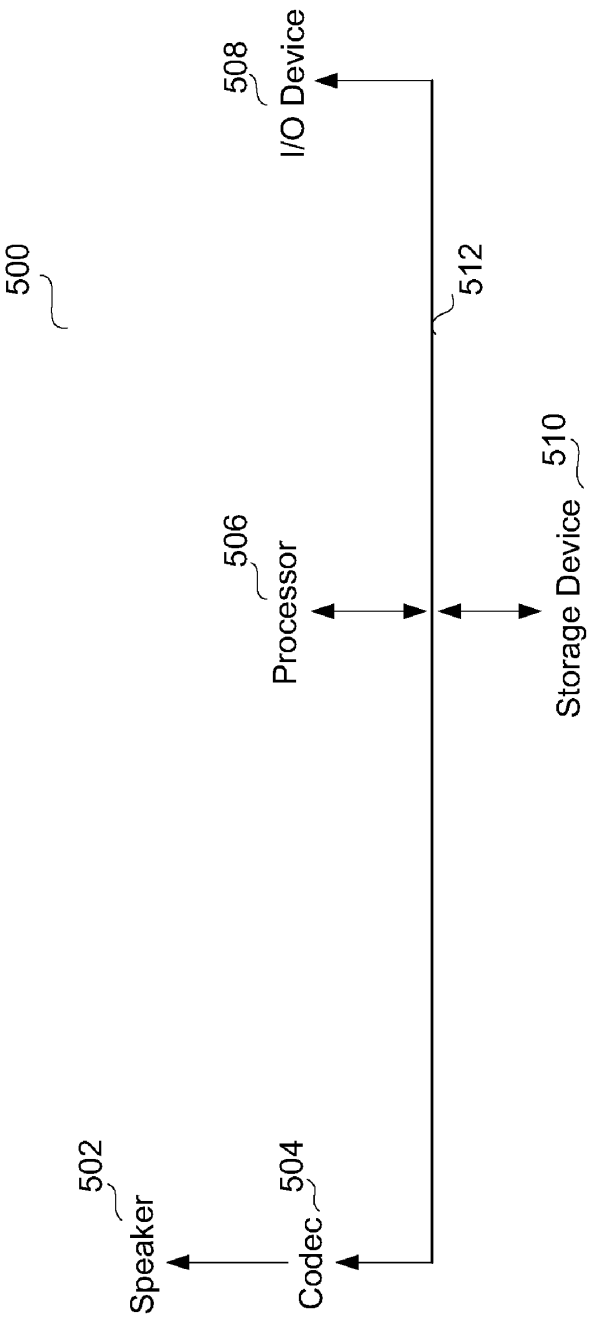

500
502
Speaker
504
Codec
506
Processor
508
I/O Device
510
Storage Device
512

FIG. 9

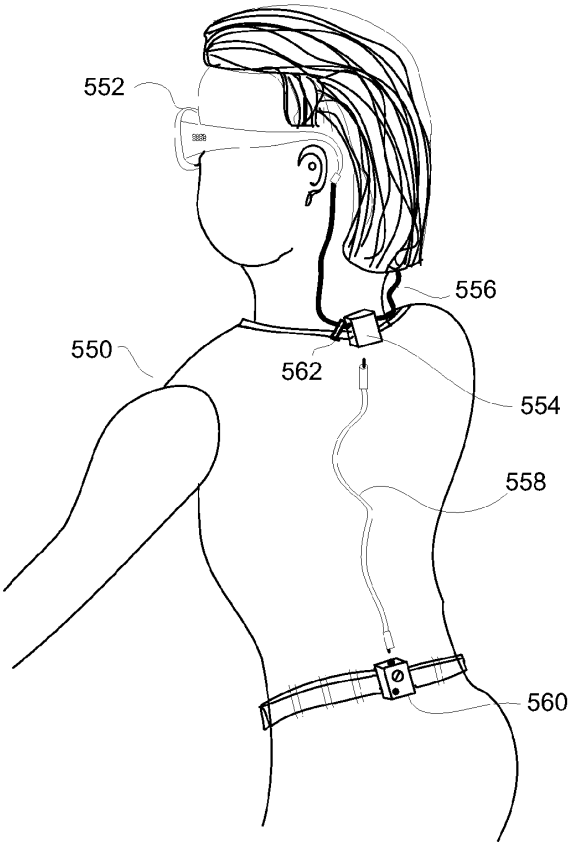


FIG. 10

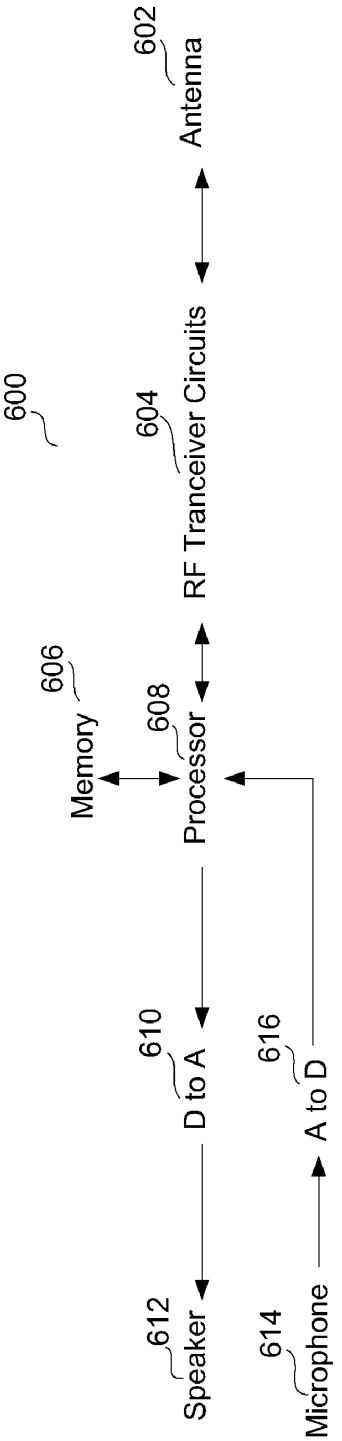


FIG. 11A

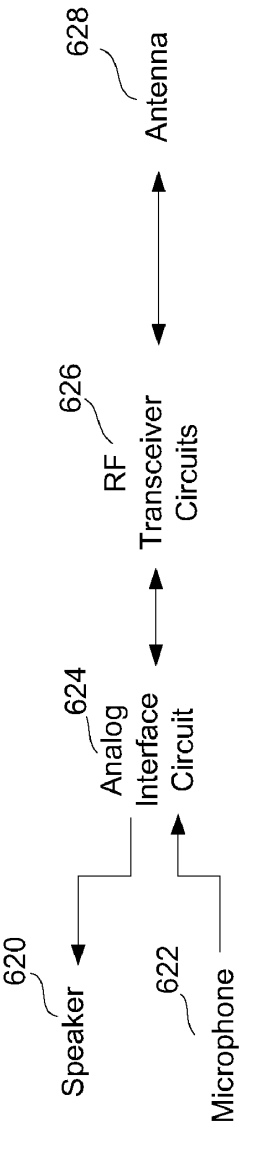


FIG. 11B

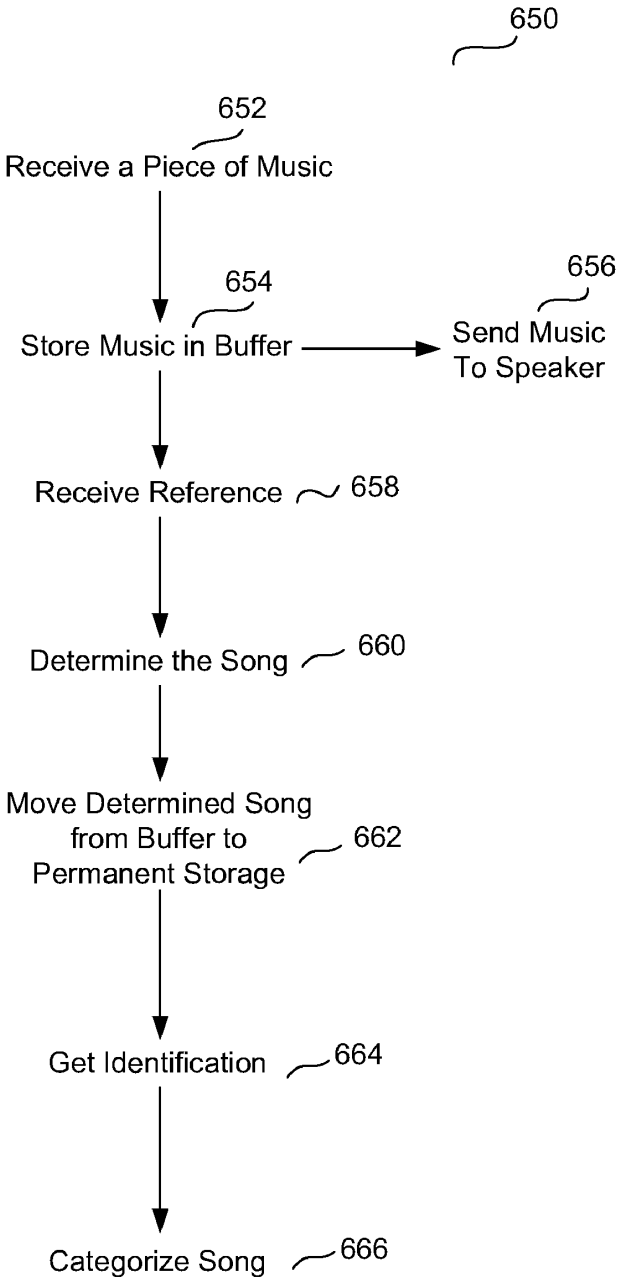

650
652
Receive a Piece of Music
654
Store Music in Buffer
656
Send Music To Speaker
Receive Reference
658
Determine the Song
660
Move Determined Song from Buffer to Permanent Storage
662
Get Identification
664
Categorize Song
666

FIG. 12

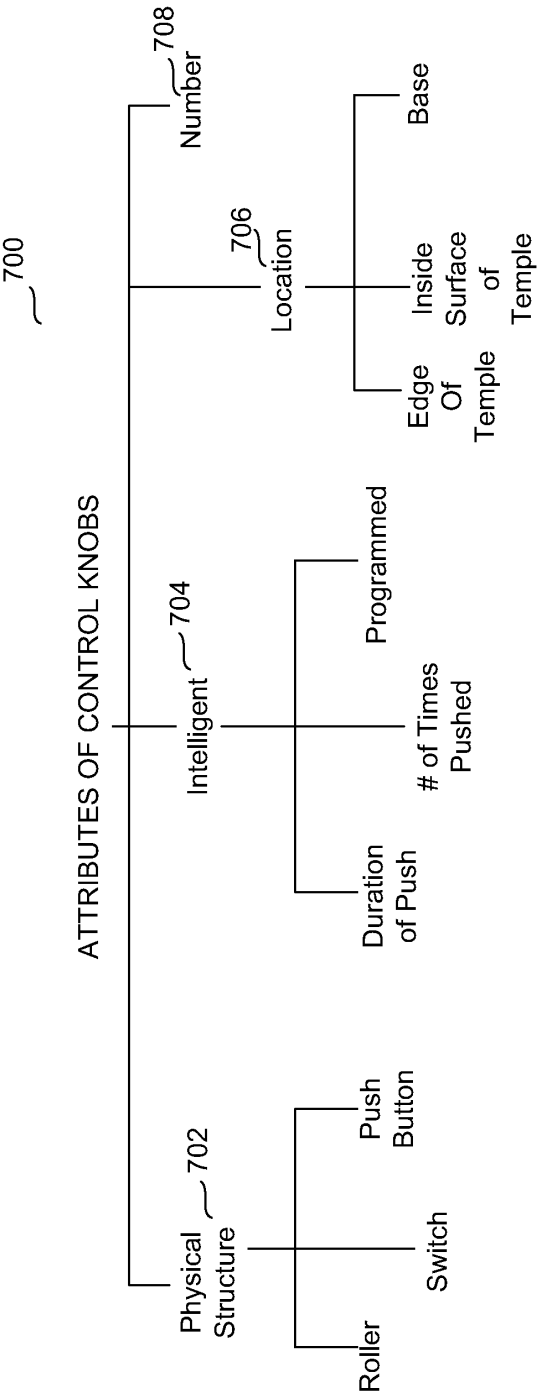

700
ATTRIBUTES OF CONTROL KNOBS
Physical Structure
702
Push Button
Switch
Roller
Intelligent
704
Programmed
of Times Pushed
Duration of Push
Location
706
Inside Surface of Temple
Base
Edge Of Temple
Number
708

FIG. 13

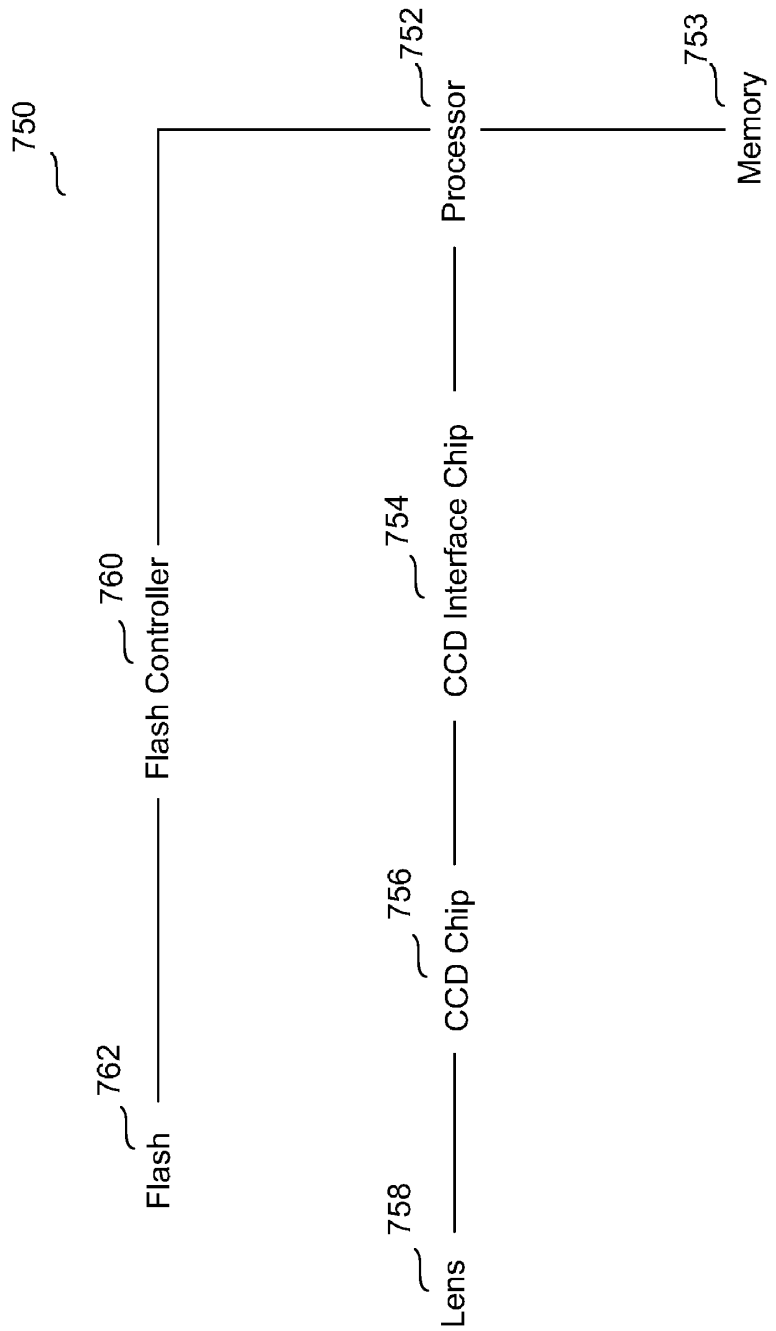

750
752
Processor
753
Memory
760
Flash Controller
754
CCD Interface Chip
762
Flash
756
CCD Chip
758
Lens

FIG. 14

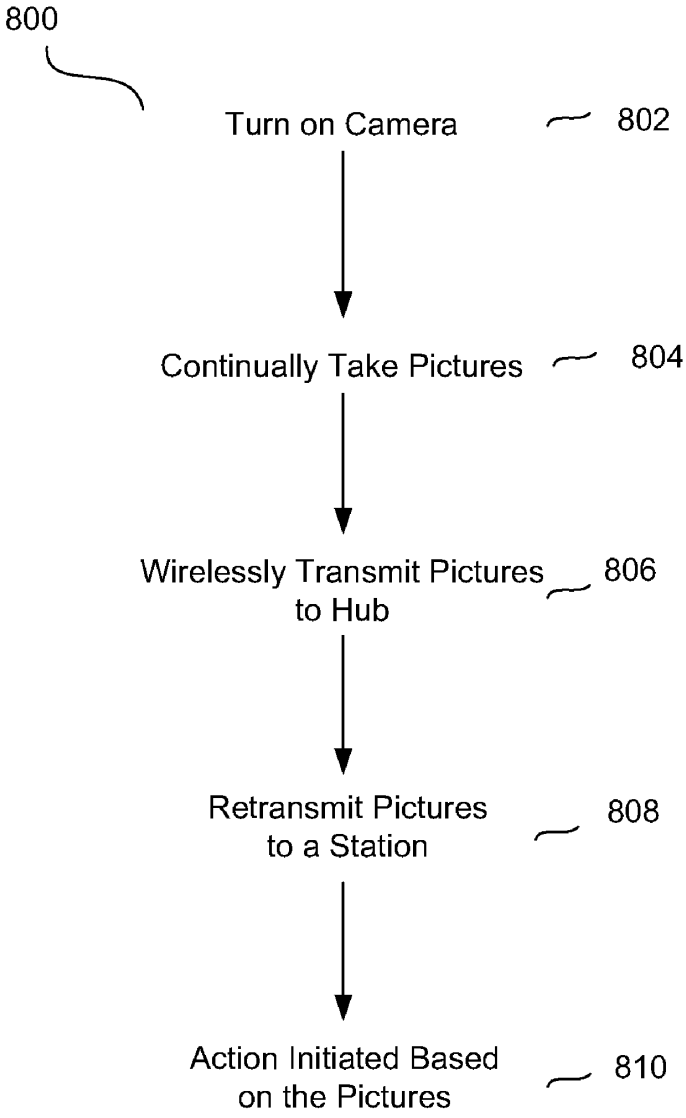

800
Turn on Camera
802
Continually Take Pictures
804
Wirelessly Transmit Pictures to Hub
806
Retransmit Pictures to a Station
808
Action Initiated Based on the Pictures
810

FIG. 15

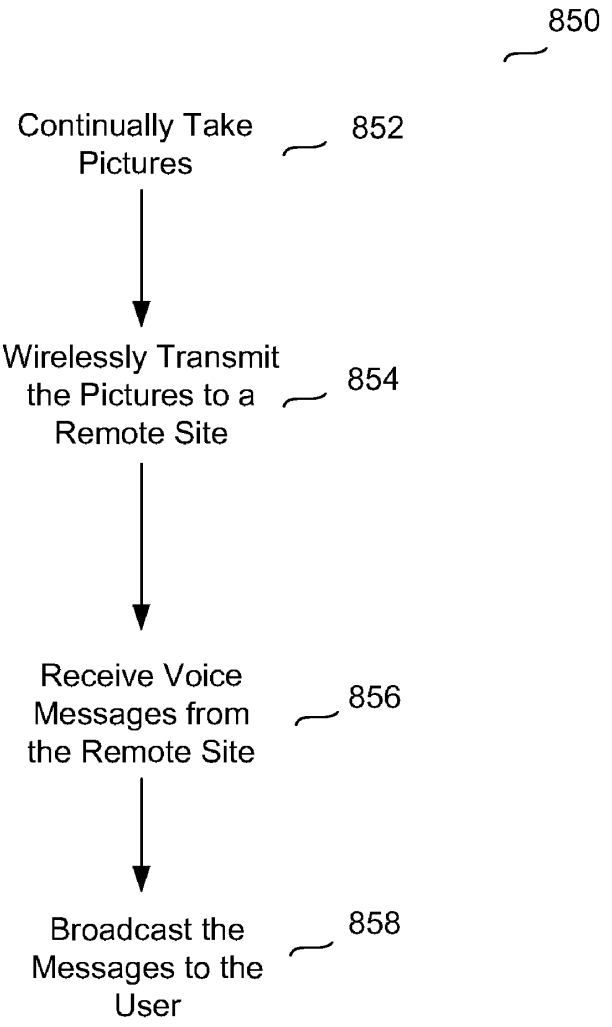

850
Continually Take Pictures
852
Wirelessly Transmit the Pictures to a Remote Site
854
Receive Voice Messages from the Remote Site
856
Broadcast the Messages to the User
858

FIG. 16

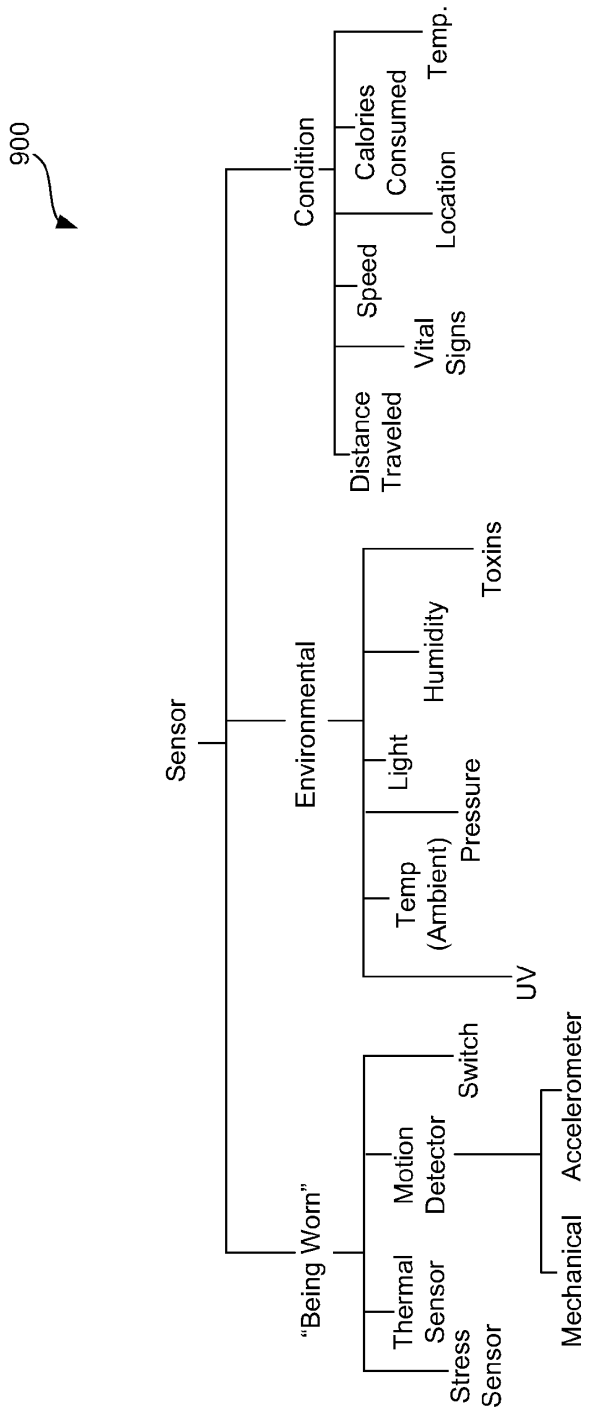

900
Sensor
Condition
Calories Consumed
Temp.
Location
Speed
Vital Signs
Distance Traveled
Environmental
Humidity
Toxins
Light
Pressure
Temp (Ambient)
UV
"Being Worn"
Motion Detector
Switch
Thermal Sensor
Stress Sensor
Mechanical
Accelerometer

FIG. 17A

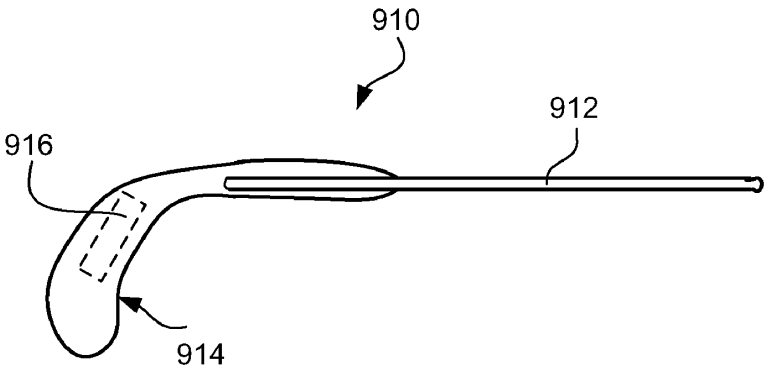


FIG. 17B

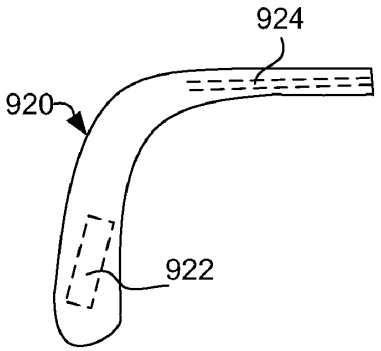


FIG. 17C

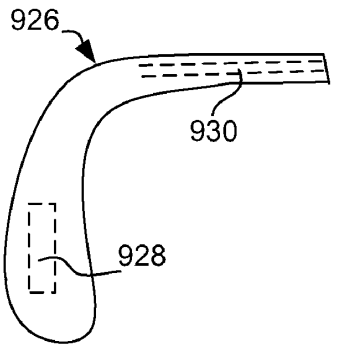


FIG. 17D

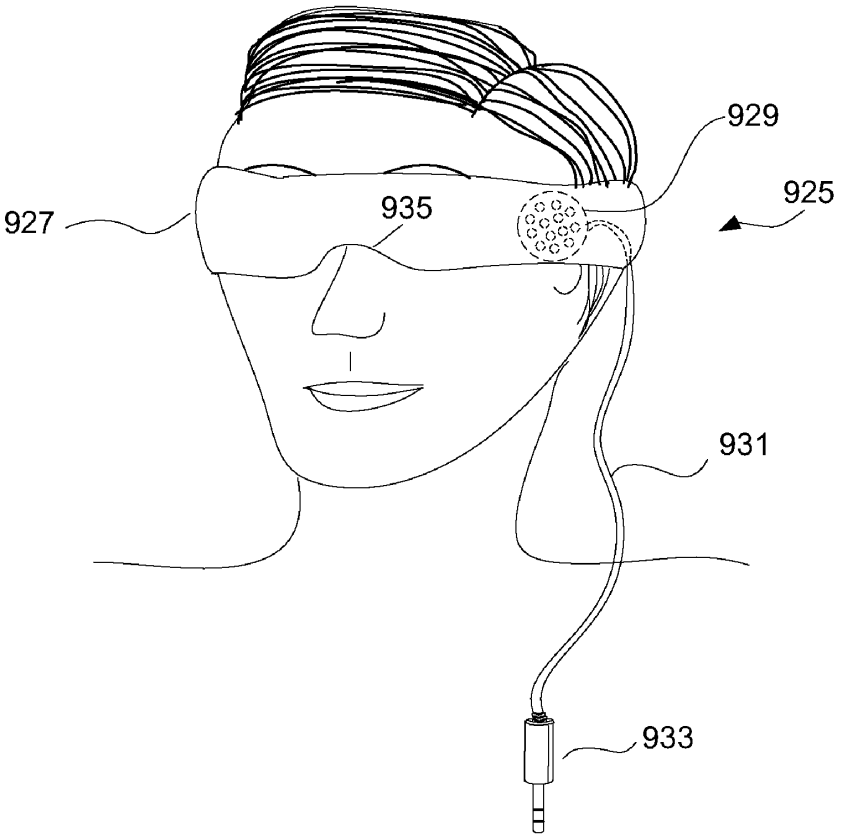


FIG. 18

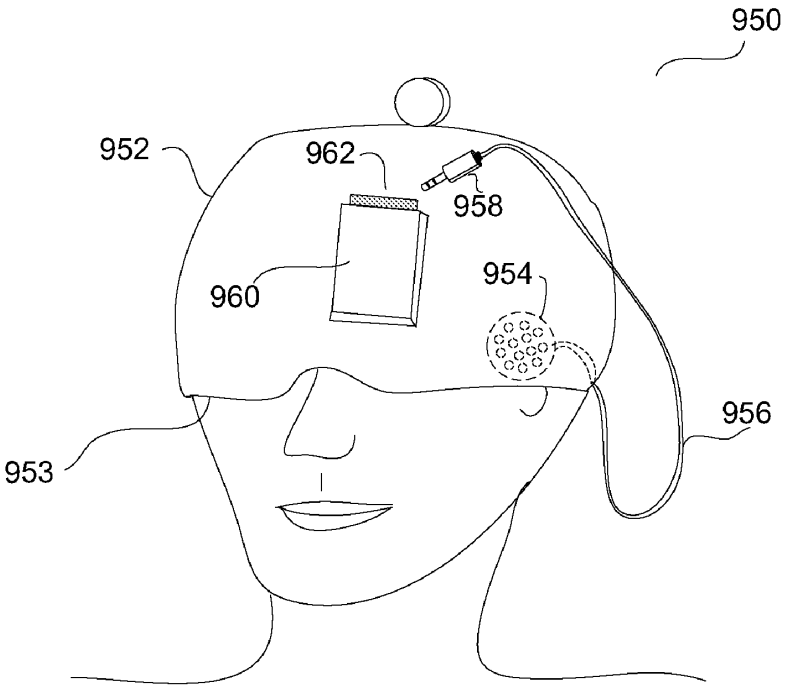


FIG. 19

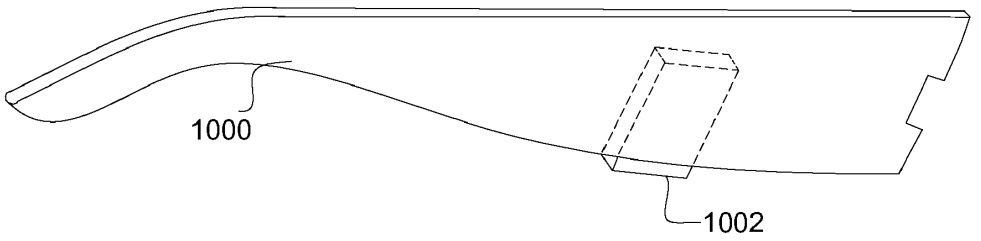


FIG. 20A

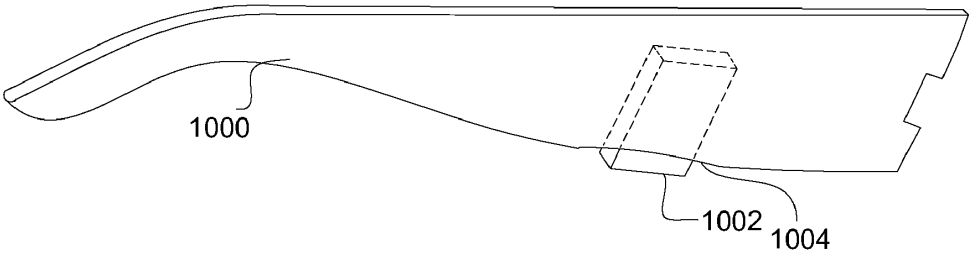


FIG. 20B

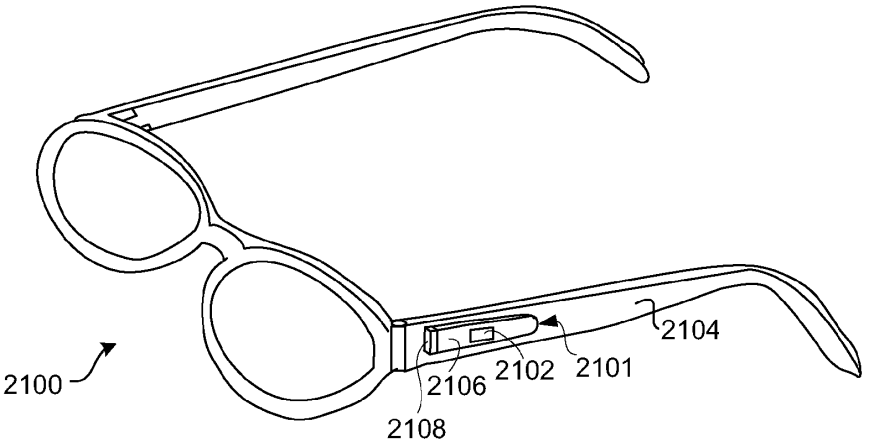


FIG. 21A

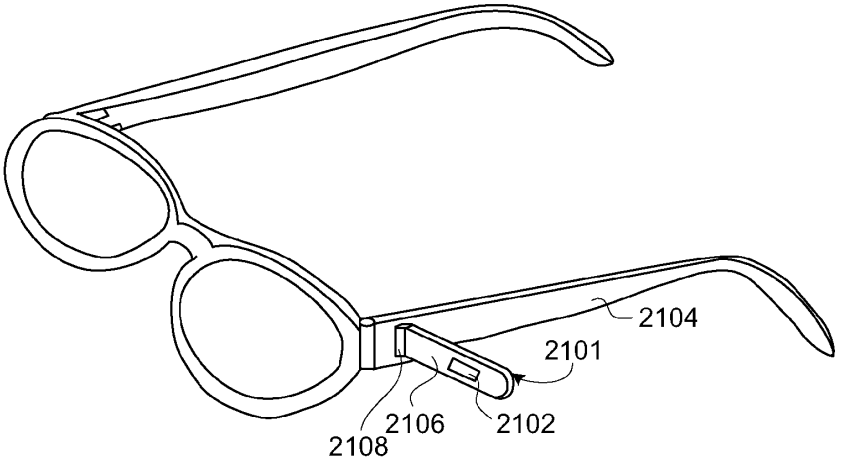


FIG. 21B

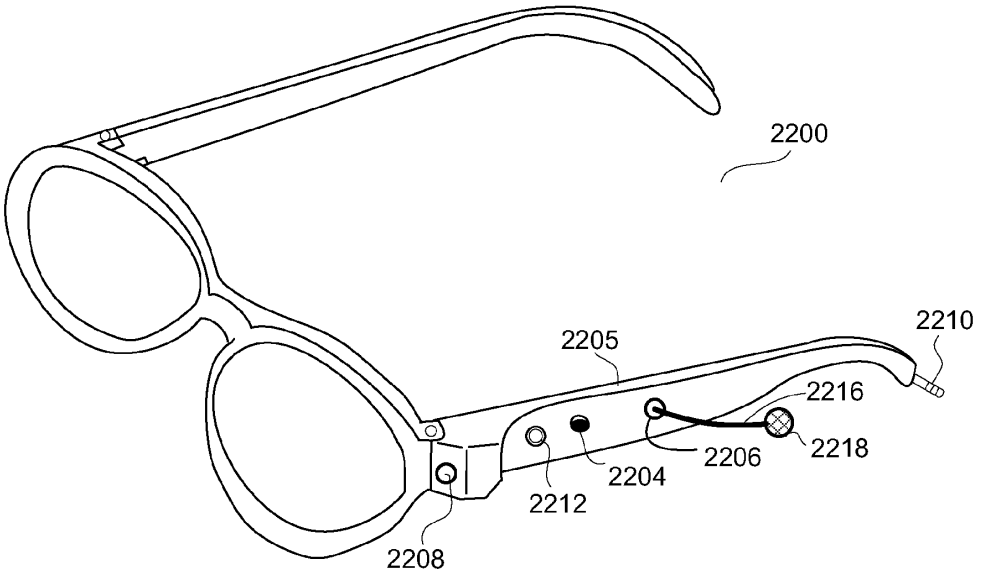


FIG. 22

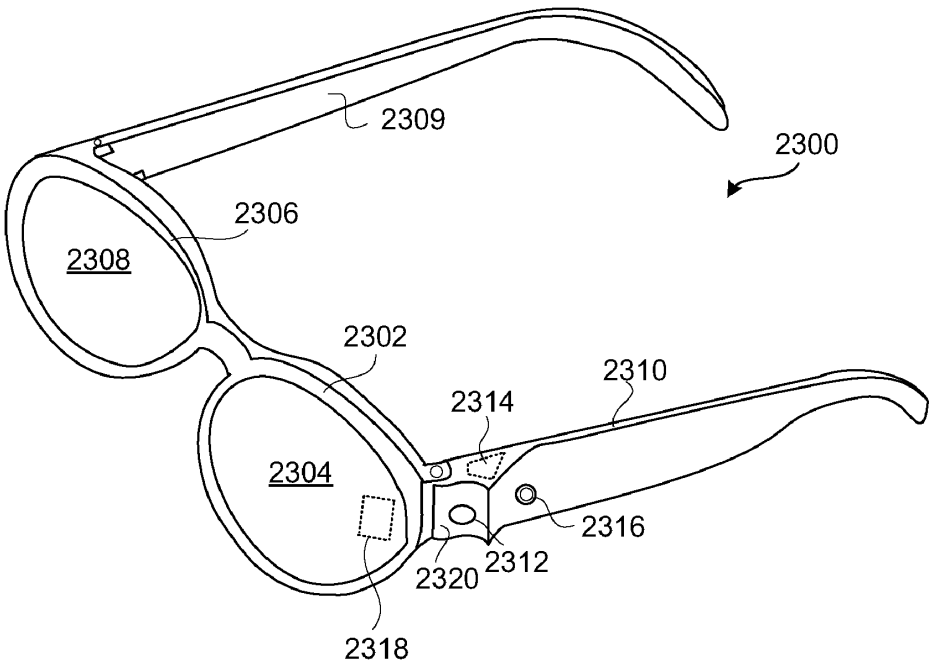


FIG. 23A

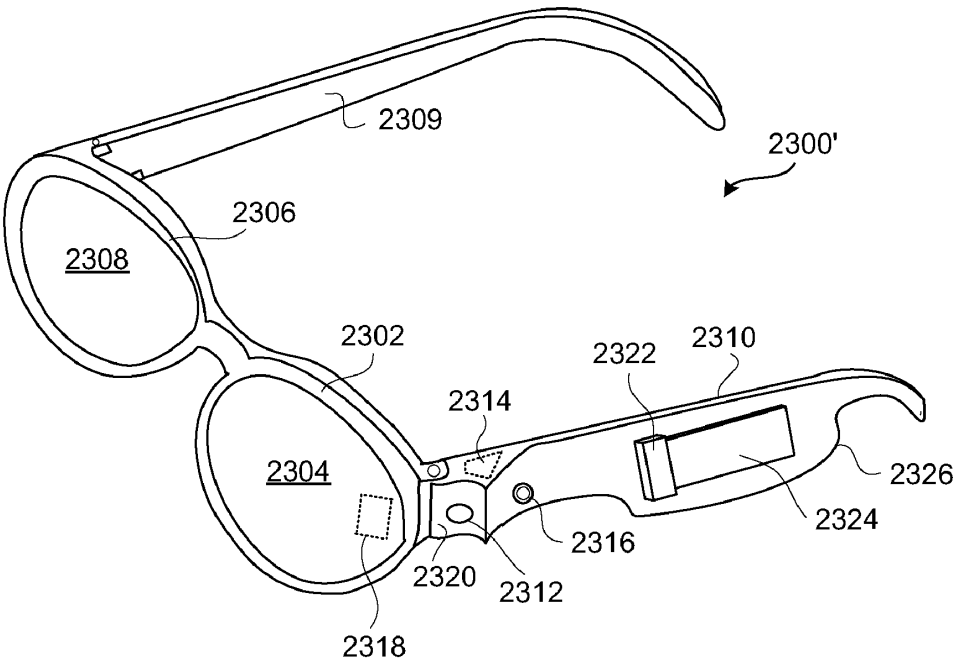

2309
2300'
2306
2308
2302
2322
2310
2314
2304
2326
2324
2316
2320
2312
2318

FIG. 23B

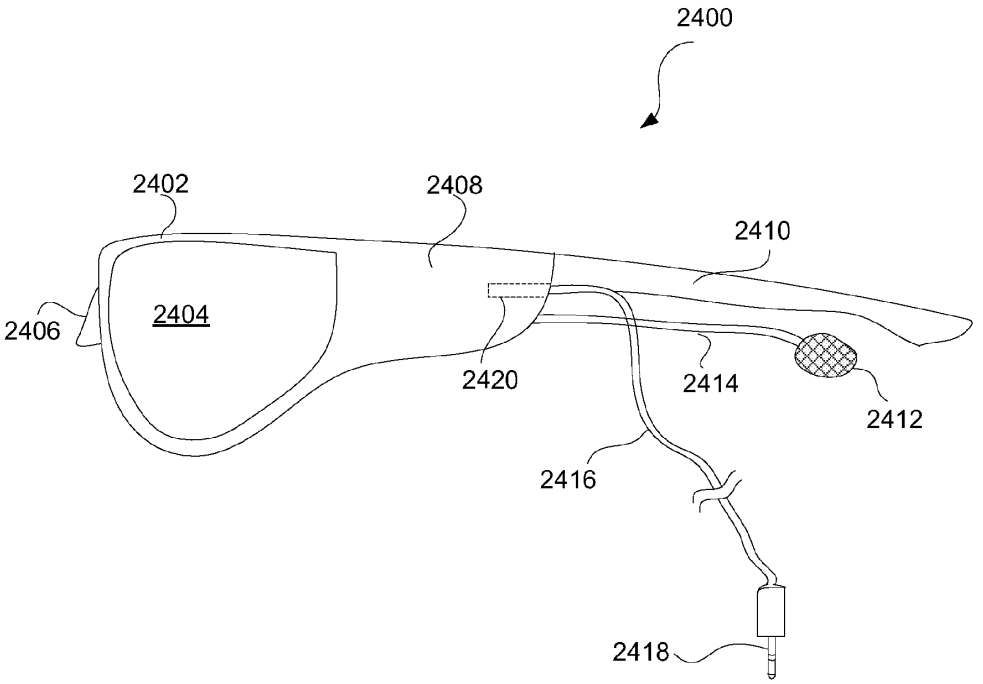


FIG. 24

EYEGLASSES HAVING A CAMERA

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of U.S. patent application Ser. No. 11/183,256, filed Jul. 15, 2005, now U.S. Pat. No. 7,500,747 and entitled "EYEGLASSES WITH ELECTRICAL COMPONENTS," which is hereby incorporated herein by reference, which in turn is a continuation-in-part of U.S. patent application Ser. No. 10/964,011, filed Oct. 12, 2004, now U.S. Pat. No. 7,192,136, and entitled "TETHERED ELECTRICAL COMPONENTS FOR EYEGLASSES," which is hereby incorporated herein by reference, which in turn claims priority to each of: (i) U.S. Provisional Patent Application No. 60/509,631, filed Oct. 9, 2003, and entitled "TETHERED ELECTRICAL COMPONENTS FOR EYEGLASSES," which is hereby incorporated herein by reference; (ii) U.S. Provisional Patent Application No. 60/527,565, filed Dec. 8, 2003, and entitled "ADAPTABLE COMMUNICATION TECHNIQUES FOR ELECTRONIC DEVICES," which is hereby incorporated herein by reference; (iii) U.S. Provisional Patent Application No. 60/562,798, filed Apr. 15, 2004, entitled "EYEWEAR WITH ULTRAVIOLET DETECTION SYSTEM," and which is hereby incorporated herein by reference; (iv) U.S. Provisional Patent Application No. 60/583,169, filed Jun. 26, 2004, entitled "ELECTRICAL COMPONENTS FOR USE WITH EYEWEAR, AND METHODS THEREFOR," and which is hereby incorporated herein by reference; (v) U.S. Provisional Patent Application No. 60/592,045, filed Jul. 28, 2004, entitled "EYEGLASSES WITH A CLOCK OR OTHER ELECTRICAL COMPONENT," and which is hereby incorporated herein by reference; and (vi) U.S. Provisional Patent Application No. 60/605,191, filed Aug. 28, 2004, entitled "ELECTRICAL COMPONENTS FOR USE WITH EYEWEAR, AND METHODS THEREFOR," and which is hereby incorporated herein by reference.

U.S. patent application Ser. No. 11/183,256 also claims priority to each of: (i) U.S. Provisional Patent Application No. 60/618,107, filed Oct. 12, 2004, and entitled "TETHERED ELECTRICAL COMPONENTS FOR EYEGLASSES," which is hereby incorporated herein by reference; (ii) U.S. Provisional Patent Application No. 60/620,238, filed Oct. 18, 2004, entitled "EYEGLASSES WITH HEARING ENHANCED AND OTHER AUDIO SIGNAL-GENERATING CAPABILITIES," and which is hereby incorporated herein by reference; (iii) U.S. Provisional Patent Application No. 60/647,836, filed Jan. 31, 2005, and entitled "EYEGLASSES WITH HEART RATE MONITOR," which is hereby incorporated herein by reference; and (iv) U.S. Provisional Patent Application No. 60/647,826, filed Jan. 31, 2005, and entitled "EYEWEAR WITH ELECTRICAL COMPONENTS," which is hereby incorporated herein by reference.

The application also claims priority to each of: (i) U.S. Provisional Patent Application No. 60/725,896, filed Oct. 11, 2005, and entitled "EYEGLASSES WITH ELECTRICAL COMPONENTS," which is hereby incorporated herein by reference; (ii) U.S. Provisional Patent Application No. 60/725,999, filed Oct. 11, 2005, and entitled "EYEWEAR SUPPORTING AFTER-MARKET ELECTRICAL COMPONENTS," which is hereby incorporated herein by reference; (iii) U.S. Provisional Patent Application No. 60/787,850, filed Apr. 1, 2006, and entitled "EYEGLASSES WITH A HEART RATE MONITOR," which is hereby incorporated herein by reference; and (iv) U.S. Provisional Patent Application No. 60/846,150, filed Sep. 20, 2006, and entitled "EYEGLASSES WITH ACTIVITY MONITORING," which is hereby incorporated herein by reference.

In addition, this application is related to each of: (i) U.S. patent application Ser. No. 10/822,218, filed Apr. 12, 2004, and entitled "EYEGLASSES FOR WIRELESS COMMUNICATIONS," which is hereby incorporated herein by reference; (ii) U.S. patent application Ser. No. 10/964,011, filed Oct. 12, 2004, and entitled "TETHERED ELECTRICAL COMPONENTS FOR EYEGLASSES," which is hereby incorporated herein by reference; (iii) U.S. patent application Ser. No. 11/006,343, filed Dec. 7, 2004, and entitled "ADAPTABLE COMMUNICATION TECHNIQUES FOR ELECTRONIC DEVICES," which is hereby incorporated herein by reference; (iv) U.S. patent application Ser. No. 11/078,855, filed Mar, 11, 2005, and entitled "EYEWEAR WITH RADIATION DETECTION SYSTEM," which is hereby incorporated herein by reference; (v) U.S. patent application Ser. No. 11/078,857, filed Mar. 11, 2005, and entitled "RADIATION MONITORING SYSTEM," which is hereby incorporated herein by reference; (vi) U.S. patent application Ser. No. 11/183,269, filed Jul. 15, 2005, and entitled "EYEWEAR SUPPORTING AFTER-MARKET ELECTRICAL COMPONENTS," which is hereby incorporated herein by reference; (vii) U.S. patent application Ser. No. 11/183,283, filed Jul. 15, 2005, and entitled "EVENT EYEGLASSES," which is hereby incorporated herein by reference; (viii) U.S. patent application Ser. No. 11/183,262, filed Jul. 15, 2005, and entitled "EYEGLASSES WITH HEARING ENHANCED AND OTHER AUDIO SIGNAL-GENERATING CAPABILITIES," which is hereby incorporated herein by reference; (ix) U.S. patent application Ser. No. 11/183,263, filed Jul. 15, 2005, and entitled "EYEGLASSES WITH A CLOCK OR OTHER ELECTRICAL COMPONENT," which is hereby incorporated herein by reference; (x) U.S. patent application Ser. No. 11/183,276, filed Jul. 15, 2005, and entitled "EYEGLASSES WITH ACTIVITY MONITORING," which is hereby incorporated herein by reference; and (xi) U.S. Provisional Patent Application No. 11/580,222, filed Oct. 11, 2006, and entitled "EYEGLASSES SUPPORTING AFTER MARKET ELECTRICAL COMPONENTS", which is hereby incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates generally to glasses and more particularly to glasses utilizing electrical components.

BACKGROUND OF THE INVENTION

Cameras are popular consumer electronic devices that allow users to capture images, i.e., taking pictures. For many years cameras have recorded their images on special film and then subsequently developed into physical pictures. More recently, digital cameras and digital photography have become popular. With digital cameras, the images can be recorded as digital data. The stored digital images can thereafter be printed, stored, or transmitted electronically. Cameras are special purpose devices, separately toted by users if they wish to have picture-taking capabilities. Unfortunately, this means that users often are without their cameras when they have a desire to take pictures. Though mobile telephones

have been including cameras for taking pictures, there remains a need for improved ways for cameras to be toted by users.

SUMMARY OF THE INVENTION

The invention pertains to a pair of glasses with one or more attached, embedded or partially embedded electrical components. In a number of the embodiments of the invention, with one or more electrical components in the glasses, the electrical components are much easier to operate.

One aspect of the invention pertains to a pair of glasses having a camera. In one embodiment, the camera can be partially or fully embedded in the glasses. For example, the camera can be embedded in a temple of the glasses. In another embodiment, the camera can be removably attached to the glasses. For example, the camera can be removably attached to a temple of the glasses. The glasses can also include one or more various other electrical components. These other electrical components can work separately or in conjunction with the camera.

The invention can be implemented in numerous ways, including as a system, device, apparatus, and method. Several embodiments of the invention are discussed below.

One embodiment of the invention pertains to a pair of glasses for a user that includes at least an eyeglass frame having at least first and second lens holders and first and second temples, and a camera partially or fully embedded in the first temple.

Another embodiment of the invention pertains to a pair of glasses for a user that includes at least an eyeglass frame having at least first and second lens holders and first and second temples, and a camera mechanically connectable to the first temple.

Other aspects and advantages of the present invention will become apparent from the following detailed description, which, when taken in conjunction with the accompanying drawings, illustrates by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows one embodiment of the invention with a speaker in one of the temples of the glasses.

FIG. **2** shows a tube extending from a speaker at a temple of the glasses to guide sound to one of the ears of the user according to one embodiment of the invention.

FIG. **3** shows a retractable tube extending from a speaker at a temple of the glasses according to one embodiment of the invention.

FIG. **4** shows a funnel at the output of a speaker in the glasses according to one embodiment of the invention.

FIG. **5** shows a male connector at the end of a temple according to one embodiment of the invention.

FIGS. **6**A-**6**B illustrate a process to make a non-standard female plug couple to a male connector at a pair of glasses according to one embodiment of the invention.

FIG. **7** illustrates another non-standard connector, applicable to clamp onto a temple of a pair of glasses according to an embodiment of the invention.

FIGS. **8**A-**8**E shows different embodiments of standard connectors located at different positions on the temple of a pair of glasses according to the invention.

FIGS. **8**F-**8**H are diagrams pertaining to providing a removable electronic device with an eyeglass frame according to one embodiment of the invention.

FIG. **8**I is a diagram of a temple of an eyeglass frame according to another embodiment of the invention.

FIG. **9** shows some of the electrical components for a MP3 player according to an embodiment of the invention.

FIG. **10** shows an embodiment of the invention where a user is wearing a pair of glasses with electrical components, tethered to a base, which is connected to a portable device.

FIGS. **11**A-**11**B show different embodiments of the present invention illustrating some of the electrical components for wireless connections to a pair of glasses.

FIG. **12** shows a process for a personalized radio according to one embodiment of the present invention.

FIG. **13** shows a number of attributes of control knobs according to different embodiments of the present invention.

FIG. **14** shows some of the electrical components for capturing images with a pair of glasses according to an embodiment of the present invention.

FIG. **15** shows an operation of taking actions based on images captured with a pair of glasses with wireless transceiver capability according to one embodiment of the invention.

FIG. **16** shows an operation to provide messages to a user based on images captured by a pair of glasses according to an embodiment of the present invention.

FIG. **17**A is a chart that depicts examples of sensors in a pair of glasses according to different embodiments of the present invention.

FIG. **17**B is a diagram of a temple arrangement according to one embodiment of the invention.

FIG. **17**C is a diagram of a cover that at least partially covers a temple according to one embodiment of the invention.

FIG. **17**D is a diagram of a fit-over temple that at least partially fits over a temple according to one embodiment of the invention.

FIG. **18** shows an embodiment including an eye mask according to the invention.

FIG. **19** shows an embodiment including a night cap according to the invention.

FIG. **20**A is a diagram illustrating a temple having a slot for receiving a removable electronic device according to one embodiment of the invention

FIG. **20**B is a diagram illustrating the temple having a recessed lower portion according to another embodiment of the invention.

FIGS. **21**A and **21**B are diagrams illustrating a pair of glasses having a camera coupled thereto, according to one embodiment.

FIG. **22** is a diagram of a pair of glasses having a camera according to one embodiment of the invention.

FIG. **23**A is a diagram of a pair of glasses having a camera according to one embodiment of the invention.

FIG. **23**B is a diagram of the pair of glasses according to another embodiment.

FIG. **24** is a side view of a pair of eyeglasses according to another embodiment of the invention.

Same numerals in FIGS. **1**-**24** are assigned to similar elements in all the figures. Embodiments of the invention are discussed below with reference to FIGS. **1**-**23**B. However, those skilled in the art will readily appreciate that the detailed description given herein with respect to these figures is for explanatory purposes as the invention extends beyond these limited embodiments.

DETAILED DESCRIPTION OF THE INVENTION

A number of embodiments according to the present invention regarding glasses with one or more electrical components attached, partially embedded or fully embedded are described. Many of them are applicable to different types of glasses, such as sunglasses, auxiliary frames, fit-over glasses, prescription glasses, safety glasses, swim masks, and goggles, such as ski goggles. In a number of embodiments, the frames of the glasses have more surface area than frames with minimal structure. For example, the temple regions of the glasses can have a tapered profile. They are wider or broader when they are closer to the lens holders. Then they get narrower. In one embodiment, a wider or broader temple implies that the temple spans across a wider or broader area longitudinally down from the top of the head of the user. FIG. **1** shows an example of such an embodiment.

FIG. **1** shows one embodiment **100** of the invention where there is a speaker **102** at least partially embedded in one of the temples **104** of the glasses **106**. The speaker **102** is closer to one end of the temple **104** than the other end. The end of the temple that the speaker **102** is closer to is the end that is in the vicinity of the lens holder or the hinge of the glasses **106**, instead of the end **108** that is free. The speaker can be partially embedded in the glasses. For example, the mouth of the speaker, where sometimes there can be small holes on a cover, can be exposed.

In the embodiment shown in FIG. **1**, the speaker **102** outputs audio signals in the direction towards the user. In another embodiment, the speaker **102** outputs audio signals in the direction away from the user. For example, the mouth of the speaker **102** can be facing outwards away from the user.

There are different approaches to embed an electrical component into a pair of glasses. For example, the glasses can be made of plastic (e.g., plastic frames). One way to produce such frames is to first assemble electrical components onto a circuit board. The circuit board can be shaped to fit, for example, the temple of the glasses. The circuit board is placed into a mold. Then, hot, molten plastic is injected around the circuit board to form the temple piece of the glasses. To reduce weight, the wall of the glasses can be made relatively thin through injection molding techniques.

In another embodiment, the glasses have metallic frames. For example, the frames can be made of Titanium, which is a relatively light metal. Also, Titanium is relatively non-conductive and strong, and is quite immune to corrosion. Further, Titanium can be anodized or heat colored.

For glasses with metallic frames, to prevent circuits from being shorted or to reduce leakage current, one embodiment provides an insulating layer between the electrical components or circuit board and the metallic frames. One example of an insulting layer is a tape to encapsulate the electrical components. The tape is non-conducting so as to provide insulation and, to a certain degree, can also provide mechanical stiffness. One way to make such temples is to have two sheets of the metal die-stamped to form the two halves, or the two faces of the temple piece. A circuit board is made to fit into the space between the faces. Then, two die-cut pieces of insulator material (e.g., dielectric tape) can cover the top and the bottom surfaces of the circuit board. The board is then sandwiched between the faces to form the temple. In one example, the dielectric tape can be double-sided sticky tape, with one side sticking to the circuit board, and the other side sticking to the temple. An adhesive can be used to glue the two faces of the temple piece together.

In yet another embodiment, the frames are made of hard rubber. The frames can be manufactured in an approach similar to injection molding techniques, with circuit boards inserted into the mold along with the rubber at the time of molding.

Different types of speakers can be used, such as, standard, fixed-magnet/moving coil speakers; speakers with fixed-coil and a steel diaphragm; piezo-electric speakers; and electrostatic speakers.

In one embodiment, the glasses further include a tube, such as a plastic tube, extending from a speaker. The tube serves to guide sound generated by the speaker to one of the ears of the user. FIG. **2** shows an embodiment where a tube **150** is located on the outside of a temple **152**. In another embodiment, the tube can be on the inside of a temple.

In one embodiment, the tube **150** can be rotated, such as from behind the temple **152** (if the tube is on the inside of the temple) to being downward at an angle towards one of the ears of the user, such as the position shown in FIG. **2**. To increase flexibility, the tube can be attached to a rotating disk **154**, which allows rotation about the speaker.

In another embodiment, the tube is malleable. This allows the tube to be placed in different positions.

In one embodiment, the length of the tube is adjustable. FIG. **3** shows such an embodiment **200** of a pair of glasses with a retractable tube **202**. In the figure, the tube is shown to be in its extended position.

To further enhance sound coupling, in one approach, there is a plug **156** at the end of the tube for inserting into an ear of the user. The plug can be an ear bud. The plug can provide a cushion, foam rubber or other materials. Such materials give comfort and/or enhance sound coupling to the ear canal.

In another approach, there is a funnel at the output of the speaker. FIG. **4** shows the cross section of such a funnel from a speaker at a temple region of the glasses. As shown in FIG. **4**, the speaker **254** sits on a speaker frame **252**, and the speaker **254** is electrically connected to a circuit board **256**. As sound is generated from the speaker **254**, the sound propagates to a tube **258** through a structure **260** in the shape of a funnel. Such a structure helps guide the sound to the tube (i.e., improved sound coupling). Also, FIG. **4** shows the tube, which can be the tube **150** shown in FIG. **2**, mounted onto the temple region of the glasses with a circular lip **262**. Such a lip **262** allows the tube **258** to rotate relative to the glasses. In the embodiment shown in FIG. **4**, the speaker **254** is fully embedded in the glasses.

As an alternative to or in conjunction with the tube, the glasses can include a channel to likewise guide sound generated by the speaker to one of the ears of the user. For example, the channel can be formed within a temple. The temple also has an opening to output the sound towards the user's ear.

FIG. **1** shows one speaker at one of the temples. There can be more than one speaker at each temple. In one embodiment, there can also be at least one speaker at each temple. The two speakers can generate stereo effects.

In another embodiment, the glasses can provide four or more speakers to give a high fidelity sound or a surround sound effect. For example, each temple can include one speaker in front of the user's ear, and one speaker behind the user's ear. The different speakers can generate different portions or sections of the sound. Further, if a base (discussed below) or portable electronic device is coupled to the glasses, the base or portable electronic device can contain another speaker, such as a base or woofer speaker. Such embodiments enable the glasses to provide a personal high-fidelity sound or a surround-sound environment.

Electrical signals can be coupled to an electrical component, such as a speaker, in a pair of glasses through a number of mechanisms. In one embodiment, there is an electrical

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connector at least partially embedded in the glasses. In other words, at least a portion of the connector is inside the glasses. The connector is electrically coupled to the speaker (or other electrical component) by, for example, a conductor. The conductor can be on a printed-circuit board. In one embodiment, the conductor is also embedded in the glasses.

Regarding connectors, FIG. **5** shows one embodiment where the connector is not a standard connector. The end **108** of the temple **104** of the glasses **106** shown in FIG. **1** has a similar connector. In FIG. **5**, the connector is a male plug or a male connector **300** at the end of a temple **302** of a pair of glasses. The connector **300** is connected to the speaker through, for example, one or more wires embedded in the temple. Electrical signals external to the glasses can then be coupled to the speaker (or other electrical component) through the plug.

As shown in FIG. **5**, the free end of the temple **302** can have a relatively flat cross section. There can be one or more electrically-conductive contacts, such as **304** and **306**, on one or both of the flat surfaces of the temple. In FIG. **5**, four contacts are shown on one surface of the temple. The contacts, **304** and **306**, can be metal pads or bumps.

In one embodiment, a non-standard connector can be made using printed-circuit board technologies. First, a printed-circuit board with printed conductors connected to metal contact bumps is produced. Then plastic is overmolded around the printed-circuit board, with the mold designed to shut off around the bumps or pads. The overmolded plastic can serve as the temple, and the pads would be left exposed. Thus, portions of the printed circuit board are covered by plastic, and areas with the bumps or pads are exposed for connection. These pads serve as the connectors for the glasses.

Regarding printed-circuit boards, there can be one or more circuit boards in the glasses. For example, there can be a circuit board in one of the temples of the glasses. Or, the circuits can be divided into two circuit boards, one in each temple of the glasses. The circuit boards can carry additional electrical components to be described below.

In one embodiment, the circuit boards are rigid. In another embodiment, the circuit boards are made of flexible materials, such as a polyimide sheet, like Kapton®. In one embodiment, the circuit board is configured or adapts to the shape of the temple in which it resides.

As shown in FIG. **5**, the end of the temple **302** serves as a male connector (plug) **300**. The non-standard male connector **300** can be received by a non-standard female connector (plug) **310**. Typically, the female connector **310** makes electrical and physical connection through grabbing around the male plug. The female connector **310** can be connected to a cable **312**.

FIGS. **6**A-**6**B illustrate a process to make the non-standard female plug **310**. First, an electrical wire **354** is attached to a small sheet or piece of metal **356**. FIG. **6**A shows a number of such wires, with a number of the metal sheets or pieces crimped to a hard PVC **358**. The figure shows the back side of the crimped board with the wires and with a number of holes, such as **360**. Then the frame is overmolded with a soft PVC. FIG. **6**B shows a cross section of the overmolded frame **362** with the soft PVC. As shown in the figure, a number of the metal sheets, such as **364** and **366**, are exposed. They are the metal contacts in the female connector **310**. Instead of the above approach, alternatively, a wire can be attached to a sheet of metal by putting the wire between the metal and the plastic as the metal is crimped onto a plastic. When the temple (i.e., male connector **300**) is inserted into the female plug, the soft PVC material stretches slightly, providing a spring-force to keep the contacts connected.

The hard PVC can have a hardness of over 80 durometer, while the soft PVC can have a hardness of less than 50 durometer. The hard PVC can be replaced by other materials, such as Polypropylene or cloth. The soft PVC can be replaced by Silicone, or a thermo-plastic elastomer, such as Kraton®.

Referring to both FIG. **5** and FIG. **6**B, when the male connector **300** is inserted into the slot **314** of the female connector **310**, the metal pads, **304** and **306**, will get in contact, or mate, with the metal sheets, **364** and **366**.

In one embodiment, as long as the male connector **300** is pushed all the way into the female connector **310**, the pads are aligned correctly to the sheets for electrical connections. In another embodiment, there is an alignment mechanism to guide the position of the temple relative to the female connector so as to ensure the conductive sheets to be in contact with the conductive pads. For example, there can be a registration location to indicate that the male connector is at the appropriate position relative to the female connector. There can be an alignment extension, which can be a partial sphere, close to the end of the temple **302**, such as between the pads **304** and **306**, at **316**. And, there can be a corresponding alignment notch at the female connector **310**. When the extension is received or caught by the notch, the male connector **300** is in the appropriate position relative to the female connector **310**. In other words, the alignment is proper, and the pads and the sheets are in contact.

FIG. **5** shows the non-standard male connector **300** at one end of a temple of a pair of glasses. In yet another embodiment, a non-standard connector can be at another location. FIG. **7** shows another example of a non-standard connector **400**. The connector **400** includes one or more conductive pads, **412** and **414**, on the top side of a temple **402**. The connector **400** is designed to receive another connector **406** that grabs onto the side of the temple **402**. There can be an indentation **404** on the temple **402** to receive the other connector **406**. The other connector **406** can include a top **420** and a bottom **416** clip. There are a number of conductive pads or sheets inside the other connector **406**. The indentation **404** provides an alignment to indicate where the top clip **420** of the other connector **406** should grab onto the temple **402** for connection. At that position, the conductive pads at the temple will be in contact with the conductive pads or sheets at the other connector **406**. There can also be another indentation **418** at the temple **402** to receive the bottom clip **416**. This can further enhance the alignment process and to secure the connection.

In FIG. **7**, the other connector **406** is coupled to one end of a cord and a plug **408**, which can be inserted into a portable device **410**, can be connected to another end of the cord. The portable device, for example, can be a cell phone. This type of non-standard clip-type connector could be easily applied to the temple with one hand, for example, while the user is driving a car.

A number of non-standard connectors have been described. In another embodiment, the contacts are based on standard connectors, which can be off-the-shelf connectors. FIGS. **8**A-**8**E show a number of examples of such connectors.

In one embodiment, the standard connector is a standard cylindrical plug located at the end of a temple. From a different perspective, the temple molds around the end of the plug. FIG. **8**A shows one such embodiment. The plug **450** can be a standard audio connector or a 3-wire or three terminal plug, such as a 3.5 mm male stereo mini-phone plug. The 3 wires for such a plug are typically one for ground, the other two applicable for two signals, such as for creating stereo effects. FIG. **8**A also shows the three wires, **452**, **454** and **456**, inside

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the temple, extended from the plug **450**. These wires are for connection to electrical components of the glasses.

In one embodiment, the cylindrical plug **450** shown in FIG. **8**A can be protected, encapsulated or shrouded. Or, at least a portion of the plug is protected, encapsulated or shrouded. Such protection can, for example, be for aesthetic reasons, or to prevent the plug from scratching the face of the user when the user is putting on the pair of glasses. In FIG. **8**A, the plug **450** is partially embedded in a temple.

Instead of a three terminal plug, other types of standard cylindrical plugs applicable to different embodiments of the present invention include a serial connector with 3 pins, typically one for ground, one for transmitting data (Tx) and the third for receiving data (Rx); or (b) a 2-wire connector, one served as ground, the other for carrying, such as power and modulated signals.

In yet another embodiment, instead of a cylindrical plug, the standard connector at the end of a temple of a pair of glasses is a USB or a FIREWIRE connector.

A number of embodiments have been described where the standard connector(s) at the glasses are male connectors. In yet another embodiment, the standard connector(s) in the glasses are female connectors. For example, there can be a 3.5 mm female stereo mini-phone plug at the end of a temple of a pair of glasses. At least a portion of the female connector can be protected, encapsulated or shrouded. For example, the female connector can be recessed within the end of a temple.

FIGS. **8**B-**8**E show different examples of standard connectors located or partially embedded not at the end of a temple of a pair of glasses, but, for example, on the side of the temple, such as on the inside surface or the outside surface of a temple. FIG. **8**B shows a 0.10" header plug **460**, commonly known as a MOLEX connector, on such a surface. FIG. **8**C shows a female mini-phone plug **465** on such a surface. FIG. **8**D shows a card connector **470** to receive a card **472**, such as a removable media card (e.g., memory card). There can be a cover **474** to secure and/or protect the media card **472** in place after it is inserted into the card connector **470**. FIG. **8**E shows a female USB connector **480** on the inside surface of a temple **482** to receive a male USB connector **484**.

FIGS. **8**F-**8**H are diagrams pertaining to providing a removable electronic device with an eyeglass frame according to one embodiment of the invention. FIG. **8**F illustrates a temple **490** that includes a connector **492**. The connector **492** includes an opening **494**. A removable electronic device can be coupled to the temple **490** using the connector **492**. More particularly, FIG. **8**G illustrates a removable electronic device **496** that includes an electronic device housing **498** and a connector **499**. As an example, the removable electronic device **496** can be a memory storage device, sometimes referred to as a memory card. FIG. **8**H illustrates the removable electronic device **496** coupled to the temple **490**. The removable electronic device **496** is coupled to one side of the temple **490**, such side can be either an inside or outside surface of the eyeglass frame. When the removable electronic device **496** is coupled to the temple **490**, the connector **499** of the removable electronic device **496** is inserted into the opening **494** of the connector **492**. Physical forces between the connector **499** and the connector **492** operate to secure the removable electronic device **496** to the temple **490**, yet permit the removable electronic device **496** to be removable therefrom.

In one embodiment, the connector **492** is not electrically connected to any electronic circuitry within the temple **490** or other parts of the eyeglass frame. In other words, the connector **492** provides a convenient means by which removable electronic devices can be coupled to the eyeglass frame. In another embodiment, the connector **492** can be coupled to electrical circuitry within the temple **490** or elsewhere within the eyeglass frame. Such an embodiment allows the electronic components within the removable electronic device **496** to be utilized with the electrical circuitry within the temple **490** or elsewhere within the eyeglass frame. For example, the removable electronic device **496** can provide data storage and/or other software modules to be utilized by or to utilize the other electrical circuitry within the temple **490** or elsewhere within the eyeglass frame. In any case, by attaching the removable electronic device **496** to the temple **490** (and thus the eyeglass frame), the removable electronic device **496** is able to be conveniently carried by the user of the eyeglass frame. In one implementation, the eyeglass frame, which includes the connector **492**, becomes a docking station for the removable electronic device **496**. As such, a variety of different removable electronic devices can be interconnected with the eyeglass frame, as desired. For example, the eyeglass frame can thus support different function or operations depending on the removable electronic device that is attached. For example, the eyeglass frame might operate as a camera, data storage device, FM radio, MP3 player, mobile telephone, pedometer, hearing enhancer, sun sensor, time piece, etc.

In one embodiment, the removable electronic device **496** can align itself with the orientation of the temple **490**, such as shown in FIG. **8**H. In FIG. **8**G, the electronic device housing **498** can be said to have an elongated housing. The configuration (e.g., shape) and/or color of the removable electronic device **496** can also be designed to conform or complement the design of the temple **490**. In one embodiment, the temple **490** might also have a recessed region to allow the portable electronic device to be less visually perceptible when attached to the temple **490** or to provide a more consistent contour of the temple **490**.

In one embodiment, the connector **499** is a male connector, and the connector **492** is a female connector or a similarly sized structure. In one implementation the connector **499** is a peripheral bus connector, such as a Universal Serial Bus (USB) connector. In such cases, the connector **492** can also be a peripheral bus connector (either electrically functional or non-functional as noted above).

Although the embodiment illustrated in FIGS. **8**F-**8**H utilize connectors, namely, electrical connectors, the removable electronic device **496** could be attached to the temple in other ways. For example, other means to provide physical forces to hold the removable electronic device **496** in place can be used.

FIG. **8**I is a diagram of a temple of an eyeglass frame according to another embodiment of the invention. In this embodiment, the temple **490'** includes an opening **491** through which a cable **493** extends outward. The cable **493** has an electrical connector **495** connected at its end. The electrical connector **495** is electrically connected to electrical circuits within the temple **490'** or elsewhere within the eyeglass frame such as by way of one or more wires contained within the cable **493**. In one implementation, the length of the cable **493** is about one to four inches. The temple **490'** shown in FIG. **8**I also includes a receptacle **497**. The receptacle **497** is affixed to or integral with the temple **490** to receive the electrical connector **495**. Typically, the receptacle **497** provides a holding mechanism for the electrical connector **495** when not been utilized. When the electrical connector **495** is being utilized, the electrical connector **495** is removed from the receptacle **497** and coupled to a corresponding counterpart connector of another electrical device. The cord **493** can provide ease-of-use so that the electrical connector **495** can be

maneuvered to couple to the counterpart connector. In one embodiment, the temple **490'** can provide a recess for receiving the entire cable **493**, with the outer surface of the receptacle **497** being substantially flush to the surface of the temple **490**. So when the connector **495** is not in use, the connector **495** can be in the receptacle **497**, with the cable **493** in the recess. In one embodiment, when the cable **493** is in the recess and the connector **495** inside the receptacle **497**, the cable **493** has substantially no slack. Also, in another embodiment, the cable **493** can be retractable into the opening **491**. In the embodiment shown in FIG. **8**I, the electrical connector **495** is a male connector, and the receptacle **497** is a female connector or a similarly sized structure.

A number of standard and non-standard connectors have been described. Other types of connectors can also be used. In one embodiment, there is a connector adapter, which serves to transform such other type of connectors to a different interface. For example, an adapter can be a cord with one type of connector at one end and a different type of connector at the other end.

In one or more of the above embodiments, the glasses can access audio signals from another device through a connector at the glasses. The another device can be a multimedia asset players or a radio.

In one embodiment of the invention, the glasses have a storage medium (i.e., memory). The memory can be on a printed-circuit board and, for example, store 256 MBs or more. The memory can be a built-in or removable flash memory. The memory can be coupled to a device external to the glasses through one or more connectors at the glasses. As an example, a 256 MB flash memory is in one of the temples of a pair of glasses, and there is a USB connector at the free end of that temple to couple to an external device.

With the embedded storage medium, the glasses can upload information in the memory to or download information into the memory from an external device, such as a computer. A user can plug the glasses into the computer through a connector, either directly, or indirectly, with, for example, an intermediate wire in between. The user can store files in the glasses. Such an embodiment should reduce the chances of the user losing the files because the user has to lose the glasses as well.

In yet another embodiment of the invention, a pair of glasses includes a multimedia asset player, such as a MP3 player. FIG. **9** shows some of the electrical components for a MP3 player **500** according to an embodiment of the invention. The player **500** includes a speaker **502** and a data bus **512**, which facilitates data transfer among, for example, a processor **506**, a storage device **510**, and a coder/decoder (CODEC) **504**. The processor **506**, which can be a microprocessor or controller, controls the operation of the player **500**. The storage device **510** stores the multimedia assets, such as MP3 files, or other types of media data that are appropriately formatted. In one example, the MP3 files are digitally encoded songs or other types of audio signals. The storage device **510** can include a number of separate storage elements. For example, the device **510** can be a flash memory device, or a minidisk device, and a cache, which can improve the access time and reduce power consumption of the storage device. The storage device **510** typically also includes a Read-Only Memory (ROM), which stores programs, utilities or processes to be executed in a non-volatile manner. The player **500** can also include a RAM, such as for the cache.

Once a media asset, such as a song, is selected to be played, the processor **506** would supply the asset to the CODEC **504**, which decompresses the asset and produces analog output signals for the speaker **502**. In one embodiment, the bus **512** is also coupled to an input/output device **508**, which would allow a user to upload songs in the glasses to an external instrument, such as a computer, or download songs from the instrument to the glasses.

There are different approaches to select a song. In one embodiment, the songs or the media assets can be categorized in the MP3 player, and the categorization can be hierarchical, with multiple levels in the hierarchy. To illustrate, assume that there are three levels. The top level can be the name of the singer; the second level can be the time period when the asset was produced, and the third level can be the names of the songs. The entries, such as the name of the singer, can be abbreviated. There can be a small display and a control knob to allow a user to scroll down entries in a level. By pushing the knob, the user selects an entry, which can lead the user to a lower level. There can be an entry for moving up a level also. In another embodiment, the display is a touch-screen display, allowing entries to be entered directly on the display. In yet another embodiment, entries can be selected based on voice recognition.

A number of embodiments have been described with the glasses having a connector. In one embodiment, the glasses can have more than one connector. For example, a pair of glasses with two connectors also has a speaker. One connector is, for example, at a broad side of a temple, as in FIG. **8**D. The connector can be for coupling to multimedia assets of a MP3 player. Another connector is, for example, at the end of a temple, as in FIG. **8**A. That connector can couple power to the glasses. The speaker can play the multimedia assets accessed from one connector, based on power from another connector.

As described, power (e.g., external power source) can be coupled to the glasses through a connector. In one embodiment, the power source is embedded inside or inserted into the glasses. Different types of power sources are applicable. For example, the power source can be a battery, a fuel cell, a solar cell, or a re-chargeable battery. The rechargeable battery can be charged through a connector at the glasses.

In an earlier application, namely, U.S. Provisional Patent Application No. 60/509,631, filed Oct. 9, 2003, and entitled "TETHERED ELECTRICAL COMPONENTS FOR EYEGLASSES," which has been incorporated herein by reference, there can be a base connected to the glasses through a cord. The cord can be just a piece of flexible conductor encapsulated by a flexible insulator. Typically, a cord includes a number of electrical wires or conductors. There can be one or more electrical components in the base, and there can also be one or more electrical components in the cord. The different types of connectors previously described can be located in the base. In one embodiment, a power source is an electrical component in the base tethered to a pair of glasses. In another embodiment, the glasses are tethered to a base that has a connector. The connector is connected to and draws power from an external electronic device. In this embodiment, electrical components in the glasses draw power from the external electronic devices.

FIG. **10** shows an embodiment where a user **550** is wearing a pair of glasses **552**, which include electrical components. There are also tethered electrical components in a base **554**, which is connected to the glasses **552** through a cord **556**. In addition, there is a wire **558** connected to a connector at the base **554** to a portable electronic device **560**. The portable device **560** can be (a) a multimedia device, such as a MP3 player/recorder or a minidisk players, (b) a wireless communication device, such as a cell phone, or (c) a personal digital assistant, or other types of portable devices with computing and/or entertaining and/or communication capabilities.

Note that instead of connecting to the portable electronic device **560** through the base **554**, in another embodiment, the glasses **552** directly connect to the portable device **560** through a cord.

In one embodiment, there is an attachment device **562**, such as a pin or clip. The attachment device attaches at least a part of the glasses to the user's clothing. The attachment device **562** can serve to attach the cord **556** and/or the wire **558** and/or the base **554** to the user's clothing. The attachment can also be through other mechanisms, such as Velcro.

In a number of embodiments, the speaker described is assumed to emit audio signals. In one embodiment, the speaker emits ultrasonic signals. The glasses can be used, for example, as an insect repellant by transmitting ultrasound to repel insects, such as mosquitoes. In this embodiment, the one or more speakers broadcast the ultrasonic signals away from the user. In other words, the speakers face outwards, not inwards towards the user. In this embodiment, the glasses, which can include a base, also has a power source to provide power to the speaker. There can also be a control knob to turn the one or more speakers on/off on the glasses. There will be additional discussions on the control knob below.

In another embodiment, the glasses generating ultrasonic signals can be used to produce audio signals that are more directional. For example, two ultrasonic signals are generated by a speaker in the glasses, with their difference frequencies being the audio signals. The audio signals generated based on mixing the two ultrasonic signals can be much more directional than audio signals directly generated from the speaker.

Referring back to FIG. **1**, in one embodiment, the glasses include a microphone **110**. The microphone **110** can be at the end of a temple **104** close to a lens holder **112**. Or, the microphone **110** can be in the lens holder **112**, located directly adjacent to the temple **104**. In yet another embodiment, there can be a small protrusion extending down from the temple to house the microphone.

With glasses having a microphone, one can use the glasses to record voices into, for example, a storage medium. The storage medium can be in the glasses, or can be in a base or a portable device attached to the glasses.

Different types of microphones can be used. For example, they can be electret microphones, crystal microphones, resistance microphones, piezoelectric microphones or moving-coil microphones.

In one embodiment, the glasses with a microphone also include a speaker that can generate directional sound. A user can speak into the microphone and his message can be transmitted from the glasses in a more directional manner.

In another embodiment, the glasses also include a notification electrical component to provide a notification to the user wearing the glasses. The notification can be to notify, alert or display information to the user. There can be a display located at the inside **114** of the lens holder, or at the vicinity of the junction **116** or the hinge of a lens holder and its corresponding temple facing the user. Or, there can be a display at the inside surface of a temple, or at other locations on the glasses. The display can be one or more light emitting diodes. To alert the user, one or more diodes can blink. The blinking can be of a specific sequence. Instead of diodes, the display can be a liquid crystal display. The display can provide indications or information to the user. For example, a number or a variable-height bar can be shown. Other than visual indications, the notification or alert can be audio, like a beeper.

In one embodiment, the notification electrical component is for selecting a multimedia asset in a multimedia asset player in a pair of glasses for the multimedia to play. The multimedia asset player can be a MP3 player.

A number of embodiments of the present invention have been described where electrical signals are transmitted to or from a pair of glasses through a physical connection. In one embodiment, electrical signals are wirelessly coupled to a pair of glasses. The coupling can be short range or long range. The coupling can be directly to the glasses, or to a base connected to a pair of glasses. The glasses with wireless coupling capabilities can be used to couple to a Bluetooth network, the Internet, a WiFi network, a WiMax network, a cell-phone network or other types of networks. The coupling can also be through a point-to-point link, such as an infrared link.

FIGS. **11**A-**11**B show examples of some of the electrical components in or tethered to a pair of glasses for wireless connections, according to embodiments of the present invention. In FIG. **11**A, a high frequency or RF antenna **602** wirelessly captures high frequency or RF signals for RF transceiver circuits **604**. If the transceiver circuits are for a conventional superheterodyne system, the transceiver circuits **604** mix the RF signals down to IF signals. Then the IF signals are processed by baseband circuits. Digital outputs from the baseband circuits are coupled to a processor **608** for analysis and synthesis.

Outputs from the processor **608** are fed to a D-to-A converter **610** to generate audio signals for a speaker **612**. Similarly, audio analog signals from a microphone **614** can be fed to an A-to-D converter **616** to generate digital low frequency signals for the processor **608** and then to the RF transceiver circuits **604**. The low frequency signals are up-converted by the RF transceiver circuits **604** and wirelessly transmitted by the antenna **602**.

In another embodiment, digital conversion is moved closer to the antenna. For example, instead of mixing RF into IF signals, the RF transceiver circuits **604** directly perform digital conversion from the RF signals.

Typically, high frequency filters are used at the front end of the RF transceiver circuits **604** for the RF signals. In one embodiment, to save space, FBAR (film bulk acoustic resonator) duplexer is employed. A set of piezoelectric filters can be used to separate incoming and outgoing signals. For cell phone operation, such filters can enable a user to hear and speak simultaneously. A number of these electronic devices can be on a circuit board in the glasses. Or, some of the devices are in the glasses, while other in the base tethered to the glasses.

FIG. **11**B shows another example of some of the electrical components in or tethered to a pair of glasses for wireless connections according to the present invention. In this embodiment, there does not need to have digital data. A speaker **620** and a microphone **622** are connected to an analog interface circuit **624**, which is coupled to a RF transceiver circuit **626** and an antenna **628**. For the speaker application, the transceiver circuit **626** mixes the RF signals down into IF signals, which are converted by the analog interface circuit **624** into analog signals for the speaker **620**. Similarly, for the microphone application, its analog signals are converted into the IF signals by the analog interface circuit **624** to be up converted by the transceiver circuit **626** into RF signals for the antenna **628**. These types of circuitry are suitable for, such as, simple radios, analog cell phones, CB radios, walkee-talkees, police radios or intercom systems.

In one embodiment, most of the electrical components are not in the glasses. The pair of glasses includes an antenna to capture the wireless signals, and a connector. The wireless signals captured are transmitted through the connector to electrical circuits external to the glasses.

A number of processors have been described. The processors can use different types of operating systems. In one embodiment, Symbian Operating Systems are used. In another embodiment, operating systems, such as TinyOS, are used. The operating system could be programmed in C++ and then compiled into machine codes.

For privacy protection, signals can be encrypted before transmission. Encryption can take significant computation power, and may generate a fair amount of heat. In one embodiment, encryption capabilities are located in a base tethered to the glasses. There can be a fan inside the base. The fan can be turned on during encryption. In another embodiment, the fan is activated during other high capacity uses for heat dissipation purposes.

In yet another embodiment, there is a fan in the glasses. The fan is located at a temple of the glasses, in the region close to its lens holder. The fan is used to cool the wearer of the glasses.

In one embodiment, a pair of glasses has access to voice recognition software. The software can be embedded in (a) the glasses, (b) a base tethered to the glasses, (c) a portable device wired or wirelessly coupled to the glasses or to the base, or (d) a computing system wired or wirelessly coupled to the glasses. Or, the software or firmware can be in more than one of the above devices.

Glasses that can couple to signals wirelessly can be used in different applications. For example, the glasses can be a cell phone wireless head set, such as a Bluetooth cordless headset. Such short-distance wireless technologies allow the headset to connect to the user's cell phone without a wire. This would allow the user to drive, eat or perform other functions without getting tangled in a pesky wire.

In one embodiment, the cell phone is a VOIP (voice over Internet protocol) phone.

In one embodiment, for the glasses operating as a cell phone head set, the head set includes active noise cancellation mechanism. For example, the glasses include two microphones. One microphone is for capturing the voice of the user. But the microphone captures ambient noise also. It can be embedded in a protrusion extending from the end of the temple close to a lens holder, towards the mouth of the user, as the microphone **110** in FIG. **1**. Another microphone can be located at the top of one of the lens holders pointing away from the mouth of the user. This microphone is for capturing ambient noise. As a first order approximation, outputs from the two microphones could be subtracted from each other to provide voice signals with noise reduced.

In yet another embodiment, the glasses with wireless coupling capabilities also have a multimedia asset player, such as a MP3 player. The glasses can be used to receive music directly in digital format over, for example, a data-capable network of a mobile operator. The music can be received, for example, at a speed of 16 Kbits per second, providing sound quality close to compact disc. If the music is transmitted in a compressed manner, such as in a MP3 format, then the music data can be received at a much lower speed. In one embodiment, the glasses also have a microphone and can serve as a cellular phone or a wireless headset of a cellular phone.

In yet another embodiment, the glasses can serve as a radio, again through electrical components in or tethered to the glasses. In this embodiment, the glasses can include a tuner with one or more control knobs. The knobs can be used to select channels and to set the volume.

In one embodiment, a pair of glasses allows personalization by including a preference indicator. The indicator allows a user to provide his preference, such as on whatever is being output by the glasses. In one example, the glasses also has a radio having a speaker and with electrical components for wireless connection. In this example, the indicator can be used by the user to provide his preference regarding whatever is being played by the radio at that time. This preference can be wirelessly transmitted from the glasses to a third party. To illustrate, when the user is listening to a piece of music, the user can indicate he likes the piece of music by pressing a control knob on the glasses. This piece of preference information is then transmitted and received by a service provider, which is then informed of the user's preference. Instead of a control knob, in another embodiment, the preference indicator is a system with a microphone and voice recognition software. The user can indicate his preference vocally.

In another example regarding the personalization process, the glasses can serve as a multimedia asset player, such as a MP3 player. The song that the user has shown preference can be stored in a storage device, which can be in the glasses.

FIG. **12** shows a process **650** according to one embodiment of the present invention for a personalized radio.

Initially, a pair of glasses according to the present invention receives **652** a piece of music from a radio station. That piece of music is stored **654** in a buffer or a temporary storage area. This temporary storage area can be in the glasses or tethered to the glasses. The piece of music is also sent **656** to a speaker in the glasses.

Assume that the user likes the music. Based on the preference indicator, the user shows his preference. After the glasses receive **658** an indication of the user's preference, the glasses determine **660** the song corresponding to the indication. That piece of music can then be moved **662** from the buffer to a permanent storage area, such as into a flash memory. This would then allow the user to subsequently access the piece of music.

There are different ways to determine **660** the song or the content being played by the radio corresponding to the indication. For example, one rule is that when the user pushes the preference button or voices his preference, the song (or media asset or media file) that is being played is the one the user likes. Since the operating system knows what song is being played at what time, based on the rule, the song of preference is determined. Another rule is that when the user shows his preference, and there is no song being played at that instance, the song immediately preceding the break is the song of preference.

In another embodiment, the glasses can get **664** an identification for the song of preference. For example, the glasses can ask the user to provide an identification for the piece of music. This identification can be the type of music, the singer, the name of the music or other identification. In another embodiment, there can be meta data embedded, such as in the beginning part of the music (or media asset). Having such meta data embedded is not uncommon for music in digital format. The meta data can include identifications for the music. The glasses can get **664** such identification. Based on the identification, the song is categorized **666** accordingly, such as grouped with other songs having the same identification. Such categorization process would enhance the ease of accessing the song by the user at a later time.

A number of control knobs have been described. FIG. **13** shows a number of attributes **700** regarding control knobs according to the present invention. The knobs can be of different physical structure **702**. For example, a control knob can be a roller, a switch or a push-button. A control knob serving as an up/down controller can use two buttons, or a roller.

A control knob can be more intelligent **704**. For example, a push-button control knob can serve different purposes depending on the duration the knob is being pushed. If a user

pushes it for more than three seconds, the knob serves as an on-off toggle switch. In another example, a knob can serve multiple purposes, and the specific purpose depends on the number of times the knob is pushed.

A knob can also be programmed. A user can connect the glasses to a computer and program the knob accordingly. For example, one can program a knob such that if the knob is pushed more than three seconds, the knob would serve as an on/off switch for the glasses.

The location **706** of a control knob can vary for different applications. A control knob can be located on the glasses. A control knob can be on the top, the side or the bottom of the temple. A control knob can be located at the inside of a temple facing the user. Assume that there are a number of control knobs and all of them are on the edges of a temple, except one. By being at a position different from other control knobs, this knob can serve a specific purpose. For example, it can be an on/off control knob. In yet another embodiment, a control knob can be located in a base tethered to the glasses.

The number **708** of control knobs can vary depending on operations. For example, there is an on/off control knob and a volume up/down control knob. If the glasses are used for cell phone headset application, in one embodiment, there is also an answer/hang-up control knob. If the glasses serve as a radio, in one embodiment, there is also a tuning control knob, which can be two push buttons. If the glasses serve as a CD player, in one embodiment, there is a play control knob, a stop control knob, and a skip forward/backward control knob. If the glasses serve as a multimedia asset player, such as a MP3 player, in one embodiment, there is a save-this-song control knob, a skip-forward/backward-song control knob and a select-song-to-play control knob.

A number of embodiments of the present invention have been described regarding audio signals. In one embodiment, the glasses further serve as a camera.

FIG. **14** shows one embodiment of electrical components in a pair of glasses with image capturing capabilities. A processor **752** is coupled to a CCD interface chip **754** and then to a CCD chip **756**. Images focused by a lens **758** are captured and collected by the CCD chip. In another embodiment, there is also be a flash controller **760** connected to the processor **752** to control a flash **762**.

In one embodiment, a number of pixels of the CCD chip **756** are used as light sensors. The pixels can be used to adjust the sensitivity of the CCD chip **756** based on the amount of ambient light. For example, if the outside environment is dim, it would take a longer period of time to collect enough charges by the CCD chip **756** to re-create the image. This implies that the integration time of the CCD chip **756** should increase.

In yet another embodiment, the camera can pertain to a video camera. The capacity of the memory **753** increases so as to store the video images.

In one embodiment, the glasses do not offer adjustment on the image distance. The CCD chip **756** can be located, for example, at the focal point of the lens **758**. In another embodiment, there is an image distance control knob. For example, a mechanical lever can be pre-programmed or pre-set to move the lens to one or more different positions. One position can be for close-up shots, such as objects from 2 to 4 ft, and another for scenic or vista images, such as objects greater than 6 ft.

Depending on the embodiment, electrical components of a camera can be in a pair of glasses, and/or a base tethered to the glasses, and/or a portable device tethered to the glasses or to the base. For example, the memory **753** can be in the base tethered to the glasses.

The location of the lens **758** can vary depending on the embodiment. In one embodiment, referring to FIG. **1**, one location is at the bridge of the glasses, with the lens of the camera facing forward. In this situation, what the user sees is substantially what the captured image would be. In other words, in a general sense, what the user sees is what the user gets. With such an embodiment, it is relatively easy for a user to take pictures, hands-free. In another embodiment, another location for the lens **758** are at a side portion adjacent to a lens holder, before the joint of the corresponding temple, such as at **116** in FIG. **1**. Again, the lens of the camera faces forward. Some of the electrical components of the camera can be in that location, and other components in the temple **104**. These components are electrically connected through one of the joints, such as with a flexible pc board. In yet another embodiment, the lens **758** can face sideways and outwards in a temple of a pair of glasses, towards the left or right side of the user.

Regarding storing the images, in one embodiment, the images are stored locally. One approach to determine which image to store is the first-in-first-out approach. Once the camera is turned on, the camera takes pictures continually in an automatic mode, such as once every few seconds. When the memory becomes full or under other pre-set or pre-programmed condition, the first picture stored will be deleted when the next picture comes in. In another embodiment, the digital content in one picture is compared to the digital content in, for example, the fifth picture further down. If the difference between the two is not more than a pre-set threshold, the four pictures in between will be deleted. One approach to determine the difference is by comparing the total charges collected by the CCD chip for the two images. If the two sets of charges do not differ by more than a certain threshold, the images in between would be deleted.

The images captured can also be stored at a remote site. For example, the glasses can upload the images to a computer, wirelessly or through a wired connection from a connector at the glasses.

FIG. **15** shows an operation **800** of taking certain actions based on images captured by a pair of glasses with a wireless transceiver, according to one embodiment of the invention. This operation can be used by a police officer on patrol. Before the officer gets out of his patrol vehicle to confront a suspect, the officer can inform the station. At that point, the camera is turned on **802**.

There can be different approaches to turn on the camera. In one embodiment, an operator at the station can remind the officer to turn on the camera. Or, the operator can remotely turn on the camera. In yet another embodiment, the camera can be automatically turned on under certain condition. One such condition is that if the camera is out of the patrol vehicle, the camera is automatically turned on. With the glasses having the capability to wirelessly communicate with the patrol vehicle, one method to detect if the glasses are out of the patrol vehicle is based on the wireless signal strength of the glasses. The patrol vehicle can detect the signal strength of the wireless signals, which depends on the distance between glasses and the vehicle. A threshold can be set. If the signal strength is below the preset threshold, the glasses would be assumed to be out of the car, and the camera would be automatically turned on.

After the camera is turned on **802**, the glasses start to continually take **804** pictures, such as once every few seconds. The pictures taken are automatically transmitted back **806** to the patrol vehicle in a wireless manner. In this situation, the patrol vehicle serves as a hub, which stores the pictures. Then, the hub re-transmits **808** the pictures back to the station. Note that the pictures can be compressed by

standard algorithms before they are transmitted. This compression mechanism can be performed by a computer in the patrol vehicle. When the station gets the pictures, they are de-compressed before being viewed, such as by the operator. The pictures enable the operator at the station to see what the officer is confronting. This effectively allows the operator at the station to perform real-time monitoring of or for the officer. If it is a high risk situation, the operator can quickly react **810**, such as by dispatching additional support for the officer. In one embodiment, the glasses can include not only a camera but also a microphone for audio pickup, such as sounds from the officer, suspect, witness or environmental sounds (such as door opening, gun shot, etc.).

Regarding ownership of the glasses, the user can own the glasses. In one embodiment, the user leases the glasses from a provider. For example, the user leases a ski goggle with a camera. After the user turns on the camera, as the user skis, the goggle automatically takes pictures. Later, the user can return the goggle to the provider or a kiosk, where the pictures can be retrieved and/or stored. Alternatively, the goggle can include a wireless transceiver and the images could be uploaded continually or automatically to the provider or the kiosk via a wireless network. The provider or the kiosk can transmit the images to a website, such as a website associated with the user. In another embodiment, the user picks up hardcopies of the images, e.g., a CD with the images or a DVD with the video, from the provider or the kiosk.

In one embodiment, the glasses allow the user to enter his identification. This can be done, for example, through a control knob at the glasses. Such identification is then linked to the images. Based on the identification, the user can return to the provider or kiosk at a subsequent time to pick up the images previously left behind.

In yet another embodiment, the pair of glasses with a camera also has a speaker and a wireless transceiver. It can be used to remotely control or direct the user wearing the glasses. FIG. **16** shows one such operation **850** according to one embodiment.

To illustrate the operation **850**, assume that the user is a paramedic helping a patient. The glasses continually take pictures **852** of objects directly in front of the paramedic, such as images around four feet away from the eyes of the paramedic. The pictures are wirelessly transmitted **854** to a remote site, such as a hospital, to be viewed by a doctor. Again, this transmission can be a two-step process. For example, pictures can be transmitted to the paramedic's ambulance, which can then re-transmit to the remote site. The first transmission from the glasses to the ambulance can be through a low-power, short-range, broadband, wireless transmission protocol. The second transmission from the ambulance to the hospital can be through a much longer-range, higher power, broadband, wireless transmission protocol. Again, compression and de-compression techniques can be used to enhance the rate of transmission by reducing the amount of data to be transmitted.

Based on the images, the doctor sends out voice messages to the paramedic. These messages are wirelessly transmitted to and received **856** by the glasses. The speaker in the glasses outputs **858** the messages to the paramedic.

In another embodiment, the glasses also have a microphone, which allows the paramedic to communicate directly with the doctor also.

In one embodiment, the glasses can take pictures and can be a multimedia asset player. Pictures and the multimedia assets can share the same memory storage device. In this situation, the capacity for the multimedia assets and pictures can be interrelated. For example, a user can take more pictures if there are less multimedia assets, such as fewer songs in the storage device.

A number of embodiments have been described regarding electrical components in the temples of glasses. The locations selected are for illustration purposes. In other embodiments, some of the components are embedded fully or partially in other areas of the glasses, such as the lens holders or the bridges of the glasses. For example, there are glasses where there are shields at the edges of the lens holders of the glasses. These shields can wrap around, or better conform to the profile of, the face of the wearer. There can be transparent or translucent windows on these shields also. The shields are not limited to be in primary frames. They can be in, for example, fit-over glasses, auxiliary frames or safety glasses. To illustrate, in fit-over glasses, such shields can go over or cover at least a portion of the primary frames. One or more electrical components can be in such shields. In still another embodiment, one or more electrical components can be in a strap tied to the corresponding eyewear, such as a sports strap tied to the corresponding sports eyewear. For example, the one or more electrical components can be at least partially embedded in or attached to a strap. As one particular example, an audio player or wireless communication module can be at least partially embedded in or attached to the strap. The strap may also provide electrical conductors (that are attached or internal to the strap). Such electrical conductors can be coupled to a speaker to produce audio output to the speaker, or can be coupled to a microphone to receive audio input from the microphone. The speaker and/or microphone can also be attached to or integral with the strap.

Note that in one embodiment, a pair of glasses does not have to include lenses. Also, a number of embodiments have been described with a pair of glasses tethered to a base. In one embodiment, a pair of glasses includes a base and a cord connecting the base to the glasses.

In yet another embodiment, a pair of glasses also includes a sensor. FIG. **17**A is a chart **900** that depicts examples of sensors in the glasses.

In one embodiment, the sensor is a "being worn" sensor. The "being worn" sensor indicates whether the glasses are being worn by its user. The "being worn" operation can be performed using, for example, a thermal sensor, a motion detector, a stress sensor or a switch.

In one embodiment, a motion detector is used as a "being worn" sensor. A threshold can be set, such that if the amount of motion exceeds the threshold, the eyewear is assumed to be worn. The motion detector can, for example, be achieved by a mechanical means or an accelerometer.

In another embodiment, the "being worn" sensor includes two thermal sensors. One sensor can be at approximately the middle of a temple, such as in a region that touches the head of the user wearing the glasses. The other sensor can be at the end of the temple, close to its hinge. If the temperature differential between the two sensors is beyond a certain preset value, the eyewear would be assumed to be worn. The differential is presumed to be caused by a person wearing the pair of glasses.

In yet another embodiment, the "being worn" sensor includes a stress sensor at the hinge of the temple. The assumption is that when the eyewear is worn, the hinge is typically slightly stretched because typically, the width of the head of the user is slightly wider than the width between the temples when the two temples are in the extended positions. If the value of the stress sensor is beyond a certain preset value, the glasses would be assumed to be worn.

In a further embodiment, the "being worn" sensor can be a switch. For example, at the hinge between a temple and its corresponding lens holder, there is a switch. When that temple is fully extended outwards, the switch is turned on. The switch can be a pin. When the temple is fully extended outwards, the pin is pressed. When both temples are fully extended outwards, in one embodiment, the glasses would be assumed to be worn by the user.

In one embodiment, another type of sensor is an environmental sensor. The environmental sensor can sense environmental conditions, such as one or more of ultraviolet radiation, temperature (e.g., ambient temperature), pressure, light, humidity and toxins (e.g., chemicals, radiation, etc.).

In another embodiment, another type of sensor is a condition sensor. The condition sensor can sense the conditions of the user of the glasses. Examples of physical sensors include sensing one or more of distance traveled, location, speed, calories consumed, temperature and vital signs associated with the user of the glasses. The distance traveled could represent the horizontal distance traveled or the vertical distance (i.e. elevation) traveled. The speed can be the rate of movement along the horizontal distance traveled and/or the vertical distance. In yet another embodiment, the condition sensor can sense the emotional conditions of the user of the glasses.

The sensors can be provided in a redundant or fault-tolerant manner. For example, sensors can come in pairs in the glasses. When one malfunctions, the other one will take over its operation. In another embodiment, the sensor information can be processed in a differential manner to examine changes to the sensor information. The sensors can by powered by a battery, solar energy, or kinetic energy. For reduced power consumption, the sensors can remain in a low-power state unless data is being acquired by the sensors. In yet another embodiment, two or more of the auxiliary sensors can communicate with one another (wired or wirelessly) to exchange data or control information.

A number of embodiments have been described regarding one or more electrical components at least partially embedded in a pair of glasses. In one embodiment, one or more electrical components are at least partially embedded in a temple tip of a pair of glasses. Temple tips are particularly common for wire or metal frames. The pair of glasses has a first and a second lens holders for receiving lenses. Each of the lens holders has a first side and a second side. The pair of glasses has a bridge element that couples the first side of the first lens holder to the second side of the second lens holder. The pair of glasses also includes a first temple and a second temple. The first temple is pivotally secured to the second side of the first lens holder through a joint, while the second temple is pivotally secured to the first side of the second lens holder through another joint. A temple typically has two ends, a first end and a second end. The first end can be the end that is pivotally secured to a lens holder through a joint, and the second end can be the other end of the temple. It is not uncommon that a temple includes a main body and an enclosure that grabs onto the main body of the temple. The second end is typically where the enclosure grabs onto the main body. The enclosure can be made of a different material than the main body of the temple. In one embodiment, such an enclosure is a temple tip, and there is an electrical component, partially or fully, embedded in the tip. There can also be a connector, such as the connector **300** shown in FIG. **5**, at the temple tip. In another embodiment, the temple tip can include a female connector, which can be similar to the female connector **310** shown in FIG. **6**B. As the temple tip grabs onto the main body of the temple, the female connector can make electrical contact with a male connector at the main body of the temple. Typically, particularly before a pair of glasses has been extensively worn, the temple tip can be removed and re-inserted back on to the main body of the temple without a lot of difficulties. Such a temple tip can be an after-market component, with different temple tips having different electrical components to serve different functions.

FIG. **17**B is a diagram of a temple arrangement **910** according to one embodiment of the invention. In this arrangement, a temple tip is not considered as a part of the temple. The temple arrangement **910** includes a temple **912** that is associated with a pair of eyeglasses. Over the end of the temple **912** that is opposite the associated lens holder, a temple tip **914** is provided. The temple tip **914** can be held to the temple **912** by frictional forces and/or adhesive. The temple tip **914** includes at least one electrical component **916** that is at least partially embedded therein. The temple tip **914** can be manufactured and delivered to resellers or retailers as such. Alternatively, the temple tip **914** can be separately provided as an optional replacement temple tip for an existing temple tip. Hence, as after manufacture, upgrade to the eyewear can be had through replacing the existing temple tip with the replacement temple tip. The colors and shapes of the temple tip **914** can vary widely. In the after manufacturing environment, the reseller or retailer can be provided with a range of different colors and shapes so that a user can receive a replacement tip that reasonably matches the color and shape of the temple or that provides an altered appearance as desired by the user.

Besides a replacement temple tip such as illustrated in FIG. **17**B, a temple tip can also be effectively modified by a fit-over temple or temple cover. FIG. **17**C is a diagram of a temple cover **920** that at least partially covers a temple (e.g., temple **912**) according to one embodiment of the invention. As another example, the temple cover **920** can be a fabric or other material, such as a sock or sleeve, that slides over and at least partially covers a temple tip. The temple cover **920** can include at one electrical component **922** that is either attached thereto or at least partially embedded therein. The temple cover **920** can also include an opening **924** so as to received a temple or a temple tip. The temple cover **920** can be held to a temple by frictional forces and/or adhesive. FIG. **17**D is a diagram of a fit-over temple **926** that at least partially fits over a temple according to one embodiment of the invention. For example, the fit-over temple **926** can at least partial fit-over a temple tip. The fit-over temple **926** includes at one electrical component **928** that is either attached thereto or at least partially embedded therein. The fit-over temple **926** can also include an opening **930** so as to receive a temple. The fit-over temple **926** can be held to a temple by frictional forces and/or adhesive. As an example, the fit-over temple **926** can be plastic or other material. The colors and shapes of the fit-over temple **926** can vary widely. In the after manufacturing environment, the reseller or retailer can be provided with a range of different colors and shapes so that a user can receive a replacement temple cover or fit-over temple that reasonably matches the color and shape of the temple or that provides an altered appearance as desired by the user.

In one embodiment, a fit-over temple or temple cover according to the invention can further include a connector or cable to facilitate electrical connection with the at least one electrical component that is either attached to a temple or a temple tip or at least partially embedded therein.

In one embodiment, an electrical component is a component of an electrical circuit, and the electrical circuit is for performing at least a desired, intended or predetermined function.

A number of embodiments have been described above for an eyeglass frame, i.e., primary frame, are also applicable to an auxiliary frame. An auxiliary frame can attach to a primary frame through different techniques, such as using clips. Another technique to attach an auxiliary frame to a primary frame is by way of magnets. Examples of using magnets as an attachment technique can be found, for example, in U.S. Pat. No. 6,012,811, entitled, "EYEGLASS FRAMES WITH MAGNETS AT BRIDGES FOR ATTACHMENT."

A number of embodiments have been described where one or more electrical components are at least partially embedded in a pair of glasses. In yet another embodiment, the one or more electrical components are at least partially embedded in an eye mask.

FIG. **18** shows one embodiment **925** where one or more electrical components are at least partially embedded in an eye mask **927**. The eye mask **927** includes a piece of fabric that is opaque so that when the mask is worn, the mask wraps around the eyes to block light from entering into the eyes of the user.

The embodiment **925** includes a wrapping mechanism to hold the fabric onto the head of a user so that when the mask is worn by the user, the mechanism allows the fabric to have a relatively tight and comfortable fit over the face of the user. In one approach the wrapping mechanism is achieved with the fabric in the shape of a band and having a certain degree of elasticity. When the mask is worn by the user, the elasticity of the fabric allows the mask to establish a relatively tight fit over the face of the user. In another example, the fabric is a long piece of material. The wrapping mechanism includes a clip or Velcro at the two ends of the piece of material to tie the two ends together. In another example, the wrapping mechanism includes two elastic pieces of elastic materials at the two ends of the fabric. To wear the mask, each elastic piece of material goes over one of the ears of the user so that the fabric establishes a relatively tight fit over the face of the user. In yet another embodiment, the mask **927** includes a notch **935** to accommodate the nose of the user. In another embodiment, there can be additional padding in the vicinity of the one or more electrical components so that if an electrical component is pressed against the user, the padding serves as a buffer or cushion.

In one embodiment, a speaker **929** can be at least partially embedded in the mask **927**, and can be positioned close to and facing one of the ears of the user. The speaker **929**, through an electrical connector, is electrically connected to a cable **931**. The cable **931** can also have a connector **933** at its distal end. The connector **933** can be plugged into another device, such as a MP3 player or a CD player. After putting on the mask, with the connector **933** plugged into the another device, the user would be able to hear, for example, audio sounds such as music. The eyemask **925** can be applied to different areas. For example, the user can be on a plane, and would like to rest. The user can put on the eyemask **925**, and plug the connector **933** into a media outlet at an armrest of her seat in the plane. Thus, the user can enjoy music while taking a rest. The embodiment **925** could also include a plurality of speakers, such as one for each of the user's ears.

In another embodiment, the eyemask **927** includes the speaker **929** and a battery that is electrically connected to the speaker **929**. The battery can be in a pocket on the eyemask and can be replaceable. The battery can also be a rechargeable battery, such as a lithium-ion battery, and there is a connector at least partially embedded in the eyemask. The connector can be used to recharge the battery.

FIG. **19** shows another embodiment **950** where one or more electrical components are at least partially embedded in a night cap **952**. In one embodiment, the cap **952** is at least partially made of fabric. In another embodiment, the cap **952** is entirely made of fabric. The cap includes a wrapping mechanism. When the cap is worn, the wrapping mechanism holds the cap onto the head of the user, and allows the cap to have a relatively tight and comfortable fit over the head of the user. Again the wrapping mechanism can be an elastic band at the base **953** of the cap **952**. Or, the wrapping mechanism can include clips or Velcro as previously described.

The cap can include at least one speaker **954**, which is at least partially embedded in the cap **952**. When the cap **952** is worn by a user, the speaker **954** is positioned close to and facing one of the ears of the user. The speaker **954** can, for example, be electrically connected through a connector to a device **962** in a pocket **960** on the cap **952**. The electrical connection can be through a cable **956** external to the cap **952**. The cable **956** also can have a connector **958** to be plugged into the device **962**. In another embodiment, the cable **956** is embedded in the cap. The device **962** can be an asset player, such as a MP3 player, with a battery. Through the connector **958**, audio signals from the device **962** can be received by the speaker **954** and heard by the user. There can be one or more additional pockets on the night cap for one or more additional electrical components. When worn, the night cap does not have to cover the eyes of the user. In yet another embodiment, when worn, the night cap further covers the eyes of the user, as shown in FIG. **19**. In one embodiment, the embodiment **950** further includes padding in the vicinity of an electrical component to serve as a buffer or cushion between the user and the electrical component.

A number of embodiments have been described involving a speaker in an eyemask or a night cap. In one embodiment, the audio output from the speaker can serve to cancel the environmental sounds in the vicinity of the user. For example, if the user is on an airplane, the surrounding environmental sound has a relatively high level of white noise. This white noise can be detected by a pickup device and cancelled by noise cancellation circuitry provided within the eyemask or night cap. Namely, the audio output from the speaker serves to cancel the white noise of the user's environment. In another embodiment, the electrical component embedded or partially embedded is not a speaker, but can be a sensor, which can sense a physiological function of the user.

FIG. **20**A is a diagram illustrating a temple **1000** having a slot for receiving a removable electronic device **1002** according to one embodiment of the invention. In one example, the removable electronic device **1002** can be a memory storage device, sometimes referred to as a memory card. As shown in FIG. **20**A, the removable electronic device **1002** is inserted into the slot. Although the slot could be electrically non-functional, typically the slot provides an avenue for the removable electronic device **1002** to be physically and electrically connected to electrical circuitry within the temple **1000** or elsewhere within the eyeglass frame. FIG. **20**B is a diagram illustrating the temple **1000** having a recessed lower portion **1004** according to another embodiment of the invention. The recessed lower portion **1004** facilitates the insertion and removal of the removable electronic device **1002**. In either embodiment, the removable electronic device can be manually inserted and removed or can use more complicated mechanical mechanisms to assist with the insertion and removal (e.g., spring-based push and release structure).

FIGS. **21**A and **21**B are diagrams illustrating a pair of glasses **2100** having a camera **2101** coupled thereto, according to one embodiment. The camera includes an image sensor **2102** and a camera housing **2106** (also referred to as a camera support arm). In this embodiment, the camera **2101** is rotat-

ably coupled to an exterior surface of a temple **2104** of the pair of glasses **2100**. The camera support arm **2106** is attached to the temple **2104**. The camera support arm **2106** can couple to the temple **2104** using a hinge **2108**. In one implementation, the hinge **2108** can use a spring or cam mechanism so that the camera support arm **2106** is held either against the temple **2104** when not in use or held in an open or extended position when in use. FIG. **21**A illustrates one position of the camera support arm **2106** when the camera **2101** is not in use. FIG. **21**B illustrates one position of the camera support arm **2106** when the camera **2101** is in use. The presence of the camera **2101** with the pair of eyeglasses **2100** enables a wearer of the pair of eyeglasses **2100** to take pictures of what the wearer is looking at. It should be noted that other supporting circuitry such as data storage for pictures, switches, battery, and electronics for the camera **2101** can be in the temple **2104**, in the camera support arm **2106**, elsewhere in the pair of glasses **2100**, or even tethered thereto. However, in one implementation, the camera **2101** is completely self-contained in the camera housing **2106**. In one embodiment, the hinge **2108** can also serve as a switch to turn the image sensor **2102** on or off.

In one implementation, to improve overall appearance of the pair of glasses **2100**, the temple **2100** can provide a recess for receiving the camera support arm **2106** when the camera is not being utilized. Such may improve the aesthetic appearance of the pair of glasses **2100**.

In another implementation, the pair of glasses **2100** can further provide a viewfinder. The viewfinder can assist the user in directing the image sensor **2102** towards whenever the user desired to photograph. The viewfinder can be a separate apparatus that is extended by user action or can be a viewfinder that is visually present or presented on one of the lenses. In one example, the viewfinder can be an extendable viewer through which the user can look through to determine the field of reference of the image sensor **2102**. The viewfinder can be extendible from either of the temples, such as in a telescoping, sliding or flipping action. Additionally, when the camera support arm **2106** is extended, a viewfinder can be automatically initiated. For example, indicators on one of the lens can be visually presented, such as through optical projection from one or more light sources. In another embodiment, the viewfinder can be always present, such as with indicators on one of the lens of the pair of glasses **2100**. The indicators can be a few faint dots to define an area (e.g., a square) on the lens.

In one embodiment, the camera support arm (camera housing) **2106** is removably coupled to the hinge **2108**. As such, the camera **2101** can be removed from or attached to the pair of glasses **2100**. Indeed, the camera support arm (camera housing) **2106** can be a camera body that houses electronics for the camera **2101**. In such case, the camera **2101** can operate as a camera apart from the pair of glasses **2100**.

In one implementation, the camera support arm **2106** has a connector and the hinge **2108** has a counterpart connector. In one example, the connectors are peripheral bus connectors, such as USB connectors. In such case, the camera support arm **2106** can be attached and removed from the pair of glasses **2100**. Such a connection via the connectors can be electrically functional or non-functional. If functional, electrical components in the pair of glasses **2100** can be electrically connected to electrical components in the camera **2101**.

Still further, in one embodiment, the connector at the end of the hinge **2108** enables connection of a variety of different peripheral devices to the pair of glasses **2100**. For example, the different peripheral devices (portable electronic devices) can be the camera, a memory card, or a media player. In one embodiment, electrical components integral with the pair of glasses **2100** can be shared by the different peripheral components. The hinge **2108** is not necessary in other embodiments, see FIGS. **8**F-**8**H, where a connector is attached or integral with a temple of a pair of glasses. If desired, the camera **2101** or other peripheral devices can include in its structure a hinge or other mechanism to permit positioning the camera or other peripheral devices.

In still another embodiment, an angled or hinged adapter can be inserted between a connector attached to the pair of glasses **2100** and a connector of the camera **2101** or other peripheral devices. The adapter can be electrically functional or non-functional.

In yet in another embodiment, a pair of glasses functioning as a headset with a speaker and a microphone further includes a camera. FIG. **22** is a diagram of a pair of glasses **2200** having a camera according to one embodiment of the invention. The glasses **2200** include a temple **2205** that has a microphone **2204**, a speaker **2206** and a camera **2208** with a connector **2210**. The connector **2210** is for connecting, for example, to another electronic device that provides at least one of data or information transfer capabilities or a power source for the glasses.

In one embodiment, the camera **2208** is a digital camera with an on/off switch **2212**. For example, the camera **2208** is a CCD camera including a CCD controller coupled to a CCD chip to capture images, a CCD memory device and a lens.

In one embodiment, with the connector **2210** connected to another electronic device (e.g., a portable electronic device), when the switch **2212** is pushed on, the CCD chip takes a picture. The charges in the CCD chip are digitized and transmitted through the connector **2210** to the other electronic device, under the management of the controller. At least some of the charges can be temporarily stored in the CCD memory device, for example, to accommodate the differences in speed in taking pictures and sending the pictures to the portable device through the connector. In this embodiment, images can be stored at the other electronic device. In another embodiment, the glasses can include sufficient data storage capabilities to store the pictures, at least until transferred to another electronic device.

In one embodiment, the glasses do not offer focusing capability. The CCD chip can be located, for example, at the focal point of the lens. In another embodiment, there is an image distance control knob. For example, a mechanical lever can be pre-programmed or pre-set to move the lens to one or more different positions. In one implementation, there can be just two positions. One position can be for close-up shots and another for distance shots, such as close-up being about 2 ft from the lens and the distant being about 6 ft away; or close-up being about 8 inches away and distant being about 2 ft away.

FIG. **22** shows one embodiment regarding the location of the camera **2208** at the end of the temple or arm **2205** of the glasses **2200** next to the hinge. The lens of the camera faces forward. In this situation, what the user sees is substantially what the captured image would be. In other words, in a general sense, what the user sees through the glasses is what the user gets, without the need for an additional view finder. With such an embodiment, it is relatively easy for a user to take pictures, hands-free, without the need for an additional strap for holding the camera.

The connector **2210** at the end of the glasses **2200** can be, for example, a 4-terminal connector, one for ground, one for power and the other two for transmit and receive signals. In

another embodiment, the connector **2210** can be a **3**-terminal connector, with the power line and one of the signal lines sharing one terminal.

Regarding the embodiment shown in FIG. **22**, the speaker **2206** can be in the glasses, with a tube **2216** and an ear bud **2218**, to help bring audio signals to the user. In one embodiment, the tube **2216** can be rotated at its end where it connects to the glasses. In another embodiment, the speaker **2206** can be provided at the ear bud **2218**.

In one embodiment, the CCD chip with the CCD memory device and the CCD controller are on the same integrated circuit.

The embodiment shown in FIG. **22** also includes a microphone **2204**. In one embodiment, the CCD memory device also stores audio signals from the microphone **2204**. For example, the memory device stores a duration of time, such as the last 15 seconds, of audio signals. When the user takes a picture, a duration of time before taking the picture, such as the previous 15 seconds, audio signals can be coupled to the picture. Another duration of time after taking the picture, such as the next 10 seconds, of audio signals can also be coupled to the picture. In one embodiment, the audio picked up can include environmental sounds present at that time. The audio signals or the digitized version of the audio signals can also be transmitted to the other electronic device with the corresponding picture. In the future, if the user wants to view the picture, the audio signals can be played with the picture at the same time. As another example, the user can provide an auditory annotation to the pictures being taken. Here, the user can leave a specific audio message to be associated with the picture. For example, the user might take a picture of his childhood home and record an audio annotation, "This is where I grew up".

In one embodiment, a pair of glasses functions as a headset with a speaker, a microphone and a camera. The pair of glasses can be coupled to another electronic device through a connector of the glasses. Additional electrical components, such as those in the other electronic device, like a portable device, for the glasses can be incorporated in the glasses. For example, the power source can also be in the glasses and the glasses do not have to include a connector. In one embodiment, the glasses include non-volatile memory to store at least a number of pictures. In another embodiment, the glasses further include a connector to receive a memory card, such as a flash memory device. One embodiment of such a removable card on a pair of glasses is shown in FIG. **17**, where the card **352** can be a removable memory card. The card can be a standard memory card with a USB connector. Pictures taken can be stored in the removable memory card.

In yet another embodiment for the glasses with a camera, the glasses do not include a speaker or a microphone. The glasses include a temple that has a CCD controller coupled to a CCD chip, a CCD memory device and a lens. The temple also includes an on/off switch with a connector. The connector is for connecting, for example, to a portable device that includes at least a power source for the camera.

In still another embodiment, an auditory feedback by a speaker is provided or coupled to a pair of glasses. For example, a clicking or "snapshot" sound can be output when a picture is taken (such as when a user initiates the picture taking).

Additional disclosure on camera in glasses can be found in U.S. Provisional Application No. 60/583,169, filed on Jun. 22, 2004, which is hereby incorporated by reference.

A number of electrical components have been described. They can be on circuit boards, which can be made of flexible materials. They can be on a substrate. They can also be integrated into one or more integrated circuits.

FIG. **23**A is a diagram of a pair of glasses (i.e., eyeglass frame) **2300** having a camera according to one embodiment of the invention. The eyeglass frame **2300** illustrated in FIG. **23**A includes a lens holder **2302** holding a lens **2304** and a lens holder **2306** holding a lens **2308**. The eyeglass frame **2300** also includes temples **2309** and **2310**. In the embodiment shown in FIG. **23**A, the temple **2310** includes a camera **2312**, supporting electronics **2314** and a switch (e.g., button) **2316**. In one embodiment, the camera **2312** includes a CCD chip. The camera **2312** can also include a lens and buffer memory. In one embodiment, the electronics **2314** illustrated in FIG. **23**A can be embedded within the temple **2310**. The electronics **2314** can include at least a microcontroller (e.g., an image processor), a memory, and a battery. These electronics **2314** can support the camera **2312**. The eyeglass frame **2300** can further include various other electrical components. For example, the eyeglass frame **2300** can further include one or more of: a microphone, an earphone, a removable memory, a display, a clock, and a Global Positioning System (GPS). These electrical components can be used in conjunction with the camera **2312** or separately from the camera **2312**. The button **2316** enables a wearer of the eyeglass frame **2300** to turn the camera **2312** on/off and/or to cause a picture to be taken (recorded). For example, by pushing the button **2316** for more than a few seconds, the camera will be turned off. However, by pushing and releasing the button **2316**, the camera takes a picture.

Still further, in the embodiment of the eyeglass frame **2300** shown in FIG. **23**A, the eyeglass frame **2300** further includes a view finder **2318** and an angled surface **2320**. Other embodiments of eyeglass frames need not include such features. Nevertheless, the view finder **2318** can assist a wearer (i.e., user) of the eyeglass frame **2300** in understanding the frame of the image (picture) being captured by the camera **2312**. In this example, the view finder **2318** is provided on the lens **2304** in a visible, yet non-distracting manner. As shown in FIG. **23**A, the view finder **2318** can be positioned such the wearer can direct the image (picture) to be captured. For example, the wearer would orient their head (using the view finder **2318**) to direct the camera **2312** towards the desired subject. Also, the angled surface **2320** allows mounting the camera **2312** in an angled manner. As a result, the direction of the camera **2312** is not straight forward but out towards the side. This facilitates the wearer in directing the camera **2312** using a single eye via the lens **2304**, and more particularly via the view finder **2318** if provided. The outward angle from straight forward being utilized by the camera **2312** can vary with implementation. For example, the outward angle can be in the range of 10-70 degrees or more particularly in the range of 15-60 degrees, or more particularly in the range of 20-40 degrees from the perpendicular direction of the plane of a front surface of the eyeglass frame **2300**. In one embodiment, with the camera positioned at an angle, the lens holder **2302** would not block the field of view of the camera even with the camera being positioned at a distance behind the lens holder **2302**.

Although the camera **2312** is provided on the left side of the pair of glasses **2300** as shown in FIG. **23**A, it should be understood that the camera could alternatively or additionally be provided on the right side of the glasses.

FIG. **23**B is a diagram of a pair of glasses (i.e., eyeglass frame) **2300'** according to another embodiment. In this embodiment, the eyeglass frame **2300'** is similar to the eyeglass frame **2300** illustrated in FIG. **23**A. However, the eyeglass frame **2300'** further includes a connector **2322** and a

memory card **2324**. More particularly, the temple **2310** includes a region **2326** larger than the temple region shown in FIG. **23**A. The larger or enlarged region can provide additional space for the connector **2322** and the memory card **2324**. The memory card **2324** can be operatively connected electrically to the electronics **2314** within the temple **2310** via the connector **2322**. The connector **2322** also can serve to provide a physical connection of the memory card **2324** to the eyeglass frame **2300**. In one embodiment, such physical connection is removable so that the memory card **2324** can be connected to or removed from the temple **2310**. Accordingly, the memory card **2324** can facilitate porting of data or information (e.g., pictures) from the eyeglass frame **2300'** to another electronic device (e.g., computer). As an example, the connector **2322** can be a USB connector or other peripheral type connector.

The eyeglass frame having a camera according to one embodiment of the invention can further include one or more sensors. For example, the one or more sensors can include one or more of a "being worn" sensor, a motion sensor, and a light sensor. These sensors can be used to influence operation of the camera provided with the eyeglass frame. For example, a "being worn" sensor can be used to determine whether the eyeglass frame is being worn by a user. If the eyeglass frame is not being worn, then the camera can be deactivated to prevent unnecessary battery consumption and/or to prevent pictures from being taken. As an example, if the camera is operated to automatically, periodically take a picture, then if the eyeglasses are not being worn, the automatic picture taking process could be stopped. In one embodiment, a motion sensor can be used in a variety of ways. A motion indication can indicate a rate of activity of the user. For example, the rate of activity could be used to avoid taking pictures during periods of high activity, such as rapid movements of the eyeglass frame (or the corresponding user), or to influence image processing, such as exposure rate. As another example, the rate of activity can be used to control the rate pictures are taken such as in the automatic picture taking example. In one embodiment, a light sensor can indicate the degree of light in the vicinity of the camera. The light indication can influence the image processing, such as exposure rate of the camera.

In one embodiment, in an automatic picture taking example, the location, time or device resources (e.g., available memory) can also be used to control the rate pictures are taken. Also, the ability of the eyeglass frame to know or acquire time and/or location information (such as the location of the eyeglass frame or the corresponding user) can enable pictures taken by the camera to be stored along with time and/or location indications.

The eyeglass frame having a camera according to one embodiment of the invention can further include a global positioning system (GPS). The information from the GPS can be used to alter configuration settings and/or influence operation of the camera. For example, the configuration settings can be different at night versus during daytime or can be different depending on time or location. As another example, the camera can take pictures depending on location. In one implementation, the camera can automatically take pictures dependent on a change in location. For example, after taking a picture, the camera can take a subsequent picture when the change in location exceeds a predetermined threshold.

In one embodiment, the camera utilized in the various embodiments is a digital camera, namely, a digital image capture device. The camera can be a still camera or a motion camera (i.e., video camera). The camera can be designed for manual focusing, auto-focusing, or predetermined fixed focusing. The camera can also support a wide angle or panoramic view.

FIG. **24** is a side view of a pair of eyeglasses (i.e., eyeglass frame) **2400** according to another embodiment of the invention. The eyeglasses **2400** include a lens holder **2402** for a lens **2404**. The lens holder **2402** is for the left side of the eyeglasses **2400**. A bridge **2406** couples the lens holder **2402** to another lens holder for the right side of the eyeglasses. In this embodiment, the lens **2404** and the lens holder **2402** extend substantially around the side and are sometimes referred to as "wrap-around" type frames. The eyeglasses **2400** include a temple having a forward temple portion **2408** and a rearward temple portion **2410**. Typically, the lens holder **2402**, the temple **2406**, the forward temple portion **2408** and the rearward temple portion **2410** are integrally formed as a single structure. The eyeglasses **2400** also support audio output to a wearer of the eyeglasses **2400**. To support audio, the eyeglasses **2400** include an ear bud **2412**, which serves as a speaker, and an extension arm **2414**. In this embodiment, the extension arm **2414** couples the ear bud **2412** to the forward temple portion **2408**. The extension arm **2414** can be pliable so that the wearer can adjust the position of the ear bud **2412**. In further support of audio, the eyeglasses **2400** couple to a cable **2416**. The cable **2416** provides audio signals to the ear bud **2412** via at least one electrical conductor extending through the cable **2416** and the extension arm **2414** to the ear bud **2412**. In one implementation, one end of the cable **2416** has a connector **2418** and the other end is integral with or connected to the forward temple portion **2408**. The connector **2418** can connect to a media output device, such as a portable media player (e.g., radio, MP3 player, CD player, etc.). In another implementation, the cable **2416** can have a connector, such as a plug, that connects to a jack **2420** embedded in the forward temple portion **2408**, thereby allowing the cable **2416** to detach from the eyeglasses **2400**. Alternatively, the cable **2416** can directly connect to the media output device without the use of the connector **2418**. Optionally, the eyeglasses **2400** can also support audio input by providing a microphone with the eyeglasses **2400**. In one embodiment, with a microphone, the eyeglasses **2400** serve as a headset for a phone.

Regardless of the electrical components being utilized with the eyeglass frames, it may be desirable for the eyeglass frames to be substantially balanced in weight. In the event that electrical components are attached and/or at least partially embedded in one of the temples of the eyeglass frame, the other of the temples can include other electrical components or even a counter weight so that the eyeglass frame can be substantially balanced.

The various embodiments, implementations and features of the invention noted above can be combined in various ways or used separately. Those skilled in the art will understand from the description that the invention can be equally applied to or used in other various different settings with respect to various combinations, embodiments, implementations or features provided in the description herein.

A number of embodiments in the invention can be implemented in software, hardware or a combination of hardware and software. A number of embodiments of the invention can also be embodied as computer readable code on a computer readable medium. The computer readable medium is any data storage device that can store data which can thereafter be read by a computer system. Examples of the computer readable medium include read-only memory, random-access memory, CD-ROMs, magnetic tape, optical data storage devices, and carrier waves. The computer readable medium can also be

distributed over network-coupled computer systems so that the computer readable code is stored and executed in a distributed fashion.

Numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will become obvious to those skilled in the art that the invention may be practiced without these specific details. The description and representation herein are the common meanings used by those experienced or skilled in the art to most effectively convey the substance of their work to others skilled in the art. In other instances, well-known methods, procedures, components, and circuitry have not been described in detail to avoid unnecessarily obscuring aspects of the present invention.

Also, in this specification, reference to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment can be included in at least one embodiment of the invention. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. Further, the order of blocks in process flowcharts or diagrams representing one or more embodiments of the invention do not inherently indicate any particular order nor imply any limitations in the invention.

Other embodiments of the invention will be apparent to those skilled in the art from a consideration of this specification or practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with the true scope and spirit of the invention being indicated by the following claims.

Other embodiments of the invention will be apparent to those skilled in the art from a consideration of this specification or practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with the true scope and spirit of the invention being indicated by the following claims.

What is claimed is:

1. A pair of glasses for a user, comprising:
- an eyeglass frame having at least first and second temples;
- a digital camera at least partially embedded in the first temple, the digital camera being configured to acquire at least an individual picture;
- a user input device configured to receive a user input to activate aquisition of the individual picture by said camera;
- a data storage device configured to store one or more individual pictures acquired by said camera; and
- a microphone configured to acquire audio input to be recorded to said data storage device,
- wherein the acquired audio input stored in said data storage device is associated with the individual picture acquired by said camera and stored in said data storage device.

2. A pair of eyeglasses as recited in claim **1**, wherein said eyeglass frame further includes first and second lens holders, with the first lens holder adjacent the first temple and with the second lens holder adjacent the second temple, and wherein said camera is mounted such that the camera does not face forward, but faces at an angle from the perpendicular direction of the plane formed by the lens holder adjacent to the first temple.

3. A pair of eyeglasses as recited in claim **2**, wherein the angle is 15-40 degrees.

4. A pair of eyeglasses as recited in claim **1**, wherein said camera is mounted on an angled surface at a forward portion of the first temple.

5. A pair of eyeglasses as recited in claim **1**, wherein said data storage device is removably coupled to the glasses.

6. A pair of eyeglasses as recited in claim **1**, wherein said camera can be operated to automatically take at least one picture without any required user interaction after a previous picture is taken.

7. A pair of glasses as recited in claim **1**, wherein, as stored in said data storage device, the acquired audio input is linked to at least the individual picture acquired by said camera.

8. A pair of glasses as recited in claim **1**, wherein said pair of glasses further comprises a speaker to allow an auditory feedback in picture taking.

9. A pair of glasses as recited in claim **1**, wherein the acquired audio input is stored in said data storage device as a separate electronic file from an electronic file storing the individual picture associated thereto.

10. A pair of glasses as recited in claim **1**, wherein said camera or said user input device is configured to initiate storage of the acquired audio input to said data storage device.

11. A pair of glasses as recited in claim **1**, wherein the acquired audio input is acquired during a predetermined period of time proximate to when the individual picture is acquired by said camera.

12. A pair of glasses as recited in claim **1**, wherein the acquired audio input is acquired during a predetermined period of time before and a predetermined time after the individual picture is acquired by said camera.

13. A pair of glasses as recited in claim **1**, wherein the acquired audio input comprises an audio message provided by a user of said pair of eyeglasses.

14. A pair of glasses as recited in claim **1**, wherein the acquired audio input comprises an audio recording of audio sounds at the location where the picture was taken.

15. A pair of glasses as recited in claim **1**, wherein the acquired audio input comprises an audio recording of environmental sounds at the location where the picture was taken.

16. A pair of eyeglasses as recited in claim **1**, wherein said data storage device is removably connectable to the first temple or the second temple.

17. A pair of glasses as recited in claim **1**, wherein said pair of glasses further comprises
- a speaker at least partially embedded in said eyeglass frame;
- at least one electrical component for wireless connection, and
- wherein said pair of glasses is configurable to be used as a wireless headset.

18. A pair of glasses as recited in claim **1**, wherein said pair of glasses further comprises:
- at least one electronic component for wireless connection,
- wherein the pictures taken by said camera can be wirelessly transmitted to another device.

19. A pair of glasses as recited in claim **1**, wherein said pair of glasses further comprises at least one sensor.

20. A pair of glasses as recited in claim **1**, wherein said data storage device is a removable media card.

21. A pair of glasses as recited in claim **1**,
- wherein said data storage device is a removable memory card, and
- wherein said pair of glasses further includes a connector adhered by or to one of the first and second temples, said connector being operatively connected to said camera, and
- wherein said removable memory card is configured to operatively connect with said connector to permit storage in said removable memory card of the one or more individual pictures acquired by said camera.

22. A pair of glasses as recited in claim 21, wherein said connector is a USB connector.

23. A pair of glasses for a user, comprising:

an eyeglass frame having at least one lens holder and first and second temples, with each of the first and second temples being connected to the at least one lens holder at least via a hinge; and

a digital camera at least partially embedded in a forward portion of the first temple,

wherein said camera is coupled to the forward portion of the first temple, such that the camera does not face directly forward but faces outward at an angle of about 15-40 degrees from the directly forward direction so that obstruction of the field of view of said camera by the at least one lens holder and/or the hinge associated with the first temple is significantly reduced.

24. A pair of glasses for a user, comprising:

an eyeglass frame having at least one lens holder and first and second temples; and

a digital camera at least partially embedded in the first temple,

wherein said camera is coupled to a forward portion of the first temple, such that the camera does not face directly forward but faces outward at an angle of about 15-40 degrees so that the at least one lens holder does not obstruct the field of view of said camera.

25. A pair of glasses as recited in claim 24, wherein said camera is mounted on an angled surface at the forward portion of the first temple.

26. A pair of glasses for a user, comprising:

an eyeglass frame having at least first and second temples;

a digital camera at least partially embedded in said eyeglass frame, said camera being configured to acquire one or more images;

a user input device configured to receive a user input to activate acquisition of the one or more images by said camera; and

a removable memory card connector provided at one of the first and second temples, said removable memory card connector being electrically connected to said camera.

27. A pair of glasses for a user as recited in claim 26, wherein said removable memory card connector is adhered to or at least partially embedded within the one of the first and second temples.

28. A pair of glasses for a user as recited in claim 26, wherein the one or more images acquired by said camera are able to be stored to a removable memory card that is connected with said removable memory card connector.

29. A pair of glasses for a user, comprising:

an eyeglass frame having at least first and second temples;

a digital camera at least partially embedded in said eyeglass frame, said camera being configured to acquire one or more images;

a user input device configured to receive a user input to activate acquisition of the one or more images by said camera; and

a removable memory card slot provided at one of the first and second temples, said removable memory card slot being configured to receive a removable memory card, whereby the one or more images acquired by said camera are able to be stored to the removable memory card while the removable memory card is inserted into said removable memory card slot.

30. A pair of glasses for a user as recited in claim 29, wherein said removable memory card slot is provided at a lower portion of the one of the first and second temples.

* * * * *

Appendix EEE

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(54) **HEAD-MOUNTED CAMERA**

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(52) **U.S. Cl.** **348/345**; 348/373

(57) **ABSTRACT**

A head-mounted camera of the present invention includes the following elements. A first image pickup device includes a first photographing optical system that can change the focal distance and a CCD for converting a subject image formed by the first photographing optical system into an image signal. A see-through image display portion displays a photographic frame indicating the photographic range as a virtual image so that it is superimposed on a subject substantially directly observed by a photographer. A remote controller includes a second operation switch for setting the visual angle of the photographic frame when viewed from the photographer. A controller/recorder includes a first CPU for setting the focal distance of the first photographing optical system so that the visual angle of the photographic frame set by the second operation switch coincides with the field angle of the first image pickup device.

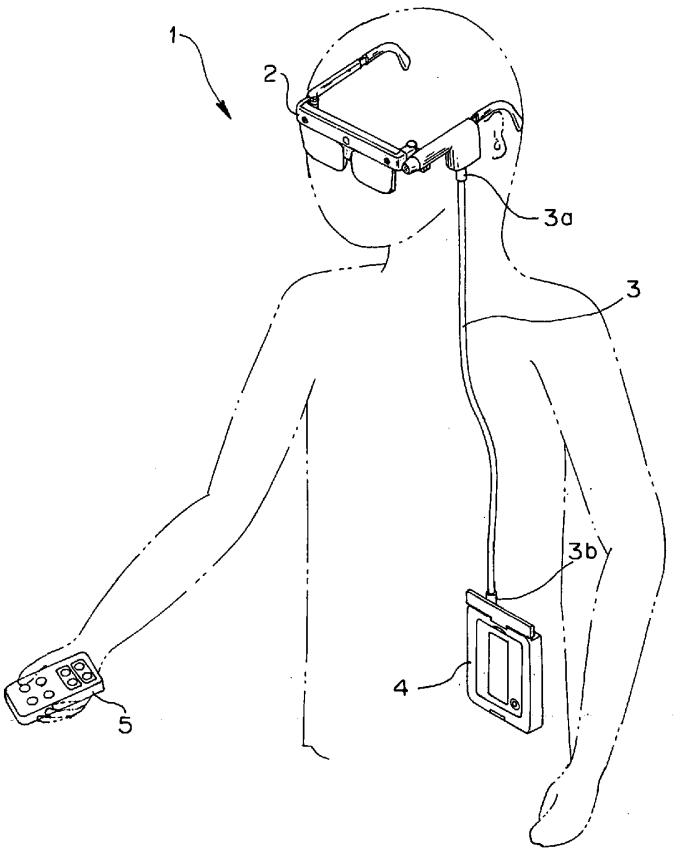


FIG. 1

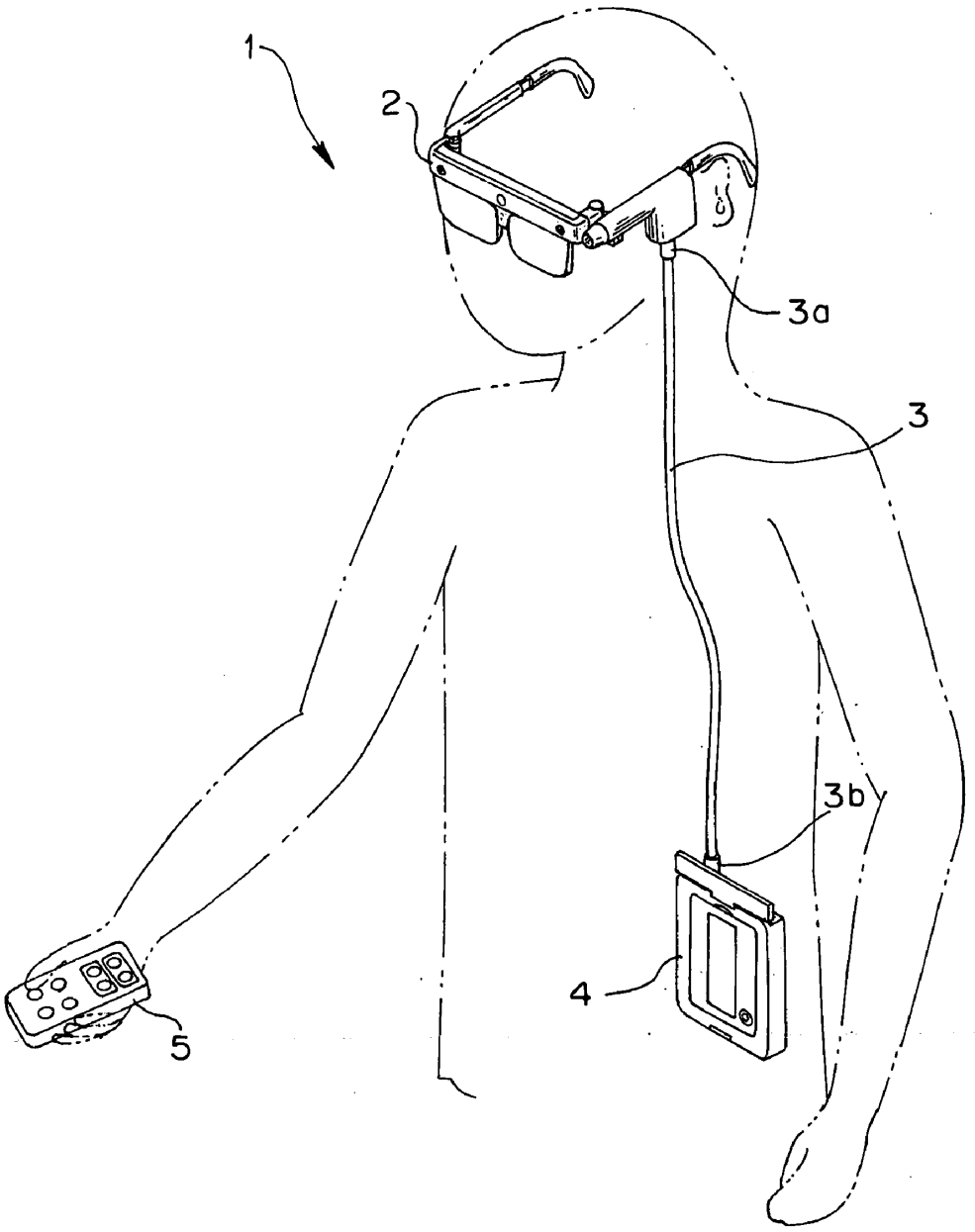


FIG.2

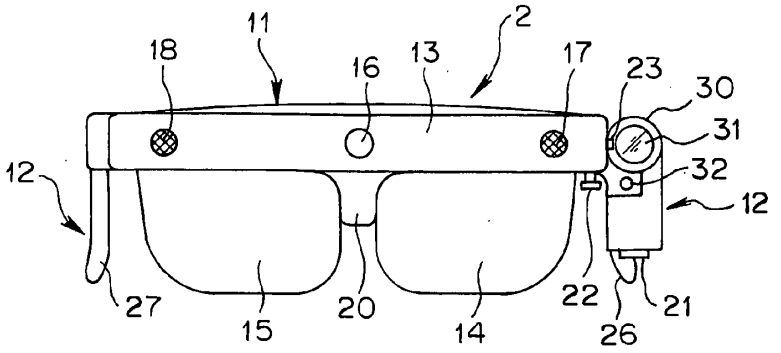


FIG.3

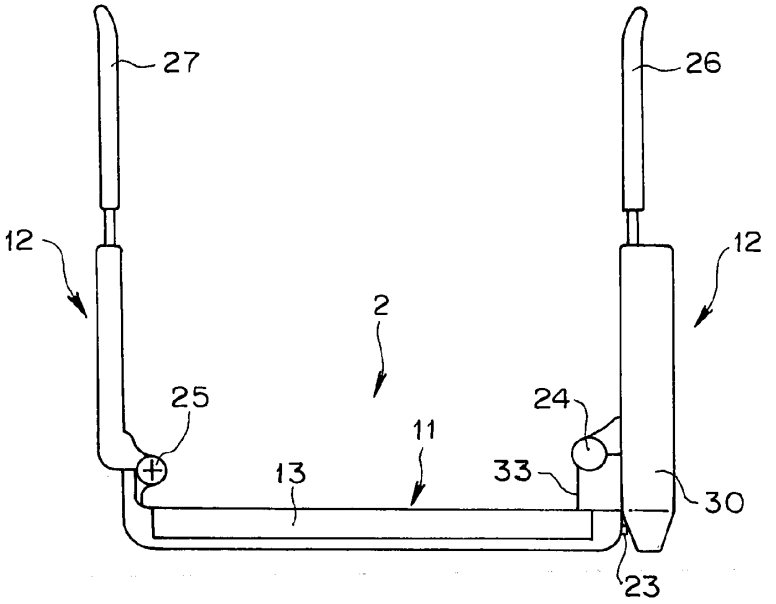


FIG.4

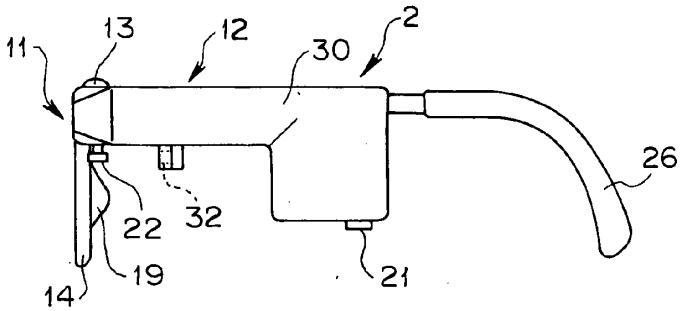


FIG. 5

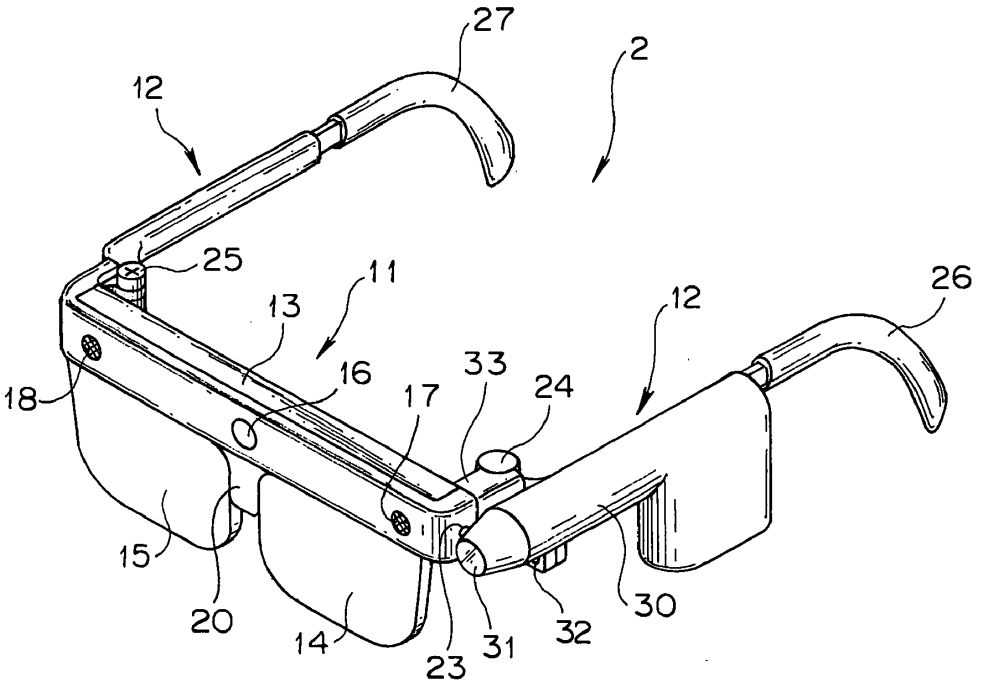


FIG.6

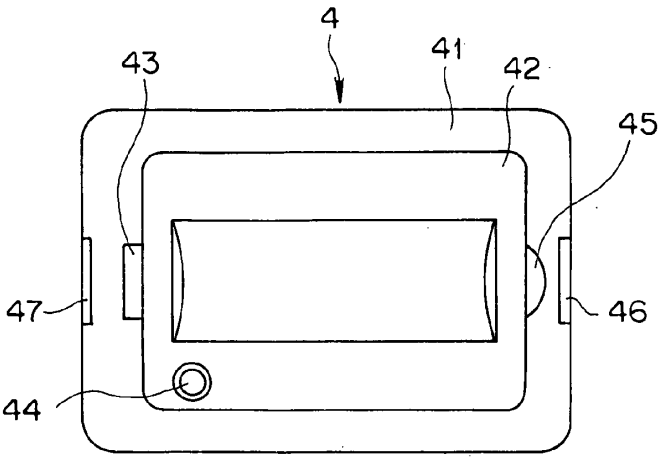


FIG.7

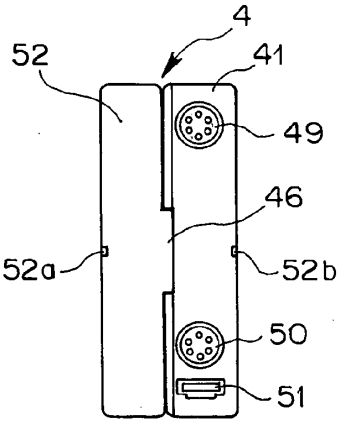


FIG.8

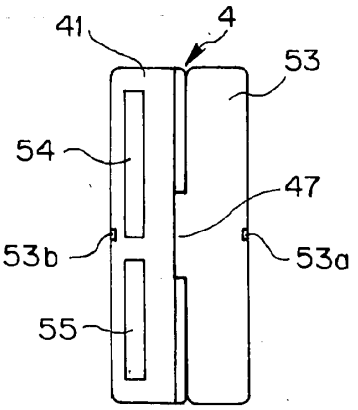


FIG. 9

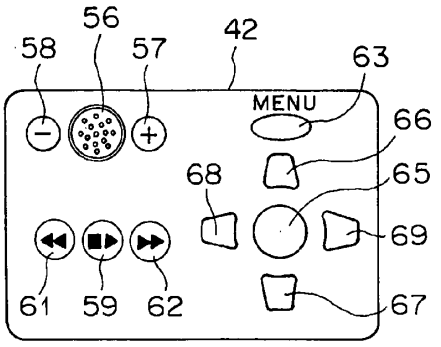


FIG. 10

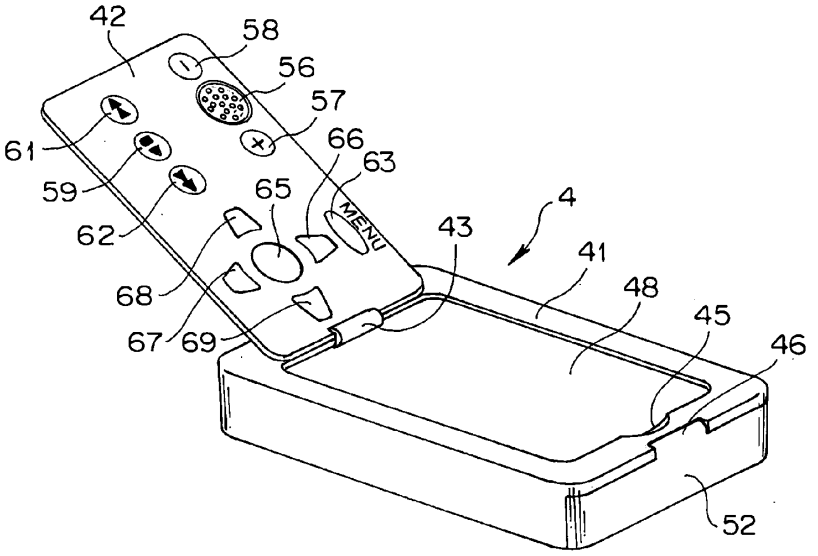
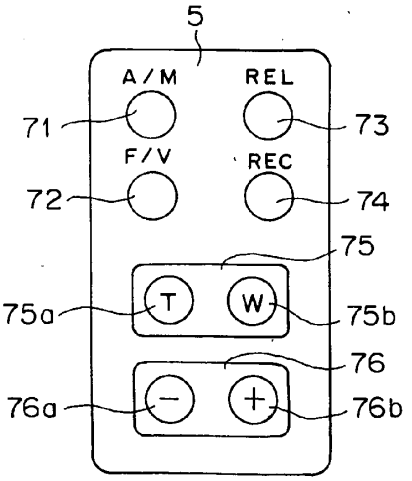


FIG. 11



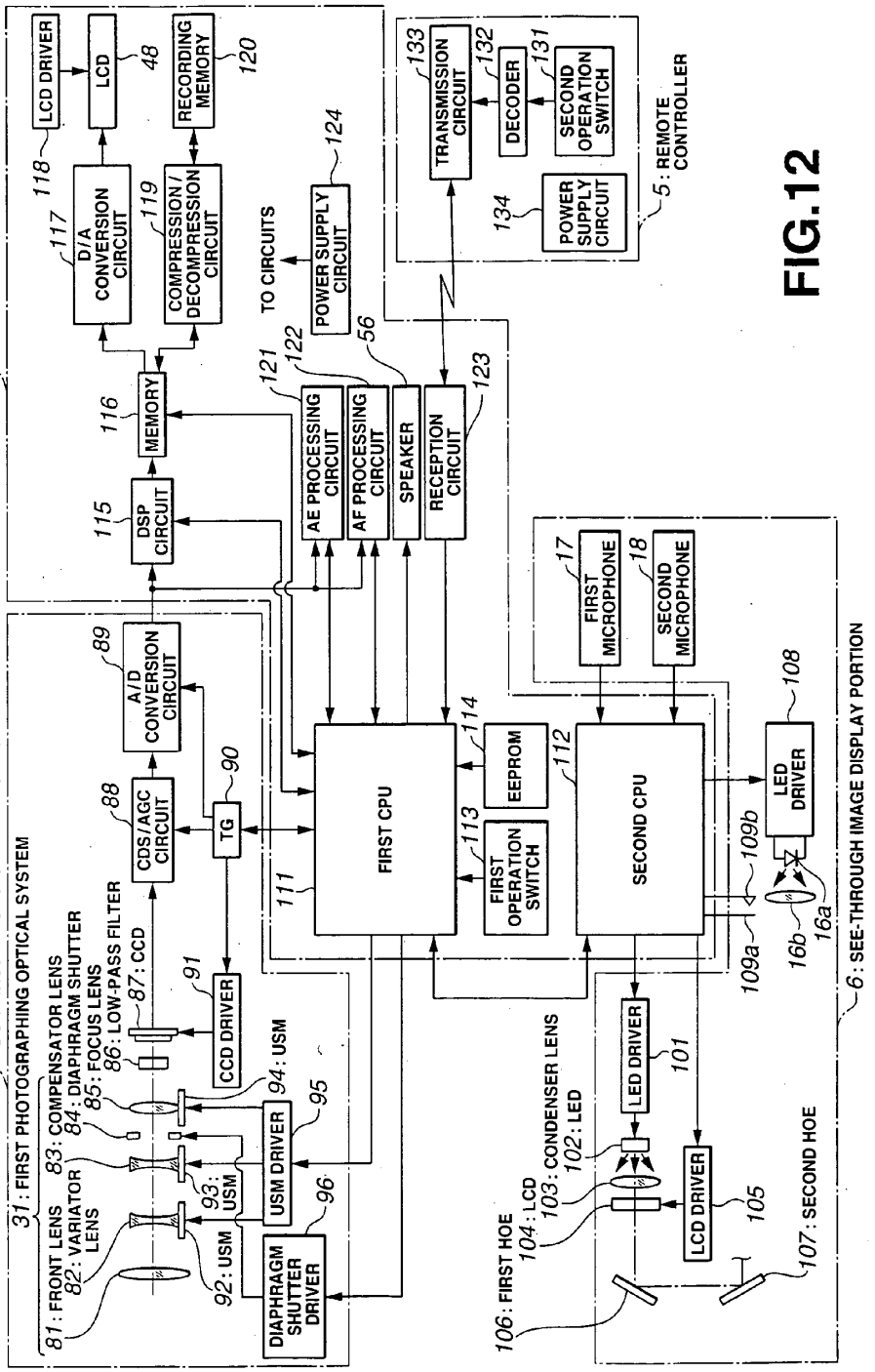

4 : CONTROLLER/RECORDER
LCD DRIVER
LCD
48
RECORDING MEMORY
120
118
D/A CONVERSION CIRCUIT
117
119
COMPRESSION/ DECOMPRESSION CIRCUIT
TO CIRCUITS
POWER SUPPLY CIRCUIT
124
TRANSMISSION CIRCUIT
133
DECODER
132
SECOND OPERATION SWITCH
131
POWER SUPPLY CIRCUIT
134
5 : REMOTE CONTROLLER
MEMORY
116
121
122
56
AE PROCESSING CIRCUIT
AF PROCESSING CIRCUIT
SPEAKER
RECEPTION CIRCUIT
123
DSP CIRCUIT
115
FIRST MICROPHONE
17
SECOND MICROPHONE
18
A/D CONVERSION CIRCUIT
89
CDS/AGC CIRCUIT
88
TG
90
FIRST CPU
114
EEPROM
112
SECOND CPU
LED DRIVER
108
111
113
FIRST OPERATION SWITCH
109b
109a
16b
16a
6 : SEE-THROUGH IMAGE DISPLAY PORTION
30 : FIRST IMAGE PICKUP DEVICE
31 : FIRST PHOTOGRAPHING OPTICAL SYSTEM
81 : FRONT LENS
82 : VARIATOR LENS
83 : COMPENSATOR LENS
84 : DIAPHRAGM SHUTTER
85 : FOCUS LENS
86 : LOW-PASS FILTER
87 : CCD
CCD DRIVER
91
94 : USM
95
93 : USM
92 : USM
USM DRIVER
96
DIAPHRAGM SHUTTER DRIVER
LED DRIVER
101
102 : LED
103 : CONDENSER LENS
104 : LCD
LCD DRIVER
105
106 : FIRST HOE
107 : SECOND HOE

FIG.12

FIG.13

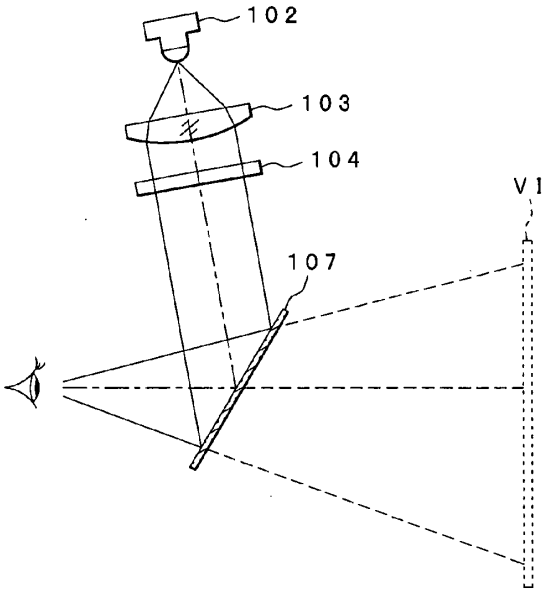


FIG.14

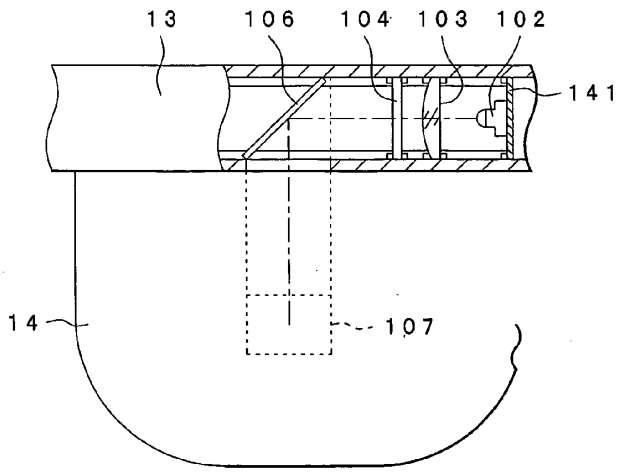


FIG.15A

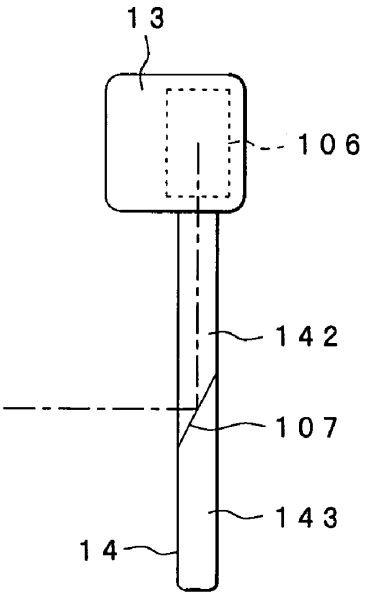


FIG.15B

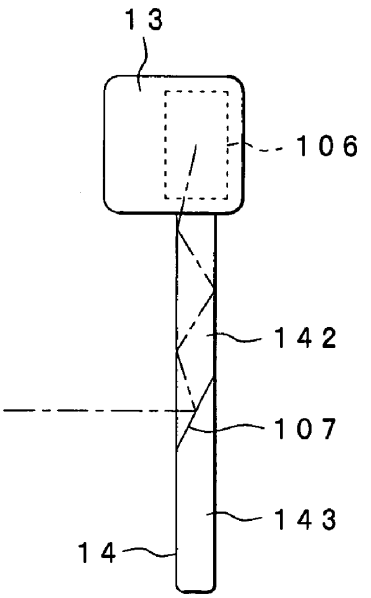


FIG.16

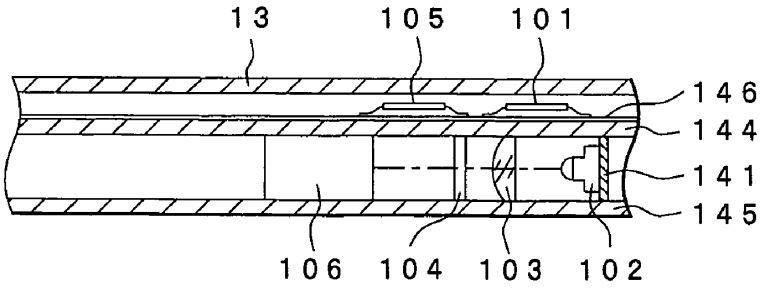


FIG.17

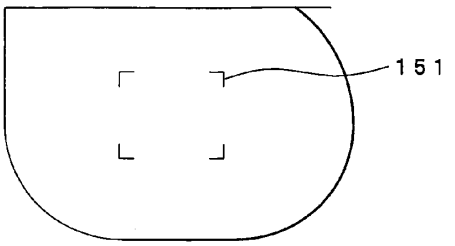


FIG.18

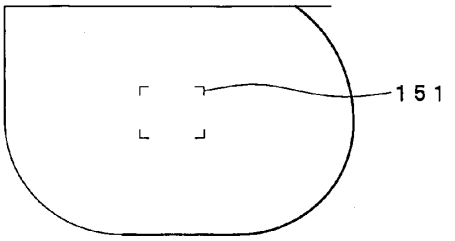


FIG.19

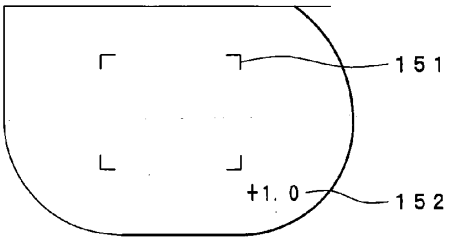


FIG.20

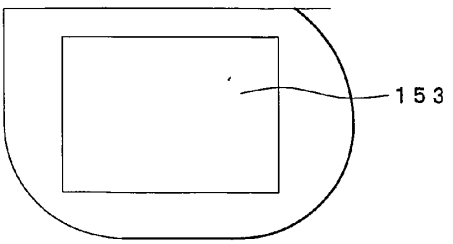


FIG.21

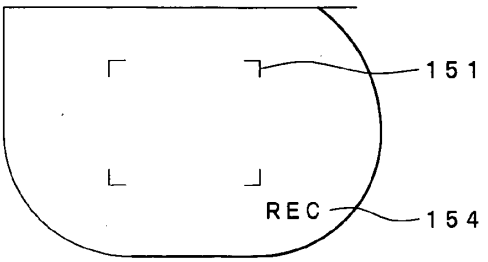


FIG.22

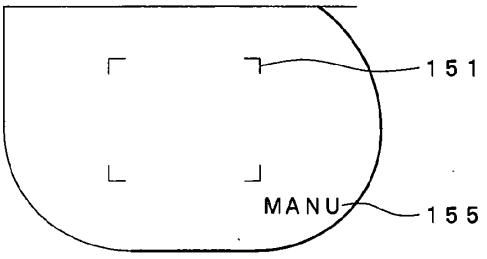


FIG.23

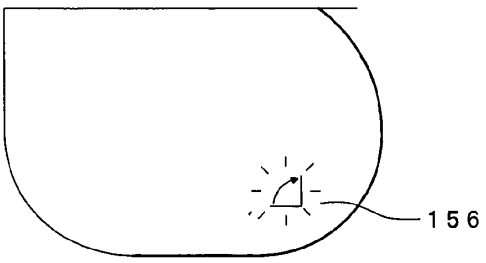


FIG.24

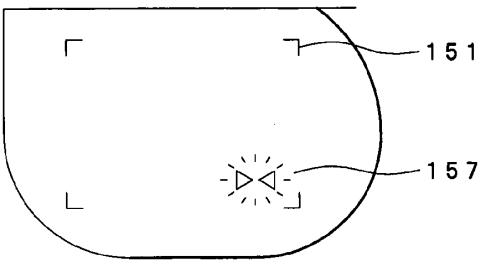


FIG.25

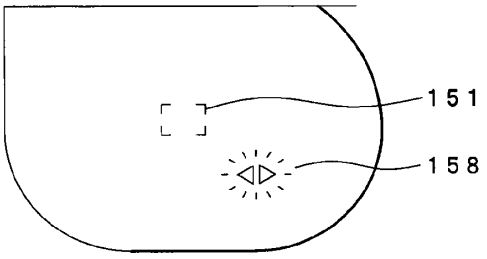


FIG.26

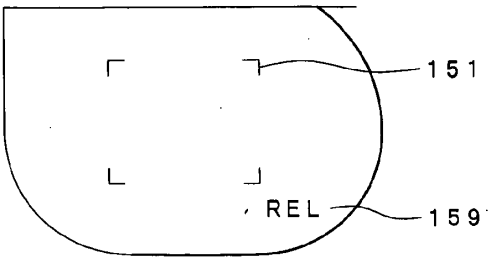


FIG.27

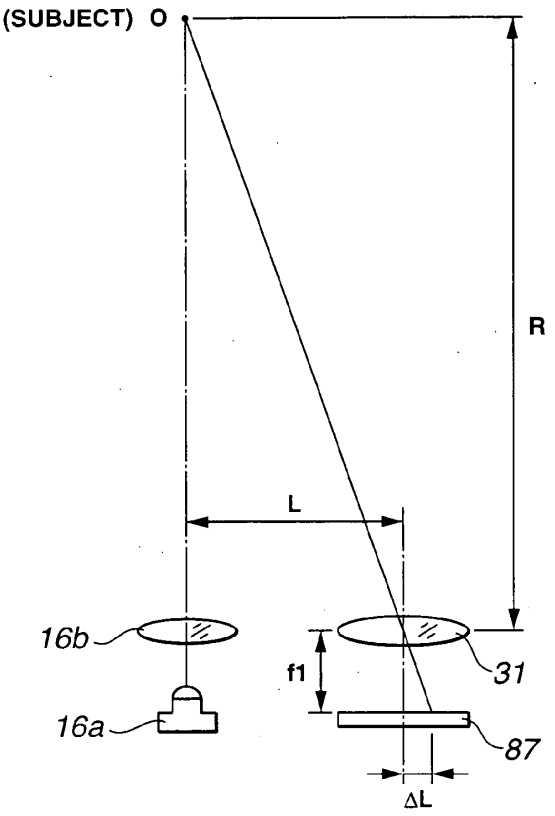


FIG.28

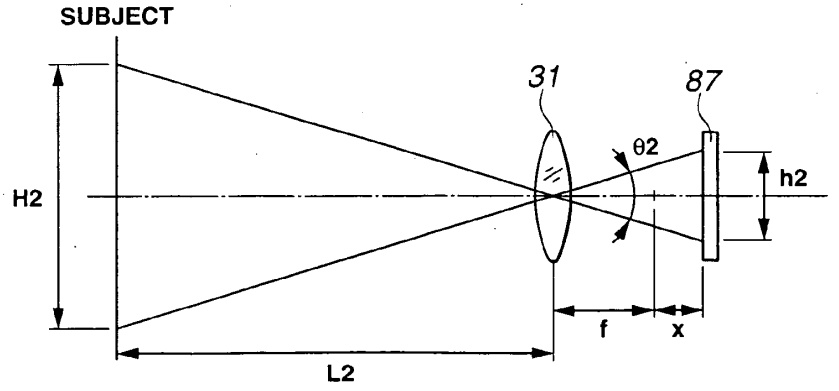


FIG.29

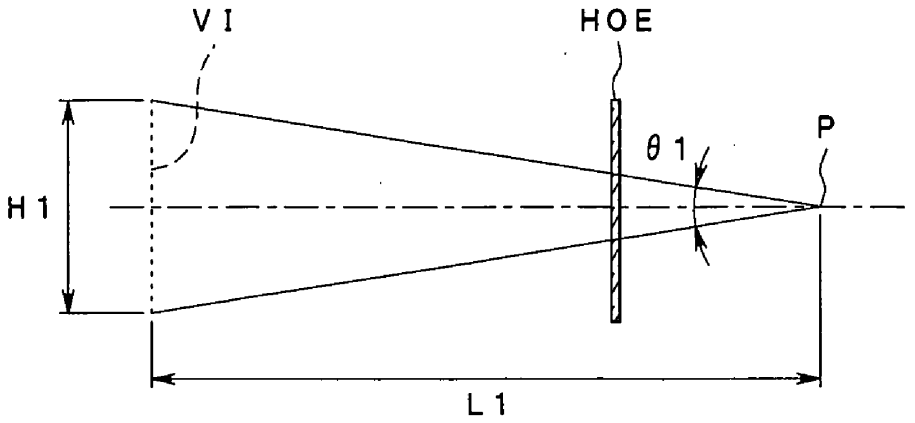


FIG.30

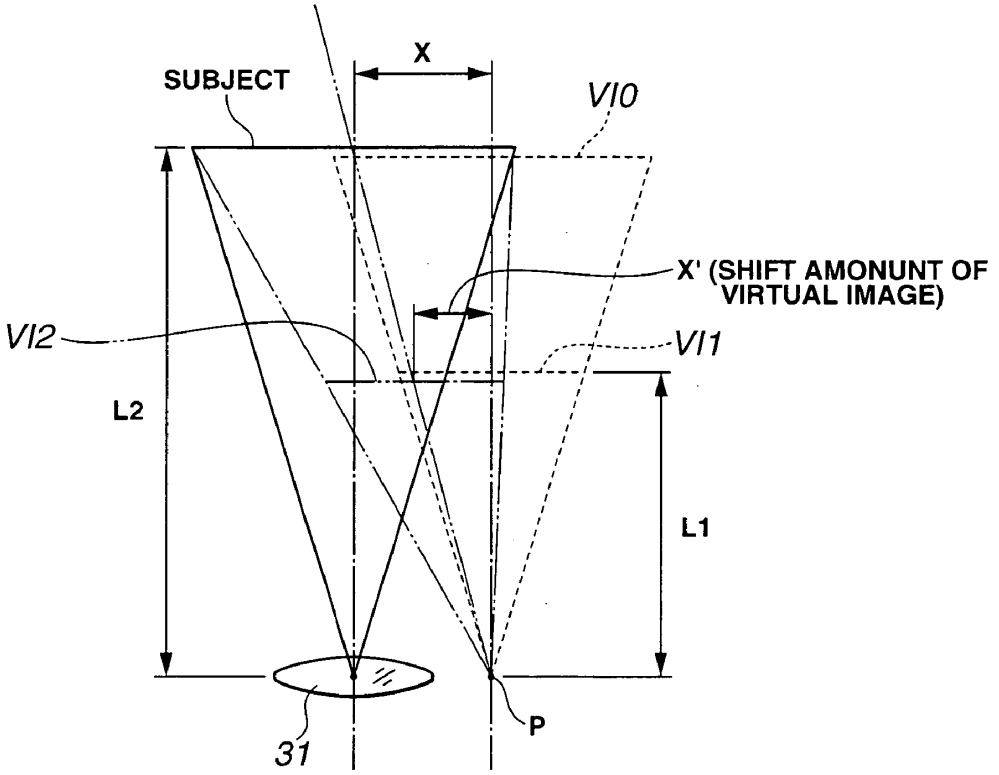

SUBJECT
X
VI0
X' (SHIFT AMONUNT OF VIRTUAL IMAGE)
VI2
VI1
L2
L1
31
P

FIG.31

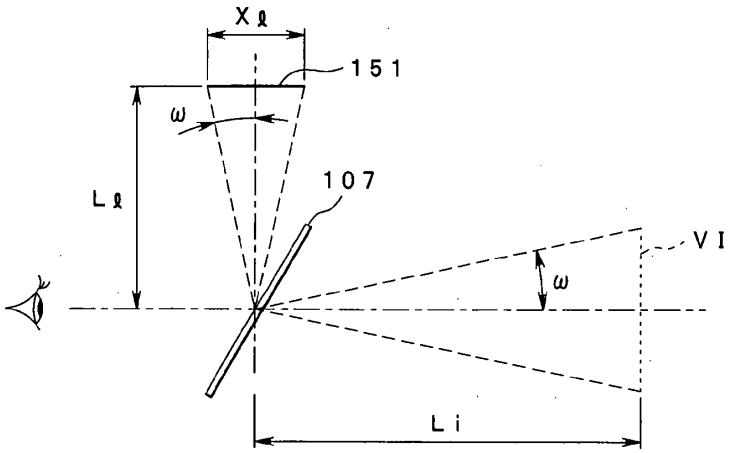


FIG.32

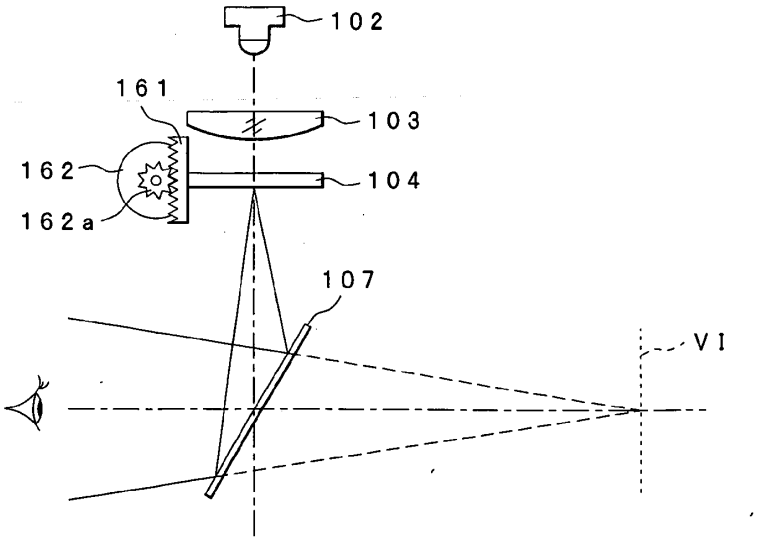


FIG.33

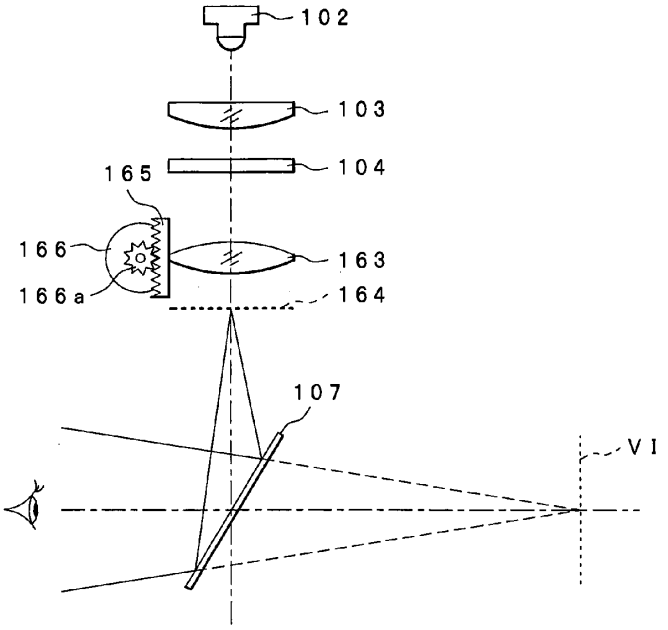

102
103
165
104
166
163
166a
164
107
VI

FIG.34

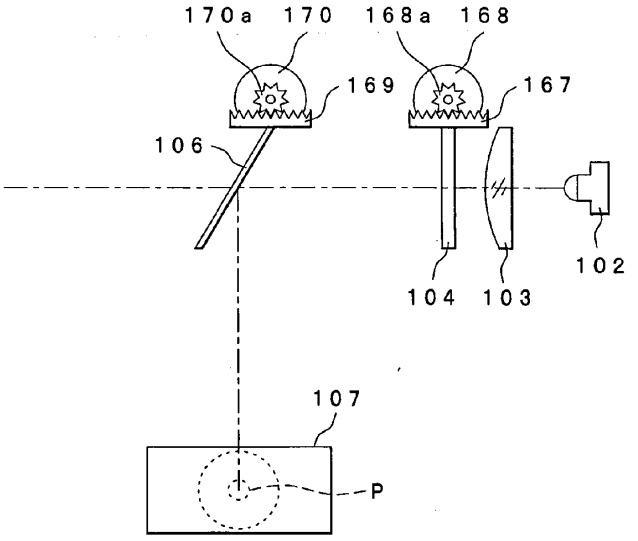

170a
170
168a
168
169
167
106
102
104
103
107
P

FIG.35

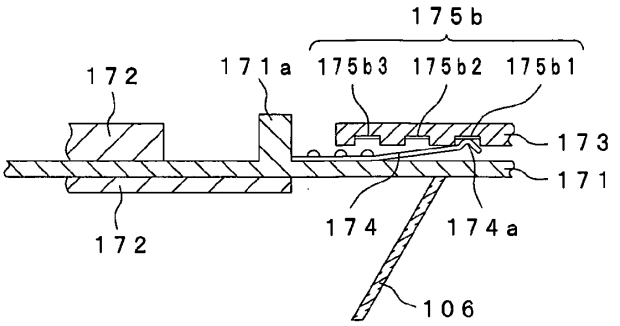

175b
172
171a
175b3
175b2
175b1
173
171
172
174
174a
106

FIG.36

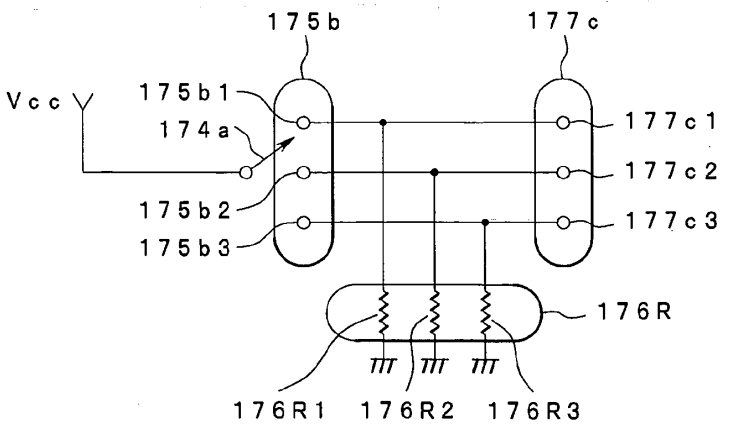

175b
177c
Vcc
175b1
174a
175b2
175b3
177c1
177c2
177c3
176R
176R1
176R2
176R3

FIG. 37

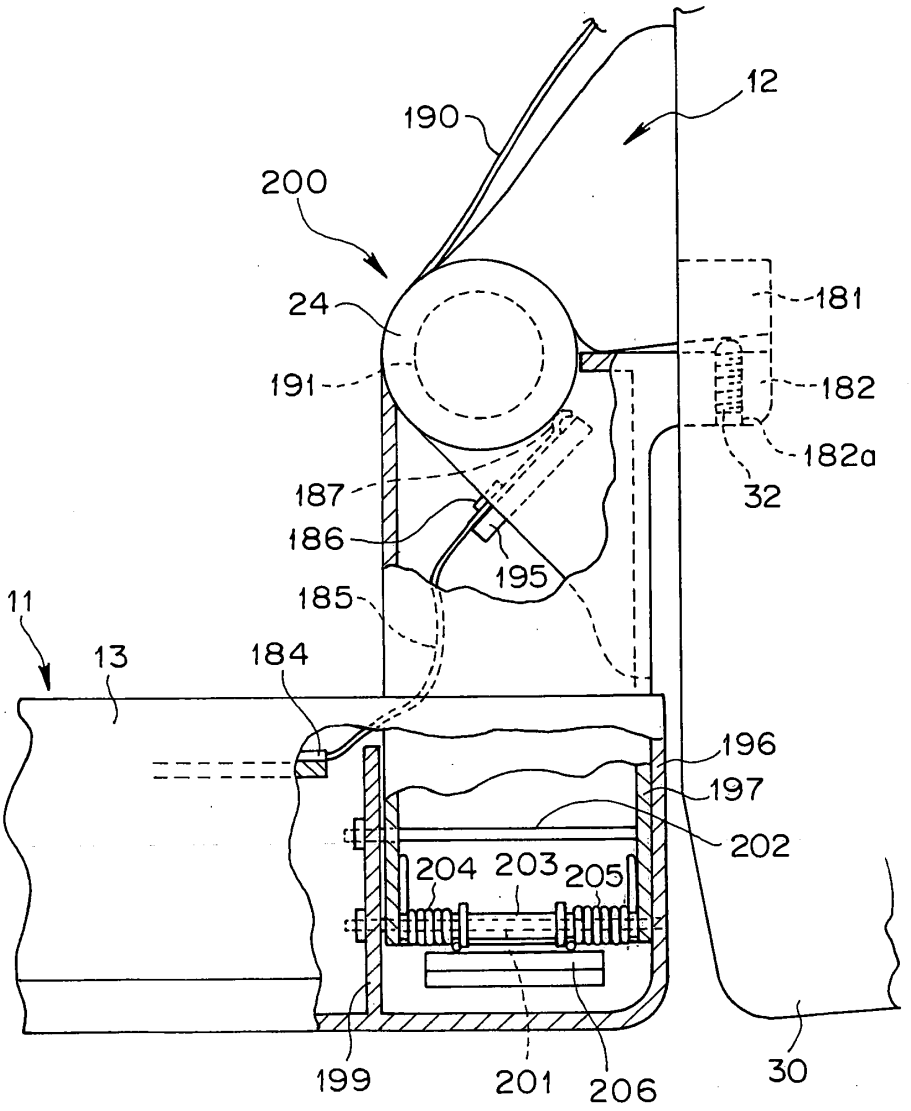

12
190
200
24
181
191
182
182a
32
187
186
195
185
11
13
184
196
197
202
204
203
205
199
201
206
30

FIG. 38

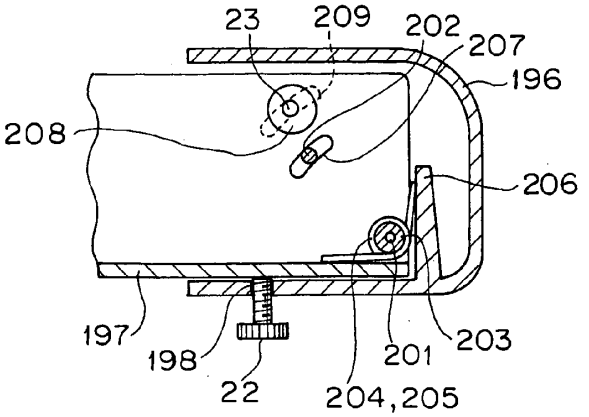


FIG. 39

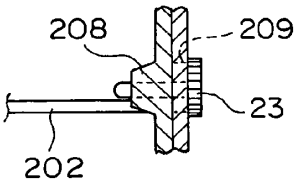


FIG. 40

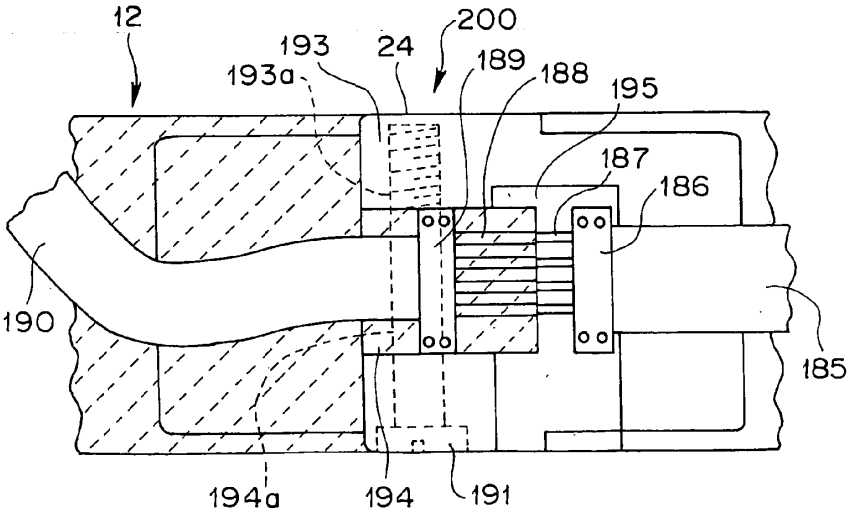


FIG.41

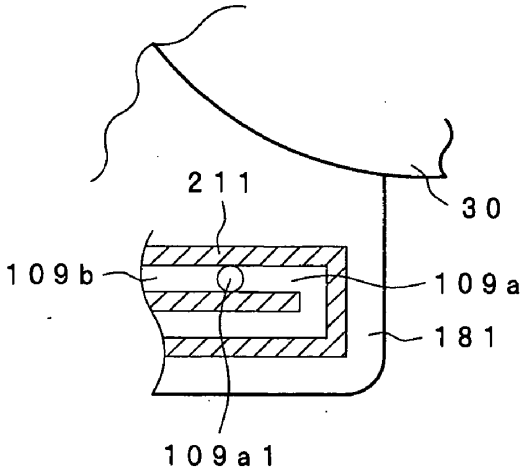


FIG.42

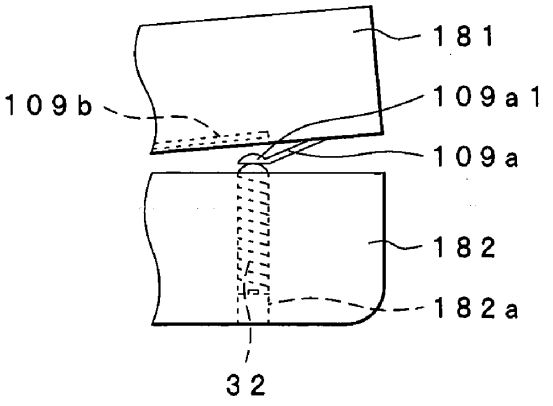


FIG.43A

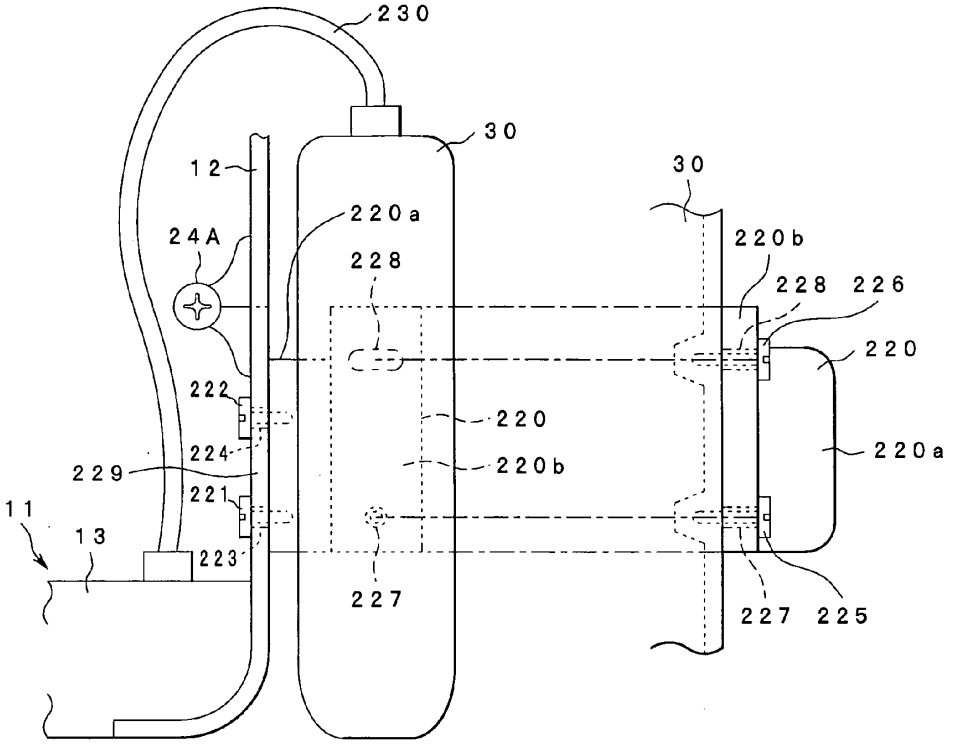


FIG.43B

FIG.44

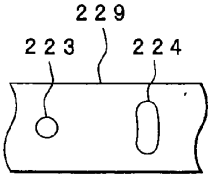


FIG.45

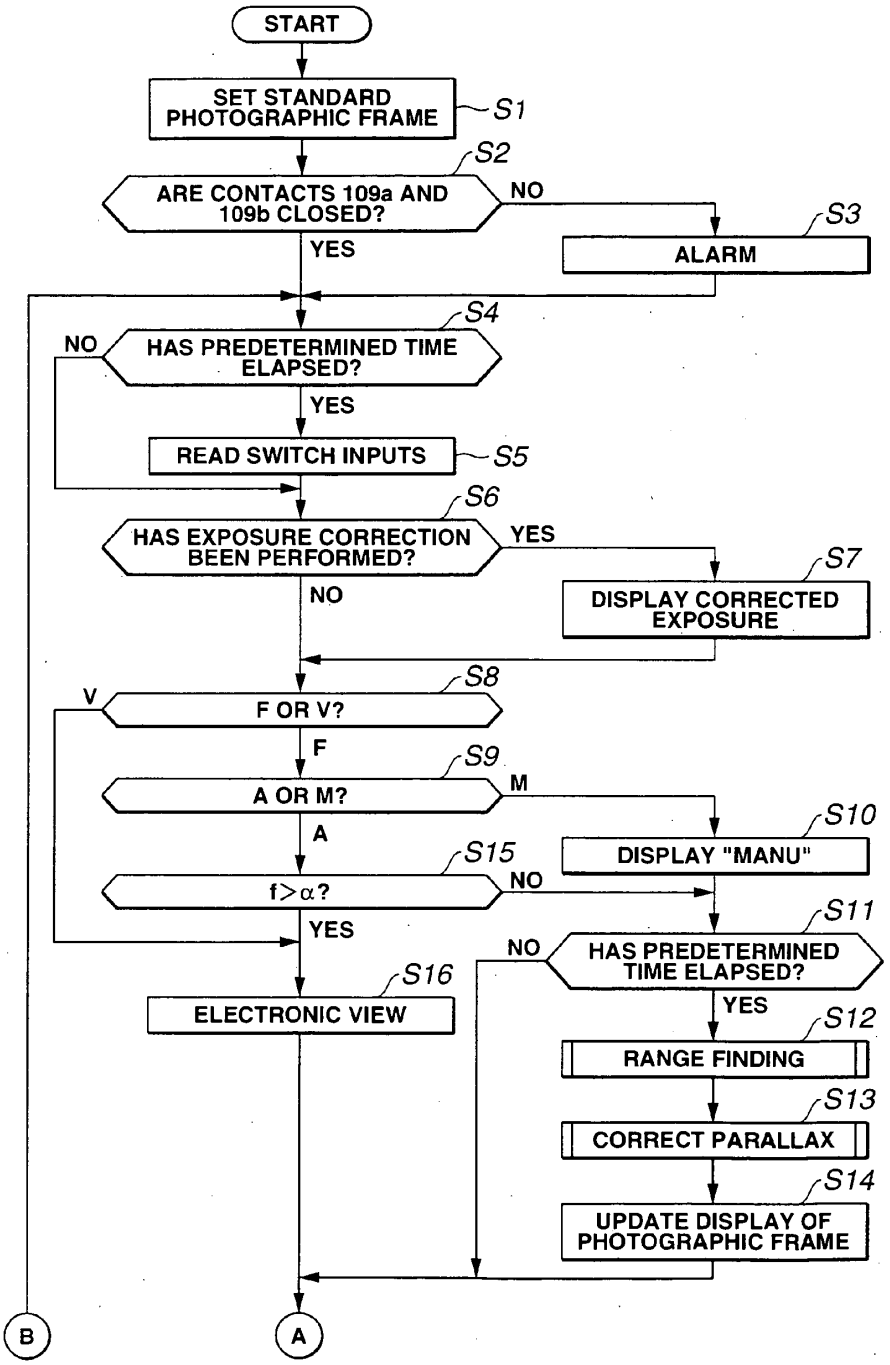

START
SET STANDARD PHOTOGRAPHIC FRAME
S1
S2
ARE CONTACTS 109a AND 109b CLOSED?
NO
S3
ALARM
YES
S4
NO
HAS PREDETERMINED TIME ELAPSED?
YES
READ SWITCH INPUTS
S5
S6
HAS EXPOSURE CORRECTION BEEN PERFORMED?
YES
S7
DISPLAY CORRECTED EXPOSURE
NO
S8
V
F OR V?
F
S9
A OR M?
M
S10
DISPLAY "MANU"
A
S15
f>α?
NO
S11
YES
NO
HAS PREDETERMINED TIME ELAPSED?
S16
ELECTRONIC VIEW
YES
S12
RANGE FINDING
S13
CORRECT PARALLAX
S14
UPDATE DISPLAY OF PHOTOGRAPHIC FRAME
B
A

FIG.46

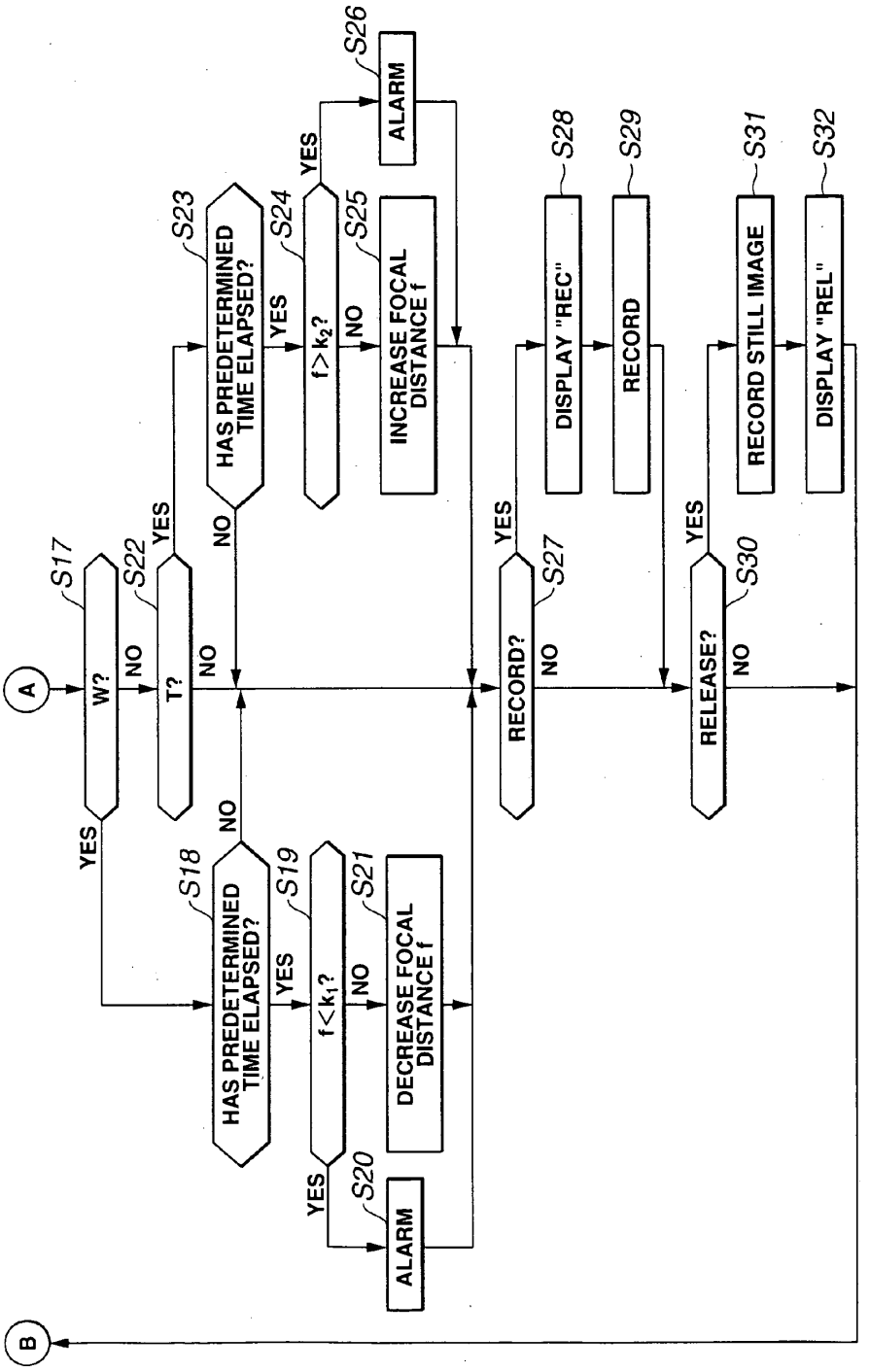

A
B
S17
W?
NO
YES
S18
HAS PREDETERMINED TIME ELAPSED?
YES
NO
S19
f<k1?
NO
YES
S20
ALARM
S21
DECREASE FOCAL DISTANCE f
S22
T?
NO
YES
S23
HAS PREDETERMINED TIME ELAPSED?
YES
NO
S24
f>k2?
NO
YES
S25
INCREASE FOCAL DISTANCE f
S26
ALARM
S27
RECORD?
NO
YES
S28
DISPLAY "REC"
S29
RECORD
S30
RELEASE?
NO
YES
S31
RECORD STILL IMAGE
S32
DISPLAY "REL"

FIG.47

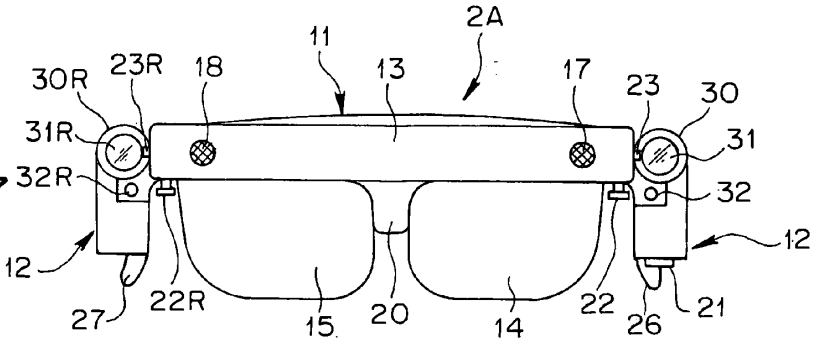


FIG.48

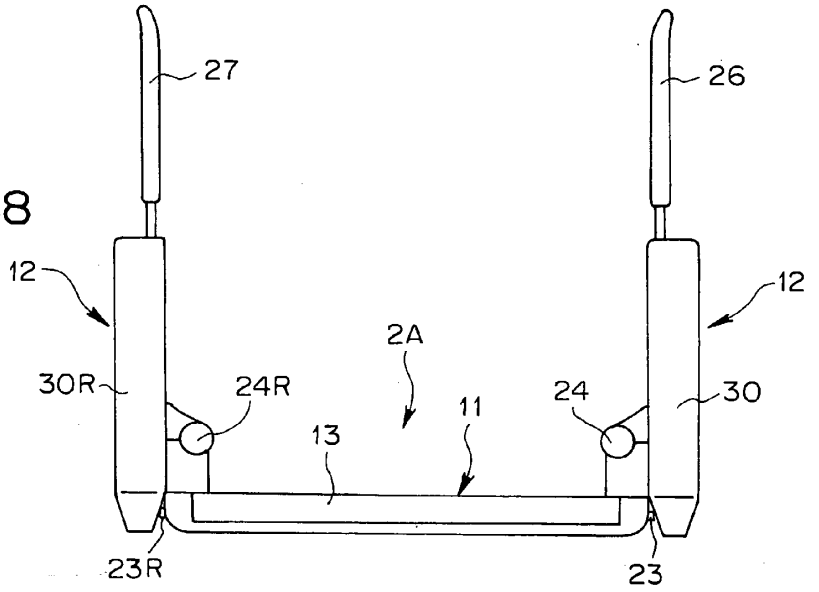


FIG.49

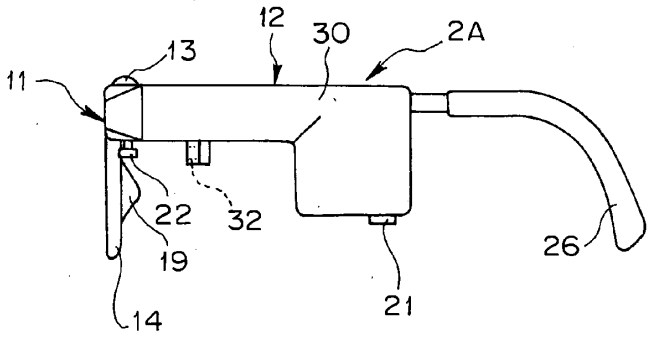


FIG.50

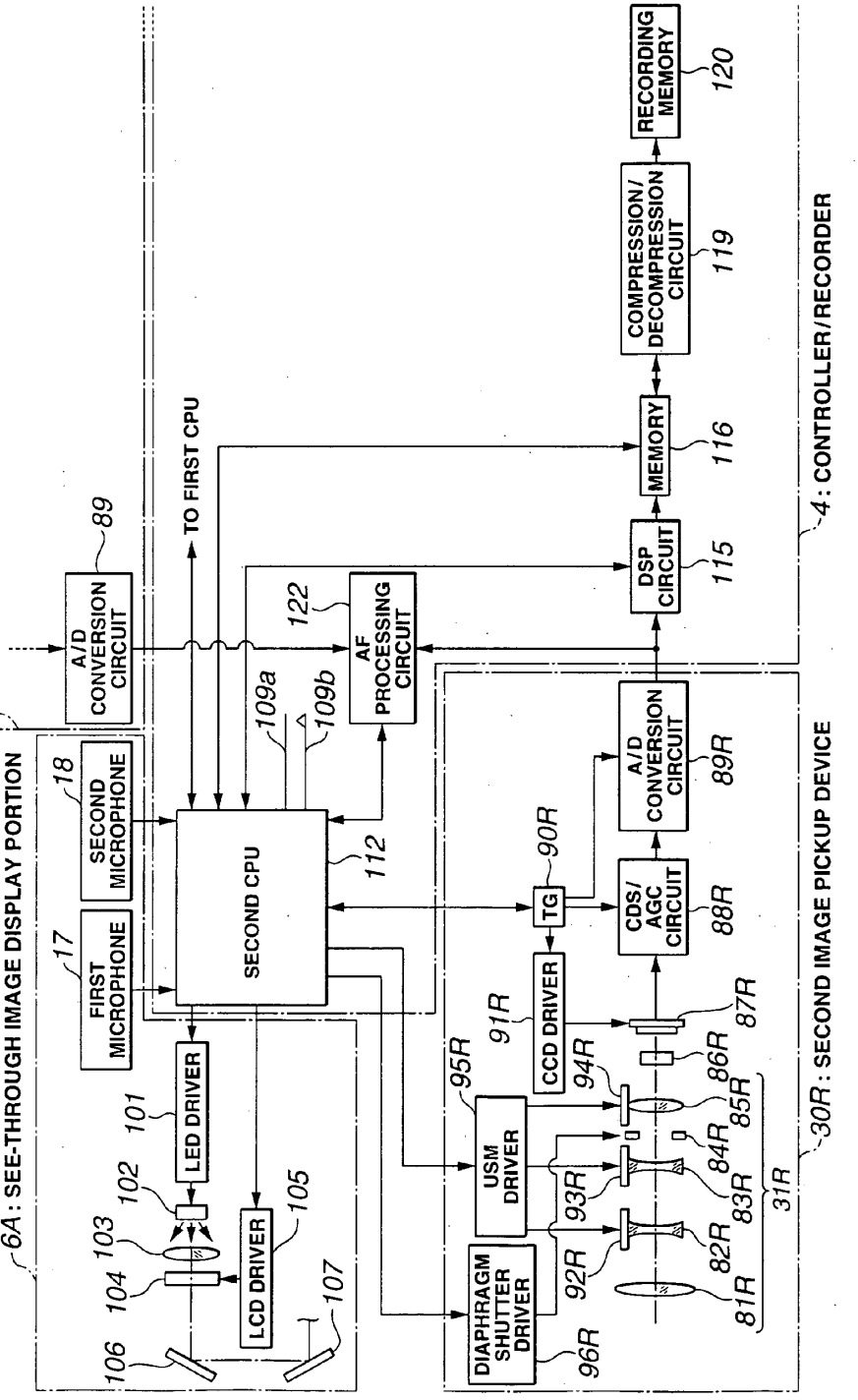

6A : SEE-THROUGH IMAGE DISPLAY PORTION
30 : FIRST IMAGE PICKUP DEVICE
30R : SECOND IMAGE PICKUP DEVICE
4 : CONTROLLER/RECORDER
TO FIRST CPU
A/D CONVERSION CIRCUIT
89
SECOND MICROPHONE
18
FIRST MICROPHONE
17
SECOND CPU
112
AF PROCESSING CIRCUIT
122
109a
109b
LED DRIVER
101
LCD DRIVER
105
102
103
104
106
107
DIAPHRAGM SHUTTER DRIVER
96R
USM DRIVER
95R
CCD DRIVER
91R
TG
90R
CDS/ AGC CIRCUIT
88R
A/D CONVERSION CIRCUIT
89R
DSP CIRCUIT
115
MEMORY
116
COMPRESSION/ DECOMPRESSION CIRCUIT
119
RECORDING MEMORY
120
87R
86R
85R
84R
83R
82R
81R
31R
92R
93R
94R

FIG.51

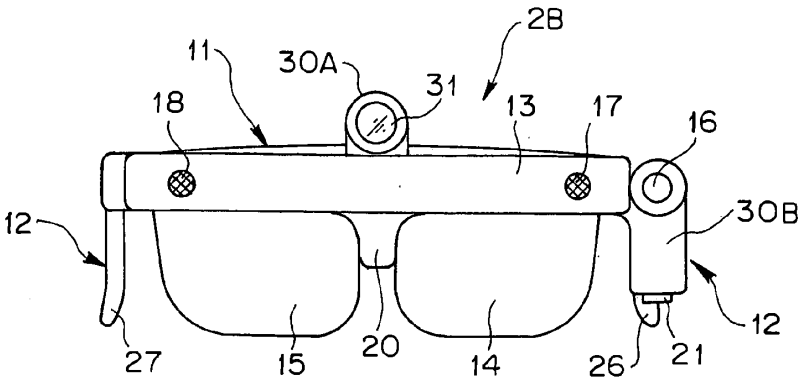


FIG.52

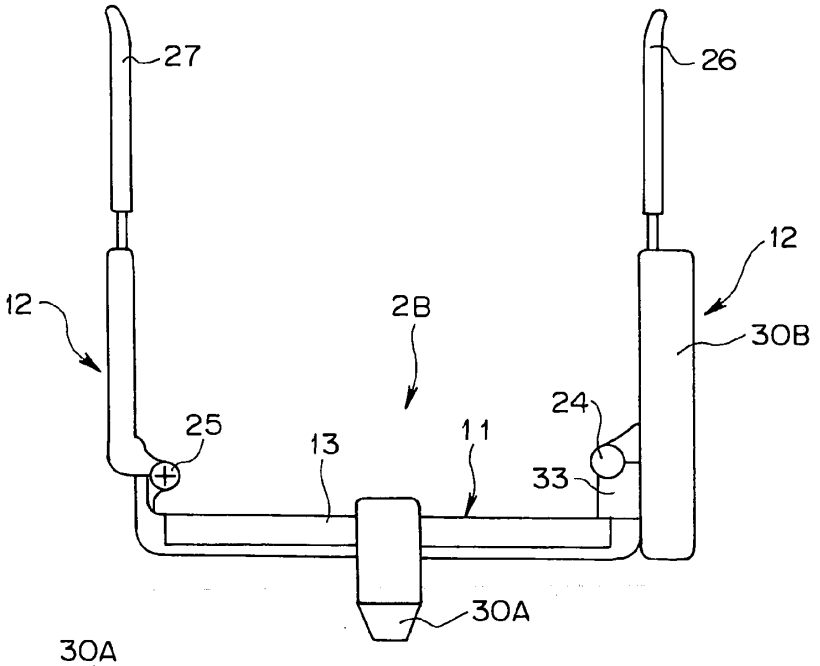


FIG.53

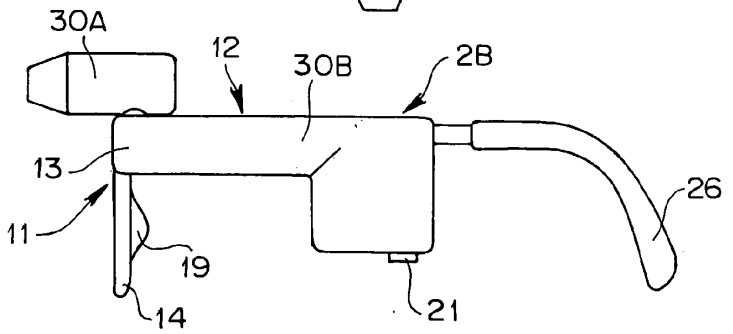


FIG. 54

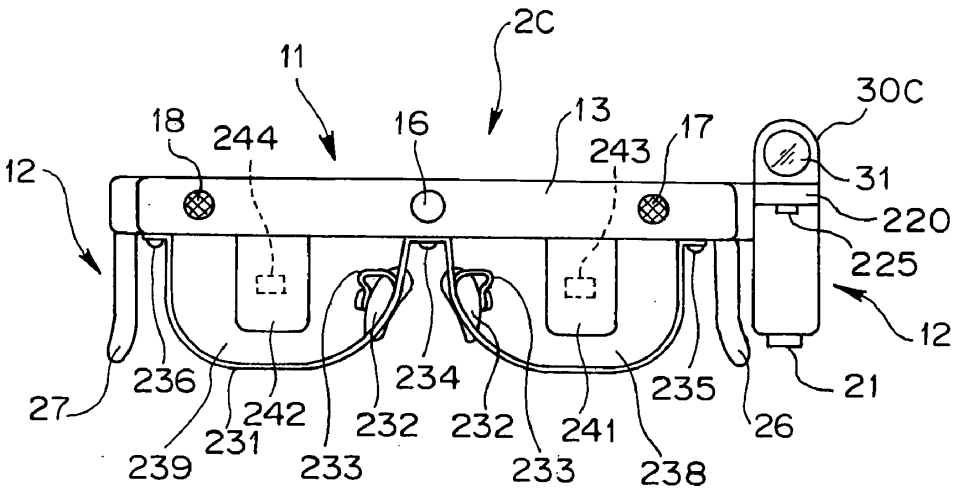

2C
11
18
244
16
13
243
17
30C
31
220
225
12
12
27
236
242
231
239
233
234
232
232
233
241
238
235
26
21

FIG. 55

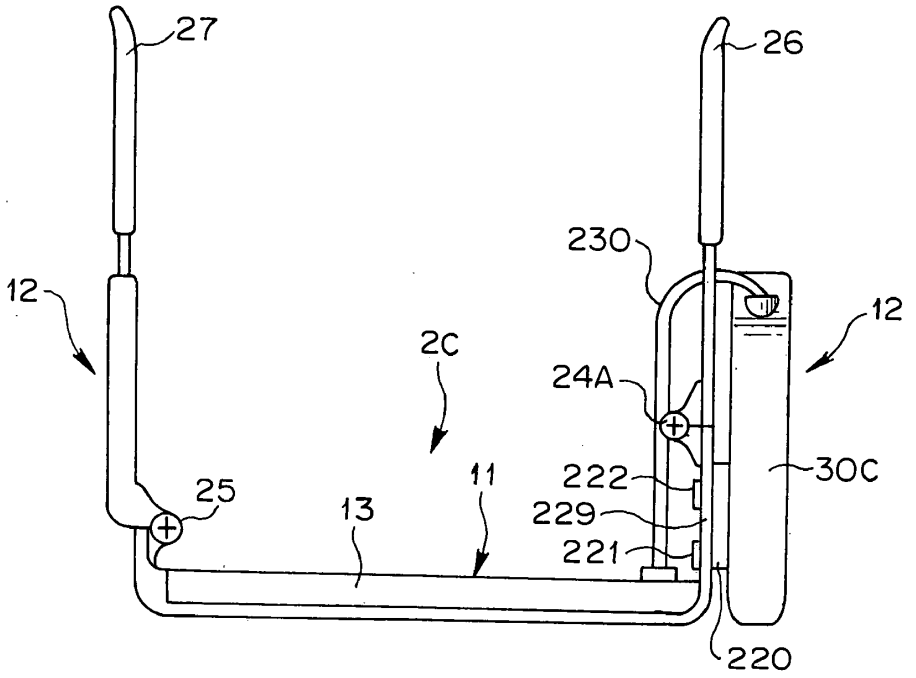
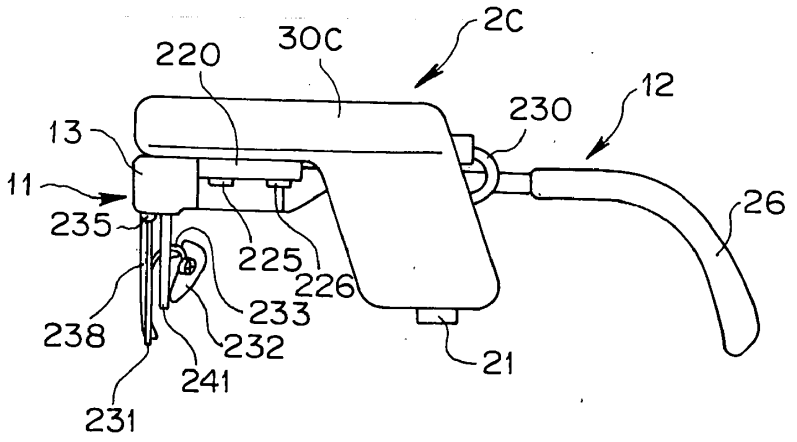

27
26
230
12
12
2C
24A
30C
222
11
25
13
229
221
220

FIG. 56


2C
30C
220
230
12
13
11
26
235
225
226
233
238
232
241
21
231

HEAD-MOUNTED CAMERA

[0001] This application claims benefit of Japanese Application No. 2004-31275 filed in Japan on Feb. 6, 2004, the contents of which are incorporated by this reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to head-mounted cameras, and more particularly, to a head-mounted camera which is worn on a head in a manner almost the same as a pair of spectacles.

[0004] 2. Description of the Related Art

[0005] Hitherto, display devices which are worn on the head to observe images and photographic devices which are worn on the head to perform photographing operations are known. Devices having both a display function and a photographic function are also known.

[0006] For example, in the head-mounted display device disclosed in Japanese Unexamined Patent Application Publication No. 7-240889, a user can perform a photographing operation by using a television camera while observing images photographed by the television camera and displayed on the display device worn on his/her head, and can also selectively obtain external light via the display device by operating a control switch provided for the television camera.

[0007] In an image recording apparatus disclosed in Japanese Unexamined Patent Application Publication No. 11-164186, an image pickup device is provided on spectacle-type frames, and the photographic lens of the image pickup device faces the same direction as a photographer, thereby allowing the photographer to photograph a subject disposed in the same direction which the photographer is facing. The invention in that publication also discloses the following configuration. An image pickup device is provided on a goggle-type personal liquid crystal projector equipped with a light transmissive casing, and an image photographed by the image pickup device is superimposed on a subject exposed to external light.

[0008] In the display device disclosed in Japanese Unexamined Patent Application Publication No. 7-240889, however, the user has to concentrate on the photographing operation while observing photographed images on the display device. Accordingly, when performing photographing at various events, such as sporting events or festivals, the user cannot enjoy himself/herself, unlike when he/she performs a photographing operation while observing actual subjects with his/her eyes. It has also been found experimentally that it is tiring to observe digital images in a closed space for a long time, unlike when the user observes real subjects with his/her eyes.

[0009] In the image recording apparatus disclosed in Japanese Unexamined Patent Application Publication No. 11-164186, an image pickup device is provided on the spectacle-type frames. However, this does not allow a user to observe a subject and check a photographic range at the same time, and the user has to turn away from the subject to check the image display unit provided for a camera separately provided from the spectacle-type frame. In the configuration in which an image pickup device is provided on the personal liquid crystal projector, even though a displayed image and a transmitted subject can be viewed at the same time, it is still difficult for a photographer to enjoy himself/herself at an event since he/she has to concentrate on a displayed image during the photographing operation.

[0010] Thus, according to the above-described related art, it is difficult for a photographer to behave as naturally as other people during a photographing operation, and he/she feels bothered since his/her actions are restricted by the photographing operation.

SUMMARY OF THE INVENTION

[0011] Accordingly, it is an object of the present invention to provide a head-mounted camera which allows a user to easily perform a photographing operation without feeling bothered.

[0012] In order to achieve the above object, the present invention provides a head-mounted camera including image pickup means containing a photographing optical system in which a focal distance is changeable and an image pickup element for converting an optical subject image formed by the photographing optical system into an electric image signal, display means for displaying a photographic frame indicating the photographic range as a virtual image so that the photographic frame is superimposed on a subject substantially directly observed by a photographer, photographic-frame setting means for setting a visual angle of the photographic frame displayed by the display means as the virtual image and observed from the photographer, and focal-distance setting means for setting the focal distance of the photographing optical system so that the visual angle of the photographic frame set by the photographic-frame setting means coincides with the field angle of the image pickup device.

[0013] The above and other objects, features, and advantages of the invention will become more clearly understood from the following description referring to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] **FIG. 1** is a perspective view illustrating a state in which a head-mounted camera constructed in accordance with a first embodiment is used;

[0015] **FIG. 2** is a front view illustrating the head-mounted camera of the first embodiment;

[0016] **FIG. 3** is a plan view illustrating the head-mounted camera of the first embodiment;

[0017] **FIG. 4** is a right side view illustrating the head-mounted camera of the first embodiment;

[0018] **FIG. 5** is a perspective view illustrating the head-mounted camera of the first embodiment;

[0019] **FIG. 6** is a plan view illustrating a controller/recorder when an operation panel is closed in the first embodiment;

[0020] **FIG. 7** is a right side view illustrating the controller/recorder when the operation panel is closed in the first embodiment;

[0021] **FIG. 8** is a left side view illustrating the controller/recorder when the operation panel is closed in the first embodiment;

[0022] **FIG. 9** is a plan view illustrating operation switches disposed on the operation panel in the first embodiment;

[0023] **FIG. 10** is a perspective view illustrating the controller/recorder when the operation panel is opened in the first embodiment;

[0024] **FIG. 11** is a plan view illustrating the configuration of a remote controller in the first embodiment;

[0025] **FIG. 12** is a block diagram illustrating the configuration of an electronic circuit of the head-mounted camera of the first embodiment;

[0026] **FIG. 13** illustrates the principle of an optical system of a see-through image display portion in the first embodiment;

[0027] **FIG. 14** is a front view, partially in section, illustrating the optical system of the see-through image display portion in the first embodiment;

[0028] **FIGS. 15A and 15B** are left side views illustrating examples of the configuration of the optical system of the see-through image display portion in the first embodiment;

[0029] **FIG. 16** is a sectional plan view illustrating the configuration of the optical system of the see-through image display portion in the first embodiment;

[0030] **FIG. 17** illustrates a display example of the see-through display initial state in the first embodiment;

[0031] **FIG. 18** illustrates a display example when the zoom is changed to the telephotographing mode in the first embodiment;

[0032] **FIG. 19** illustrates a display example when the zoom is changed to the wide mode and when exposure correction is conducted in the first embodiment;

[0033] **FIG. 20** illustrates a display example when an image is displayed as an electronic view in the first embodiment;

[0034] **FIG. 21** illustrates a display example when a moving picture is being recorded in the first embodiment;

[0035] **FIG. 22** is a display example in a manual mode in the first embodiment;

[0036] **FIG. 23** illustrates a display example of alarm information when the opening angle of a temple with respect to a front portion is not sufficient in the first embodiment;

[0037] **FIG. 24** illustrates a display example of alarm information indicated in a see-through manner in the first embodiment when the focal distance of a first photographing optical system is to be further reduced even when it has reached the adjustable lower limit;

[0038] **FIG. 25** illustrates a display example of alarm information indicated in a see-through manner in the first embodiment when the focal distance of the first photographing optical system is to be further increased even when it has reached the adjustable upper limit;

[0039] **FIG. 26** illustrates a display example when a photographing operation for a still image is performed in the first embodiment;

[0040] **FIG. 27** illustrates the principle of distance measurement in the first embodiment;

[0041] **FIG. 28** illustrates the optical relationship between a subject to the first photographing optical system and a charge-coupled device (CCD) in the first embodiment;

[0042] **FIG. 29** illustrates the optical relationship of a holographic optical element (HOE) to an eye and a virtual image formed by the HOE in the first embodiment;

[0043] **FIG. 30** illustrates the amount by which the virtual image is shifted for correcting the parallax in the first embodiment;

[0044] **FIG. 31** illustrates the principle of changing the distance from the eye to the virtual image in the first embodiment;

[0045] **FIG. 32** illustrates an example of the configuration in which a liquid crystal display (LCD) is driven in the optical axis direction by an actuator in the first embodiment;

[0046] **FIG. 33** illustrates an example of the configuration in which an image of the LCD is firstly formed and the position of the linear image is changed in the optical axis direction in the first embodiment;

[0047] **FIG. 34** illustrates an example of the configuration in which the position of a first HOE in the pupil-distance direction is changed by an actuator in the first embodiment;

[0048] **FIG. 35** illustrates an example of the configuration in which the position of the first HOE in the pupil-distance direction is changed mechanically in the first embodiment;

[0049] **FIG. 36** is a circuit diagram illustrating the electrical configuration of the mechanical configuration shown in **FIG. 35**;

[0050] **FIG. 37** is a plan view, partially in section, illustrating the structure of a connecting portion including the front portion, a hinge unit, and the temple in the first embodiment;

[0051] **FIG. 38** is a vertical sectional view illustrating the connecting portion between the front portion and the hinge unit when viewed from the left side of **FIG. 37** in the first embodiment;

[0052] **FIG. 39** is a sectional view illustrating a fixed portion formed of the front portion, the hinge unit, and the screw in the first embodiment;

[0053] **FIG. 40** illustrates the connecting portion between the hinge unit and the temple when viewed from the left side to substantially the right side of **FIG. 37** in the first embodiment;

[0054] **FIG. 41** is a front view illustrating an electrical contact provided on a projection of the temple in the first embodiment;

[0055] **FIG. 42** is a plan view illustrating the electrical contact provided on the projection of the temple in the first embodiment;

[0056] **FIGS. 43A and 43B** are a plan view and a right side view, respectively, illustrating the configuration in

which the first image pickup device is attached to the side surface of the frame in the first embodiment;

[0057] **FIG. 44** is a right side view illustrating the configuration of holes formed in the frame for attaching the first image pickup device in the first embodiment;

[0058] **FIGS. 45 and 46** are flowcharts illustrating a part and another part of the operation of the camera of the first embodiment;

[0059] **FIG. 47** is a front view illustrating a head-mounted unit of the camera constructed in accordance with a second embodiment of the present invention;

[0060] **FIG. 48** is a plan view illustrating the head-mounted unit of the camera of the second embodiment;

[0061] **FIG. 49** is a right side view illustrating the head-mounted unit of the camera of the second embodiment;

[0062] **FIG. 50** is a block diagram illustrating the configuration of an electronic circuit of the head-mounted camera of the second embodiment, mainly the elements different from those shown in **FIG. 12**;

[0063] **FIG. 51** is a front view illustrating a head-mounted unit of the camera constructed in accordance with a third embodiment of the present invention;

[0064] **FIG. 52** is a plan view illustrating the head-mounted unit of the camera of the third embodiment;

[0065] **FIG. 53** is a right side view illustrating the head-mounted unit of the camera of the third embodiment;

[0066] **FIG. 54** is a front view illustrating a head-mounted unit of the camera constructed in accordance with a fourth embodiment of the present invention;

[0067] **FIG. 55** is a plan view illustrating the head-mounted unit of the camera of the fourth embodiment; and

[0068] **FIG. 56** is a right side view illustrating the head-mounted unit of the camera of the fourth embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0069] The embodiments of the present invention are described in detail below with reference to the accompanying drawings.

First Embodiment

[0070] **FIGS. 1 through 46** illustrate a first embodiment of the present invention. **FIG. 1** is a perspective view illustrating a state in which a head-mounted camera **1** is used.

[0071] The head-mounted camera (hereinafter simply referred to as the "camera") **1** includes, as shown in **FIG. 1**, a head-mounted unit **2** formed substantially in the shape of a pair of spectacles, a controller/recorder **4**, which serves as the main body of the camera **1**, connected to the head-mounted unit **2** via connecting means, such as a cable **3**, and a remote controller **5** for remotely performing input operations for the camera **1**.

[0072] The head-mounted unit **2** allows a user to observe a subject substantially directly in a see-through display mode and also to pick up an image of the subject. The head-mounted unit **2** can be worn on the head in a manner similar to ordinary eyesight-correcting spectacles, as is seen from the shape of the head-mounted unit **2**. The head-mounted unit **2** is light and small so that the weight and the size thereof can be as close as possible to those of actual spectacles.

[0073] A connecting terminal **3***a* provided at one end of the cable **3** is connected to a cable connecting terminal **21** (see **FIG. 2**) of the head-mounted unit **2**, and a connecting terminal **3***b* provided at the other end of the cable **3** is connected to a cable connecting terminal **49** (see **FIG. 7**) of the controller/recorder **4**, thereby connecting the head-mounted unit **2** with the controller/recorder **4**. As means for electrically connecting the head-mounted unit **2** with the controller/recorder **4**, although wired means such as the cable **3** is used, wireless means for wirelessly connecting the two elements may be used.

[0074] The controller/recorder **4** controls the entire camera **1** and also records images picked up by the head-mounted unit **2**. The controller/recorder **4** is also formed to be as light and small as possible so that it can be used under various conditions. For example, it can be attached to a belt at the user's waist or it can be stored in an inner pocket of a jacket. The controller/recorder **4** can also be stored in a bag by using a long cable **3**.

[0075] The remote controller **5** allows a photographer to remotely control with a photographer's hand, operations that are comparatively frequently performed, such as controlling the see-through display operation and photographing operations performed by the head-mounted unit **2**. Accordingly, the remote controller **5** is formed to be light and small so that it can be held in the palm of the hand, and wirelessly communicates with the controller/recorder **4**.

[0076] In this embodiment, the head-mounted unit **2**, the controller/recorder **4**, and the remote controller **5** are separately provided from each other. This makes the user comfortable when wearing the head-mounted unit **2**, which is formed light and small, and also allows the user to easily operate this camera **1** by using the remote controller **5**.

[0077] The external appearance and the overview of the head-mounted unit **2** are described below with reference to **FIGS. 2 through 5**. **FIGS. 2, 3, 4**, and **5** are a front view, a plan view, a right side view, and a perspective view, respectively, illustrating the head-mounted unit **2**.

[0078] The head-mounted unit **2** includes a front portion **11** corresponding to lens, rims, a bridge, and joint portions of regular spectacles and temples **12** extended from the left and right sides of the front portion **11** in the backward direction (opposite to the subject) and foldable with respect to the front portion **11**.

[0079] The front portion **11** includes a frame **13** and transparent optical members **14** and **15**, which serve as optical waveguide members, attached to the frame **13** in association with the left and right eyes.

[0080] The frame **13** is provided substantially at the center with a projector light-emitting portion **16**, which serves as distance-measurement means used for ranging the distance to a subject. The frame **13** is also provided at the left and right ends with a first microphone **17** and a second microphone **18** for collecting stereo sound from a subject. At the

center of the frame **13**, nose pads **19** for placing the head-mounted unit **2** against the ridge of the nose and a bridge **20** formed between the transparent optical members **14** and **15** are also provided. At the right side of the frame **13**, screws **22** and **23** for an adjusting mechanism (adjusting means) of an adjusting device for adjusting the mounting position of a first image pickup device **30** (also serving as the above-described distance-measurement means), which is described below, are exposed to be operable. The adjusting device is used for adjusting the camera **1** by using the adjusting method for the camera **1**.

[**0081**] The temples **12** are connected to the front portion **11** by using hinges **24** and **25** so that they are foldable against the front portion **11**. That is, when the head-mounted unit **2** is not used, the temples **12** are folded toward the center of the front portion **11**, i.e., they can be folded along the front portion **11**, thereby making the head-mounted unit **2** easy to store and carry. End covers **26** and **27** for placing the head-mounted unit **2** on the ears are provided at the distal ends of the left and right temples **12**.

[**0082**] At the left-side (i.e., the right side in **FIG. 2** or **3**) temple **12**, the first image pickup device **30**, which serves as image pickup means for picking up an image of a subject, is integrally provided for the temple **12**. Thus, when the temple **12** is folded, the first image pickup device **30** is also folded. The cable connecting terminal **21** connected to the connecting terminal **3***a*, which is one end of the cable **3**, is provided at the bottom of the first image pickup device **30**. The right-side temple **12** is also provided with the above-described adjusting mechanism (adjusting means). The adjusting mechanism adjusts the optical axis and the visual axis of a first photographing optical system **31** (see **FIG. 12**), which is described below, contained in the first image pickup device **30** by adjusting the relative angle between the front portion **11** and the first image pickup device **30**. The head of an angle adjusting bis **32** contained in this adjusting mechanism is exposed to allow the user to externally rotate the bis **32**.

[**0083**] A box **33** is disposed between the right side of the front portion **11** and the hinge **24**. In the box **33**, a flexible printed board for connecting the individual circuits of the front portion **11** to the individual circuits of the first image pickup device **30** is stored in a manner described below.

[**0084**] The external appearance and the overview of the controller/recorder **4** are described below with reference to **FIGS. 6 through 10**. **FIGS. 6, 7**, and **8** are a plan view, a right side view, and a left side view, respectively, illustrating the controller/recorder **4** when an operation panel **42** is closed. **FIG. 9** is a plan view illustrating operation switches disposed on the operation panel. **FIG. 10** is a perspective view illustrating the controller/recorder **4** when the operation panel is opened.

[**0085**] The controller/recorder **4** is formed of a controller/recorder main unit **41** and the operation panel **42** provided for the controller/recorder main unit **41** via a hinge **43** so that it can be opened and closed.

[**0086**] The controller/recorder main unit **41** has built-in circuits, which are described below, and also includes a liquid crystal display device (hereinafter simply referred to as the "LCD") **48**, which serves as an LCD monitor, such that the user can check the LCD **48** when the operation panel **42** is opened. The LCD **48** is used for displaying images during a playback operation and also for displaying menu screens for setting various modes. A recess **45** is also formed so that the user can place a finger when opening or closing the operation panel **42**.

[**0087**] At the right side of the controller/recorder main unit **41**, as shown in **FIG. 7**, a lid **52** that can be opened and closed with respect to the controller/recorder main unit **41** via a hinge **46** is provided. By allowing an engagement portion **52***a* of the lid **52** to engage with a mating engagement portion **52***b* provided for the controller/recorder main unit **41**, the controller/recorder main unit **41** can remain closed. When the lid **52** is opened, as shown in **FIG. 7**, the cable connecting terminal **49** to be connected with the cable connecting terminal **21** of the head-mounted unit **2** via the cable **3**, an AV/S connecting terminal **50** for connecting the controller/recorder **4** with a television set, and a PC connecting terminal **51** for connecting the controller/recorder **4** with a personal computer (PC) are exposed. In this manner, cords can be connected together at the right side surface of the controller/recorder main unit **41** without being extended from the other surfaces, thereby reducing a troublesome operation for arranging the cords.

[**0088**] Also at the left side of the controller/recorder main unit **41**, as shown in **FIG. 8**, a lid **53** that can be opened and closed with respect to the controller/recorder main unit **41** via a hinge **47** is provided. By allowing an engagement portion **53***a* of the lid **53** to engage with a mating engagement portion **53***b* provided for the recorder/controller main unit **41**, the controller/recorder main unit **41** can remain closed. When the lid **53** is opened, as shown in **FIG. 8**, a recording memory insertion slot **54** for inserting a recording memory **120** (see **FIG. 12**), which serves as detachable recording means, for example, a card memory, and a battery insertion slot **55** for detachably inserting batteries for supplying power are exposed.

[**0089**] On the outer surface of the operation panel **42**, as shown in **FIG. 6**, a power switch **44** which is exposed even when the operation panel **42** is closed is provided. On the inner surface of the operation panel **42**, various operation switches shown in **FIG. 9** which are exposed only when the operation panel **42** is opened are disposed.

[**0090**] More specifically, on the inner surface of the operation panel **42**, there are provided a speaker **56** for playing back sound, a switch **57** for increasing the volume of sound generated from the speaker **56**, a switch **58** for decreasing the volume, a playback start/stop switch **59** for starting or pausing playing back image information recorded on the image memory **120**, a switch **61** for fast-forwarding and searching images in the backward direction, a switch **62** for fast-forwarding and searching images in the forward direction, a menu button **63** for displaying menu screens for setting various functions and dates concerning the camera **1** on the LCD **48**, menu selection switches **66**, **67**, **68**, and **69** for moving an item to be selected or scrolling information displayed on the menu screens in the up, down, left, and right directions, and a setting switch **65** for setting the selected item.

[**0091**] The switches disposed on the operation panel **42** are switches mainly for setting items of information which are not frequently changed.

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[0092] The external appearance and the overview of the remote controller **5** are described below with reference to the plan view of **FIG. 11**.

[0093] As stated above, switches which are relatively frequently changed during a photographing operation are disposed on the remote controller **5**. More specifically, the following switches are provided, as shown in **FIG. 11**. An A/M switch **71**, which serves as switching means, switches between an auto mode (A mode) and a manual mode (M mode) for a telephotographing operation having a focal distance exceeding a predetermined distance. More specifically, the A/M switch **71** is switched during a telephotographing operation in which a photographic image corresponding to a photographic frame indicating a photographic range is enlarged and see-through displayed as an electronic view. An F/V switch **72**, which serves as switching means, is used for the see-through display, which is described below, in the transparent optical member **14** (and/or transparent optical member **15** (various configurations, which are described below, can be employed according to whether images are displayed with only one eye or both eyes). More specifically, the F/V switch **72** switches between the photographic frame (F) indicating the photographic range and the photographic image (V) (electronic view) output from the first image pickup device **30** for implementing the see-through display. A release switch (REL) **73** is used for starting photographing still images, which have higher definition than moving pictures. A record switch (REC) **74** switches between a recording start operation and a recording end operation for moving pictures, which can be switched every time the record switch **74** is pressed. A zoom switch **75**, which serves as photographic-frame setting means, includes a tele switch **75***a* and a wide switch **75***b* for switching the zoom (optical zoom and/or electronic zoom) of the first image pickup device **30** containing the first photographing optical system **31** to the tele (T) mode and to the wide (W) mode, respectively. An exposure correction switch **76** includes an exposure-decreasing correction switch **76***a* and an exposure-increasing correction switch **76***b* for respectively decreasing and increasing the exposure of an image to be photographed.

[0094] The zoom operation performed by the first photographing optical system **31** and changing of the visual angle of a photographic frame observed from a photographer, who is also an observer, are performed in cooperation with each other. From this point of view, it can be said that the zoom switch **75** includes the tele switch **75***a* and the wide switch **75***b* for respectively reducing and enlarging the visual angle of the photographic frame observed from the photographer.

[0095] **FIG. 12** is a block diagram illustrating the configuration of, mainly, an electronic circuit of the camera **1** shown in **FIG. 1**.

[0096] The camera **1** is largely divided into the head-mounted unit **2**, the controller/recorder **4**, and the remote controller **5**, as described above. The head-mounted unit **2** is further divided into the first image pickup device **30**, which serves as image pickup means, and a see-through image display portion **6**, which serves as display means mainly for displaying images in a see-through manner. Both the first image pickup device **30** and the see-through image display portion **6** are connected to the controller/recorder **4** via the cable **3**.

[0097] The first image pickup device **30** includes the following elements. The first photographing optical system **31** is used for forming an optical subject image and is formed as a zoom optical system that can change the focal distance. A low-pass filter **86** removes undesired high frequency components from light passing through the first photographing optical system **31**. A charge-coupled device (CCD) **87**, which serves as an image pickup device, converts the optical subject image formed by the first photographing optical system **31** via the low-pass filter **86** into an electric signal and outputs it. A correlated double sampling (CDS)/automatic gain control (AGC) circuit **88**, which serves as signal processing means, performs processing, such as noise elimination and amplification, which are described below, on the signal output from the CCD **87**. An analog-to-digital (A/D) conversion circuit **89**, which serves as signal processing means, converts an analog image signal output from the CDS/AGC circuit **88** into a digital image signal. A CCD driver **91** controls the driving of the CCD **87**. A timing generator (TG) **90** supplies timing signals to the CDS/AGC circuit **88**, the A/D conversion circuit **89**, and the CCD driver **91**. A diaphragm shutter driver **96**, which serves as a drive circuit, controls the driving of a diaphragm shutter **84**, which is described below, contained in the first photographing optical system **31**. An ultra sonic motor (USM) driver **95**, which serves as a drive circuit, selectively drives USMs **92**, **93**, and **94**, which are described below, contained in the first photographing optical system **31**.

[0098] More specifically, the first photographing optical system **31** includes a front lens **81**, a variator lens **82** for changing the focal distance, a compensator lens **83** for correcting a deviation of the focus position in accordance with a change in the focal distance, the diaphragm shutter **84** serving as both a diaphragm function and a shutter function, a focus lens **85** for adjusting the focus, and the USMs **92**, **93**, and **94** for driving the variator lens **82**, the compensator lens **83**, and the focus lens **85**.

[0099] The operation of the above-described first image pickup device **30** is as follows.

[0100] Light passing through the first photographing optical system **31** forms an image on the image forming plane of the CCD **87** via the low-pass filter **86**.

[0101] In response to an instruction from the remote controller **5** to photograph a still image by the operation of the release switch **73** or an instruction from the remote controller **5** to photograph a moving picture by the operation of the record switch **74**, photoelectric conversion is performed by the CCD **87** under the control of the controller/recorder **4**, thereby outputting an analog image signal.

[0102] The signal output from the CCD **87** is input into the CDS/AGC circuit **88**. Then, the signal is subjected to known correlated double sampling by the CDS circuit of the CDS/AGC circuit **88** so as to remove reset noise, and the resulting signal is then amplified into a predetermined signal level by the AGC circuit of the CDS/AGC circuit **88**.

[0103] The analog image signal output from the CDS/AGC circuit **88** is converted into a digital image signal (image data) by the A/D conversion circuit **89**. In this embodiment, the output signal from the A/D conversion circuit **89** is referred to as "raw image data". The raw image data in this embodiment is defined as digital data obtained

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immediately after conducting A/D conversion on the analog output signal from the CCD **87** and before being subjected to other digital signal processing.

[**0104**] A timing signal generated by the timing generator **90** is input into the CDS/AGC circuit **88** and the A/D conversion circuit **89**, and a timing signal from the timing generator **90** is also input into the CCD driver **91**. The timing generator **90**, the USM driver **95**, and the diaphragm shutter driver **96** are controlled by a first central processing unit (CPU) **111**, which is described below, provided for the controller/recorder **4**.

[**0105**] As described above, in the first image pickup device **30**, an image signal generated in the CCD **87** is subjected to analog signal processing and is then converted into a digital signal. Accordingly, analog signals are not output from the first image pickup device **30**. The first image pickup device **30** is thus resistant to external noise that may influence an image signal transmitted via the cable **3**.

[**0106**] The first image pickup device **30** outputs raw image data, which eliminates the need to provide a signal processing circuit for performing signal processing, such as color separation and white balance control, in the first image pickup device **30**. With this configuration, the head-mounted unit **2** provided with the first image pickup device **30** can be lighter and smaller.

[**0107**] The digital image signal output from the A/D conversion circuit **89** of the first image pickup device **30** is processed by the controller/recorder **4** connected with the head-mounted unit **2** via the cable **3** and is recorded.

[**0108**] The controller/recorder **4** includes the following elements. A digital signal processor (DSP) circuit **115** performs predetermined digital signal processing on a signal output from the A/D conversion circuit **89**. A memory **116**, such as a frame buffer, temporarily stores the signal from the DSP circuit **115**. A digital-to-analog (D/A) conversion circuit **117** converts the digital signal stored in the memory **116** into an analog signal. The LCD **48** (see **FIG. 10**) displays the image based on the analog image signal converted by the D/A conversion circuit **117**. An LCD driver **118** controls the driving of the LCD **48**. A compression/decompression circuit **119** compresses the digital signal stored in the memory **116** and decompresses a compressed digital signal read from the recording memory **120**, which is described below. The recording memory **120** records the digital signal compressed by the compression/decompression circuit **119**. An auto exposure processing circuit (hereinafter referred to as the "AE processing circuit") **121** conducts calculations for exposure control based on the digital image signal from the A/D conversion circuit **89**. An auto focus processing circuit (hereinafter referred to as the "AF processing circuit") **122** conducts calculations for auto focus (AF) control based on the digital image signal from the A/D conversion circuit **89**. The speaker **56** (see **FIG. 9**) plays back sound or issues alarming sound while playing back images under the control of the first CPU **111**. A reception circuit **123** receives a signal from a transmission circuit **133**, which is described below, of the remote controller **5**. A first operation switch **113** includes various switches, such as those shown in **FIG. 9**, and is used for inputting various operations concerning the camera **1**. An electrically erasable programmable read-only memory (EEPROM) **114** records various data used in the camera **1**. A power supply circuit **124** includes detachable batteries and supplies power not only to the controller/recorder **4**, but also to the first image pickup device **30** and the see-through image display portion **6**. A second CPU **112**, which serves as control means, controls mainly the see-through image display portion **6**. The first CPU **111**, which serves as synthetic control means for the camera **1** and also serves as alarming and switching means, controls the individual circuits of the controller/recorder **4** and the individual circuits of the first image pickup device **30**, and also communicates with the second CPU **112** to control the see-through image display portion **6** via the second CPU **112**.

[**0109**] The operation of the above-described controller/recorder **4** is as follows.

[**0110**] The DSP circuit **115** performs predetermined image processing computation on the image data output from the A/D conversion circuit **89**, and also performs auto white balance processing on the image data based on the obtained computation result.

[**0111**] The image data processed by the DSP circuit **115** is temporarily stored in the memory **116**.

[**0112**] The image data stored in the memory **116** is compressed in the compression circuit of the compression/decompression circuit **119**, and is then stored in the recording memory **120**.

[**0113**] When a recorded image is selected by operating the menu button **63**, the menu selection switch **66**, **67**, **68**, or **69**, or the setting switch **65**, and when a playback instruction is given by operating the playback start/stop switch **59**, compressed data stored in the recording memory **120** is decompressed by the decompression circuit of the compression/decompression circuit **119**, and the decompressed data is temporarily stored in the memory **116**. This image data is converted into an analog image signal by the D/A conversion circuit **117**, and the analog image signal is then displayed on the LCD **48**. In this case, the operation of the LCD **48** is controlled by a signal generated by the LCD driver **118**.

[**0114**] Meanwhile, the digital image data output from the A/D conversion circuit **89** is transmitted to the controller/recorder **4** via the cable **3** and is then input into the AE processing circuit **121** and the AF processing circuit **122**.

[**0115**] The AE processing circuit **121** calculates the luminance of the image data for one frame and adds the luminance values by weighting them so as to compute an AE evaluation value corresponding to the brightness of the subject, and outputs the computation result to the first CPU **111**.

[**0116**] The AF processing circuit **122** extracts high frequency components from the luminance components of the image data for one frame by using a high-pass filter, and calculates the accumulative values of the extracted high frequency components so as to compute an AF evaluation value corresponding to the contour components at the high frequency side, and outputs a computation result to the first CPU **111**. In the first embodiment, the first CPU **111** detects the focal point based on the AF evaluation value calculated by the AF processing circuit **122**.

[**0117**] In the EEPROM **114**, various correction data required for, for example, exposure control or auto focus processing, are recorded when the camera **1** is manufac-

tured. The first CPU **111** executes various types of computation by reading the correction data from the EEPROM **114** if necessary.

[**0118**] The second CPU **112** is, as stated above, used for controlling the see-through image display portion **6**. The second CPU **112** is connected to the first CPU **111** so that it performs predetermined operations in cooperation with the first CPU **111**. The second CPU **112** is electrically connected to contacts **109***a* and **109***b*, details of which are described below, for detecting whether the opening angle of the temple **12** equipped with the first photographing optical system **31** is sufficiently large.

[**0119**] The see-through image display portion **6** projects a photographic frame indicating the photographic range or an image which is being picked up by the first image pickup device **30** by using a holographic optical element (hereinafter referred to as a "HOE"), which serves as a reflection-type combiner, and displays the projected image in front of the viewing direction of a photographer as a virtual image. The "photographic frame" is an index of the range of a subject photographed by the first image pickup device **30** (see **FIG. 17**).

[**0120**] The see-through image display portion **6** includes the following elements. A light-emitting diode (LED) driver **101** controls an LED **102**, which is described below, to emit light under the control of the second CPU **112**. The LED **102** serves as a light-emitting source for emitting light by being driven by the LED driver **101** and also forms projection means (horizontal projection means). A condenser lens **103** condenses light emitted from the LED **102** and also forms the projection means (horizontal projection means). An LCD **104** displays photographic frames or photographed images, and serves as transmissive LCD means illuminated from backward by light emitted from the LED **102** via the condenser lens **103**. The LCD **104** also forms the projection means (horizontal projection means). An LCD driver **105** drives the LCD **104** to display photographic frames and the like under the control of the second CPU **112**, and also serves as correction means for correcting the parallax, which is described below. A first HOE **106**, which serves as a reflective optical member for reflecting light emitted from the LCD **104** vertically downward (see **FIG. 14**) while correcting the aberration, which is described below. A second HOE **107**, which serves as a combiner, reflects and diffracts the light from the first HOE **106** toward the photographer's eyes so as to project a photographic frame displayed on the LCD **104** to allow the photographer to observe the frame and also to transmit external light toward the photographer's eyes. A projector LED **16***a* contained in the projector light-emitting portion **16** performs distance measurement. An LED driver **108** drives the projector LED **16***a* under the control of the second CPU **112**. A condenser lens **16***b* projects the distance-measurement light emitted from the projector LED **16***a* toward a subject. The first microphone **17** and the second microphone **18** collect stereo sound from the subject and outputs it to the second CPU **112**.

[**0121**] The remote controller **5** includes a second operation switch **131** containing switches, such as those shown in **FIG. 11**, a decoder **132** for converting an operation input from the second operation switch **131** into a wireless transmitting signal, the transmission circuit **133** for transmitting the signal converted by the decoder **132** to the controller/recorder **4**, and a power supply circuit **134** containing batteries to supply power to the individual circuits of the remote controller **5**.

[**0122**] The optical structure of the see-through image display portion **6** is described below with reference to **FIGS. 13 through 16**. **FIG. 13** illustrates the principle of the optical system of the see-through image display portion **6**. **FIG. 14** is a front view, partially in section, illustrating the configuration of the optical system of the see-through image display portion **6**. **FIGS. 15A and 15B** are left side views illustrating examples of the configuration of the optical system of the see-through image display portion **6**. **FIG. 16** is a sectional plan view illustrating the configuration of the optical system of the see-through image display portion **6**.

[**0123**] In the see-through image display portion **6**, a photographic frame indicating a photographic range can be superimposed as a virtual image on a subject substantially directly observed by the photographer. Such a display mode is referred to as the "see-through display". The term "substantially directly observing/observed" includes not only a case where the photographer observes the subject directly with his/her eyes, but also a case where the photographer observes the subject through a generally planar transparent member formed of, for example, glass or plastic, or a case where the photographer observes the subject through an eyesight-correcting lens.

[**0124**] The principle of displaying see-through images by the optical system of the see-through image display portion **6** (hereinafter referred to as the "see-through image display optical system") in the first embodiment is described below with reference to **FIG. 13**.

[**0125**] Light emitted from the LED **102** is condensed by the condenser lens **103** and illuminates the LCD **104** from backward. The LED **102** includes diodes that can emit red (R), green (G), and blue (B) light, and when a photographic frame is displayed, for example, only the G diode is allowed to emit light.

[**0126**] The second CPU **112** generates a signal corresponding to the photographic frame indicating the photographic range and outputs it to the LCD driver **105**. The LCD driver **105** drives the LCD **104** based on this signal to allow the LCD **104** to display the photographic frame.

[**0127**] The photographic frame image output from the LCD **104** is reflected by the second HOE **107** and is guided to the photographer's eyes. Then, the photographer can observe the photographic frame indicating the photographic range as a virtual image VI. The first HOE **106** is not shown since only the principle is illustrated in **FIG. 13**.

[**0128**] The second HOE **107** is a volume-phase holographic optical element using a photosensitive material, such as photopolymer, and is designed to reflect light having R, G, and B wavelengths emitted from the LED **102** with the maximum reflectivity. Accordingly, when emitting G light to display a photographic frame, the green photographic frame is clearly displayed as a virtual image. The HOE exhibits excellent wavelength selectivity, and more specifically, the HOE exhibits high reflection characteristics for the R, G, and B wavelength light with extremely narrow wavelength intervals and exhibits high transmission characteristics for the other wavelength light. Accordingly, external light having the same wavelength range as the display light is

diffracted and reflected and does not reach the photographer's eyes, but external light having the other wavelength ranges reaches the photographer's eyes. Generally, since visible light has a wide wavelength interval, an external image can be observed without any problem even if light having very narrow wavelength intervals including the R, G, and B wavelengths does not reach the photographer's eyes.

[0129] In the see-through image display portion **6**, an image picked up by the first image pickup device **30** can be see-through displayed as a color image. In this case, the captured image is displayed on the LCD **104**, and also, the LED **102** is controlled to emit three R, G, and B types of light. This allows the captured image to reach the photographer's eyes through the second HOE **107** as a virtual image.

[0130] The first HOE **106** reflects light from the LCD **104** toward the second HOE **107**, and also has a function of correcting the curvature of field. Although in this embodiment the first HOE **106** is used, a free-form optical element may be used. Although the free-form optical element is light and small, it can correct the complicated aberration, and thus, clear images with small aberration can be displayed without increasing the weight of the head-mounted unit **2**.

[0131] Specific arrangements of the see-through image display optical system are described below with reference to **FIGS. 14 through 16**.

[0132] In the portion inside the frame **13** and closer to a subject and above the transparent optical member **14** (and/or the transparent optical member **15**), the LED **102**, the condenser lens **103**, the LCD **104**, and the first HOE **106** are disposed in the order shown in **FIG. 14**. Those elements are fixed, as shown in **FIG. 16**, by being sandwiched between support frames **144** and **145**. In this case, the LED **102** is fixed by the support frames **144** and **145** while being mounted on an electronic circuit board **141**. The first HOE **106** is inclined so that it can reflect light from the LED **102** vertically downward.

[0133] The transparent optical member **14** (and/or the transparent optical member **15**) includes, as shown in **FIGS. 15A and 15B**, optical waveguide members **142** and **143** formed of transparent glass or plastic to have a predetermined thickness and the second HOE **107** inclined between the optical waveguide members **142** and **143** to reflect light backward. With this configuration, light reflected by the first HOE **106** propagates the inside of the optical waveguide member **142** disposed above the second HOE **107** and reaches the second HOE **107**. The propagation of light inside the optical waveguide member **142** may be only the transmission, as shown in **FIG. 15A**, or a combination of the transmission and internal total reflection, as shown in **FIG. 15B**. If the optical system is designed as shown in **FIG. 15B**, the transparent optical member **14** (and/or transparent optical member **15**) can be thin-walled, thereby further reducing the weight of the head-mounted unit **2**.

[0134] In the portion inside the frame **13** and closer to the photographer's head (opposite to the subject), an electronic circuit board **146** for mounting the LED driver **101** and the LCD driver **105** is disposed, as shown in **FIG. 16**, opposite to the see-through image display optical system across the support frame **144**.

[0135] Among the above-described elements, the see-through image display optical system includes the LED **102**, the condenser lens **103**, the LCD **104**, the first HOE **106**, the second HOE **107**, and the optical waveguide members **142** and **143**.

[0136] As the arrangement of the see-through image display portion **6** to observe a subject with the two eyes of a photographer, the following two examples can be considered.

[0137] In a first example, only the portion corresponding to one eye is formed of a see-through image display optical system, such as that shown in **FIG. 14**, and the portion corresponding to the other eye is formed of merely a transparent optical member without a see-through image display function. In this case, it is preferable that the luminous transmittance characteristic of the transparent optical member without a see-through image display function is the same as that of the transparent optical member **14** (or transparent optical member **15**), thereby reducing the eyestrain of the photographer even over a long use.

[0138] In a second example, a see-through image display optical system, such as that shown in **FIG. 14**, is formed for both the eyes. By the use of a pair of see-through image display optical systems, the eyestrain can further be reduced, and images that should be observed three-dimensionally can also be displayed.

[0139] Display examples of images by the see-through image display portion **6** are described below with reference to **FIGS. 17 through 26**.

[0140] **FIG. 17** illustrates a display example in the see-through display initial state. When the camera **1** is powered on or when the system is reset, the see-through image display portion **6** displays a screen, such as that shown in **FIG. 17**. In this case, as shown in **FIG. 17**, a photographic frame **151** indicating a photographic range corresponding to a standard lens (for example, having a field angle of 50°) is displayed in a see-through manner. That is, the photographic frame **151** having a visual angle of 50° when viewed from a photographer is displayed in a see-through manner.

[0141] **FIG. 18** illustrates a display example when the zoom is changed to the tele (T) mode, and the photographic frame **151** shown in **FIG. 18** indicates a photographic range corresponding to the telephotographing operation. As stated above, the photographic frame **151** can be changed by the operation of the zoom switch **75**, and in this case, the focal distance of the first photographing optical system **31** is changed so that the field angle of the first image pickup device **30** coincides with the visual angle of the photographic frame **151**. More specifically, the photographic range corresponding to the focal distance of the standard lens shown in **FIG. 17** is shifted to the photographic range corresponding to the tele (T) mode shown in **FIG. 18** by the operation of the tele switch **75***a* of the zoom lens **75**.

[0142] **FIG. 19** illustrates a display example when the zoom is changed to the wide (W) mode and when the exposure correction is conducted. The photographic frame **151** shown in **FIG. 19** indicates a photographic range corresponding to the wide (W) mode, and the corrected exposure is indicated at the bottom right of the photographic frame **151** as information **152**. In this example, the exposure was corrected to +1.0 by the operation of the exposure correction switch **76**. The information **152** concerning the exposure correction can be indicated by other than numeri-

cal values, such as a bar graph or an index. The photographic range corresponding to the focal distance of the standard lens shown in **FIG. 17** is shifted to the photographic range of the photographic frame **151** shown in **FIG. 19** by the operation of the wide switch **75***b* of the zoom switch **75**.

[0143] **FIG. 20** illustrates a display example when an image is displayed as an electronic view. When the electronic view display (V) is selected by the F/V switch **72**, an electronic image **153** picked up by the first image pickup device **30** is projected on the photographer's eyes as a virtual image. The size of the image displayed as an electronic view can be set according to the resolution of the image, and when the resolution is low, the image can be displayed with a small size.

[0144] **FIG. 21** illustrates a display example when a moving picture is being recorded. When the record switch **74** is operated to start recording, the photographic frame **151** indicating the photographic range is displayed, as shown in **FIG. 21**, and also, information **154** indicating that a recording operation is in progress is indicated as "REC" at the bottom right of the photographic frame **151**. The information **154** may be other than characters.

[0145] **FIG. 22** illustrates a display example in a manual mode. When the manual mode (M) is set by the operation of the A/M switch **71**, information **155** indicating the manual mode (M) is displayed as "MANU" at the bottom right of the photographic frame **151**. When the information **155** indicating "MANU" is not displayed, the camera **1** is in the auto (A) mode.

[0146] **FIG. 23** illustrates a display example of alarm information **156** when the opening angle of the temple **12** with respect to the front portion **11** is not sufficient. If the temple **12** is not opened to a predetermined position, a deviation of the angle is generated between the first image pickup device **30** and the visual axis. Accordingly, such a deviation is detected and an alarm is issued by a configuration described below.

[0147] **FIG. 24** illustrates a display example of alarm information **157** indicated in a see-through manner when the focal distance f of the first photographing optical system **31** is to be further reduced even if it has reached the adjustable lower limit k**1**. That is, when the zoom operation is further continued to decrease the focal distance f in the wide mode even if the zoom has reached the limit of the wide mode, the alarm information **157** is displayed together with the photographic frame **151** indicating the photographic range.

[0148] **FIG. 25** illustrates a display example of alarm information **158** indicated in a see-through manner when the focal distance f of the first photographing optical system **31** is to be further increased even if it has reached the adjustable upper limit k**2**. That is, when the zoom operation is further continued to increase the focal distance f in the tele mode even if the zoom has reached the limit of the tele mode, the alarm information **158** is displayed together with the photographic frame **151** indicating the photographic range.

[0149] **FIG. 26** illustrates a display example when a photographing operation for a still image is performed. In this case, the photographic frame **151** indicating the photographic range is displayed, and also, information **159** indicating that a still image has been recorded is indicated as "REL" at the bottom right of the photographic frame **151**. The information **159** is not restricted to characters.

[0150] In the above-described display examples, the regular information is displayed by allowing, for example, the green (G) diode of the LED **102**, to emit light, and the alarm information is displayed by allowing, for example, the red (R) diode of the LED **102**, to emit light.

[0151] **FIG. 27** illustrates the principle of distance measurement.

[0152] A distance-measurement projector optical system including the projector LED **16***a* and the condenser lens **16***b* of the projector light-emitting portion **16** and an image pickup system including the first photographing optical system **31** and the CCD **87** are disposed such that the optical axes of the two systems are separated from each other by a predetermined distance (L).

[0153] With this configuration, light emitted from the projector LED **16***a* is output from the condenser lens **16***b* almost in the form of parallel light, and is applied to a subject O. The light is reflected by the subject O and is incident on the image pickup plane of the CCD **87** via the first photographing optical system **31**.

[0154] In this case, when the distance between the optical axis of the condenser lens **16***b* and the optical axis of the first photographing optical system **31** is indicated by L, when the distance from the principal point of the first photographing optical system **31** to the image pickup plane of the CCD **87** is represented by f**1**, and when the distance between the image forming position of the reflected light from the subject O on the image pickup plane of the CCD **87** and the optical axis of the first photographing optical system **31** is indicated by ΔL, the distance R from the principal point of the first photographing optical system **31** to the subject O can be determined by the following equation.

$$R = \frac{L}{\Delta L} \cdot f1 \tag{1}$$

[0155] The principle of the correction for the parallax based on the distance to the subject is described below with reference to **FIGS. 28 through 30**. **FIG. 28** illustrates the optical relationship of the subject to the first photographing optical system **31** and the CCD **87**. **FIG. 29** illustrates the optical relationship of a HOE to the eye and a virtual image formed by the HOE. **FIG. 30** illustrates the amount by which the virtual image is shifted for correcting the parallax.

[0156] As shown in **FIG. 28**, when the horizontal size of the image pickup area of the CCD **87** is indicated by h**2**, when the focal distance of the first photographing optical system **31** is represented by f, when the distance from the principal point of the first photographing optical system **31** to the CCD **87** is designated by f+x, when the distance from the principal point of the first photographing optical system **31** to the subject is indicated by L**2**, when the horizontal length of the subject picked up by the CCD **87** is represented by H**2**, and when the photographic field angle in the horizontal direction is indicated by θ**2**, the following equation holds true.

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$$\tan\left(\frac{\theta 2}{2}\right) = \frac{\frac{h2}{2}}{(f+x)} \quad (2)$$

[0157] As shown in **FIG. 29**, when the distance from the pupil P of the photographer to the position of the photographic frame (virtual image VI) indicating the photographic range is indicated by L**1**, when the horizontal length of the photographic frame is represented by H**1**, and when the angle (visual angle) of the horizontal length H**1** of the photographic frame from the position of the pupil P is designated by θ**1**, the following equation hold true.

$$\tan\left(\frac{\theta 1}{2}\right) = \frac{\frac{H1}{2}}{L1} \quad (3)$$

[0158] In order to perform a photographing operation in the photographic range set by the photographer, it is necessary that the photographic field angle and the visual angle be equal to each other, i.e., θ**2**=θ**1**. Under the condition of θ**2**=θ**1**, the right side of equation (2) and the right side of equation (3) should be equal to each other. To satisfy this requirement, the focal distance f of the first photographing optical system **31** can be determined by the following equation.

$$f = \frac{L1}{H1} \cdot h2 - x \quad (4)$$

[0159] From the principle of the image formation using a lens, the following equation holds true.

$$\frac{1}{L2} + \frac{1}{f+x} = \frac{1}{f} \quad (5)$$

[0160] By eliminating x from equation (4) and equation (5), the following equation (6) can be derived.

$$f = \frac{h2}{\frac{h2}{L2} + \frac{H1}{L1}} \quad (6)$$

[0161] If the subject distance L**2** is found from equation (6), the focal distance f can be determined.

[0162] To establish the relationship of h**2**/L**2**<<H**1**/L**1** in an ordinary subject, when it is desired that calculations are simplified or when means for determining the distance to a subject is not provided, the approximation can be obtained by the following equation.

$$f \cong \frac{L1}{H1} \cdot h2 \quad (7)$$

[0163] The principle of the parallax correction is described below with reference to **FIG. 30**.

[0164] To describe the principle of the parallax correction, it is assumed that the optical axis of the first photographing optical system **31** and the visual axis of the photographer are perpendicular to the photographer's face and that the optical axis and the visual axis are disposed separately from each other by the distance X. The parallax is caused by the fact that the optical axis and the visual axis are separated from each other by the distance X. If the optical axis and the visual axis are relatively tilted, a large parallax may occur, and it is thus necessary to adjust them to be in parallel. Means for adjusting the optical axis and the visual axis is described in detail below.

[0165] As indicated by the solid lines and the broken lines in **FIG. 30**, if the distance to a virtual image VI**0**, which is a photographic frame indicating the photographic range, is equal to the distance to a subject, a deviation (parallax) between the range observed by the photographer and the range picked up by the first image pickup device **30** is a constant value X. In actuality, however, the distance L**1** from the pupil P of the photographer to a virtual image VI**1** is different from the distance L**2** from the principal point of the first photographing optical system **31** to the subject. The amount X' by which the parallax is corrected (hereinafter referred to as the "parallax correction amount X'") which allows the photographic frame as the virtual image to match the actual image pickup range is expressed by the following equation.

$$X' = \frac{L1}{L2} \cdot X \quad (8)$$

[0166] When the reciprocal of the magnification (i.e., the ratio of the size of the virtual image to the size of the image displayed on the LCD **104**) of the virtual image VI**1** of the photographic frame is represented by β, the amount SP by which the image displayed on the LCD **104** is shifted (hereinafter referred to as the "shift amount SP") for correcting the parallax is expressed by the following equation.

$$SP = \beta \cdot X' = \frac{L1}{L2} \cdot \beta \cdot X \quad (9)$$

[0167] Accordingly, the second CPU **112** controls the LCD driver **105** to shift the image displayed on the LCD **104** by the shift amount SP expressed by equation (9). Then, the position of the virtual image VI**1** is shifted to the position of a virtual image VI**2** by the distance X', and as indicated by the two-dot-chain lines in **FIG. 30**, the range indicated by the photographic frame of the virtual image coincides with the actual image pickup range.

[0168] As described above, the shift amount SP for conducting the parallax correction is determined by the subject

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distance L2, and basically, the parallax correction should be performed every time the subject distance L2 is changed.

[0169] However, when, for example, β=1/100, L1=2 m, L2=2 m, X=4 cm, the shift amount SP is calculated to be 0.4 mm. This parallax correction amount can be converted into the visual angle Sθ by using the following equation.

$$S\theta = \tan^{-1}\left(\frac{X}{L2}\right) \tag{10}$$

[0170] According to equation (10), the visual angle Sθ is calculated to be about 1 degree, which is not a very large parallax. Accordingly, it can be said that the parallax correction is not necessary in most cases when regular photographing is conducted. On the other hand, since the element in the parentheses of the right side of equation (10) is proportional to the reciprocal of the subject distance L2, the visual angle Sθ is increased and the parallax correction using equation (9) is required when the subject distance L2 is small, i.e., when short-distance photographing is performed.

[0171] A description is now given, with reference to **FIGS. 31 through 33**, of a configuration in which a photographer can clearly observe a subject and a virtual image such that that they can be in focus at the same time.

[0172] If there is a large difference between the distance from the eye to a virtual image in the photographic frame and the distance from the eye to a subject, it is difficult to adjust both the photographic frame and the subject in focus, and thus, the photographer cannot clearly observe the photographic frame and the subject at the same time.

[0173] Accordingly, a description is given below of the configuration in which the distance from the eye to the virtual image in the photographic frame is set to be equal to the distance from the eye to the subject so as to allow the photographer to clearly observe the photographic frame and the subject at the same time.

[0174] **FIG. 31** illustrates the principle of changing the distance from the eye to the virtual image. In **FIG. 31**, since only a simple description of the principle is given without referring to details of the individual members, the first HOE **106** is not shown or a description thereof is omitted.

[0175] When the focal distance of the second HOE **107** is indicated by f, when the distance from the position of the photographic frame **151** displayed on the LCD **104** to the second HOE **107** is represented by L1, when the distance from the second HOE **107** to the virtual image VI is designated by Li, when the angle (visual angle) of the virtual image on the diagonal line of the photographic frame **151** when viewed from the photographer is indicated by 2ω, and when the length of the diagonal line of the photographic frame **151** displayed on the LCD **104** is represented by X1, the following equations hold true.

$$L1 = \frac{1}{\frac{1}{f} - \frac{1}{Li}} \tag{11}$$

-continued

$$X1 = 2 \cdot L1 \cdot \tan\varpi = \frac{2 \cdot \tan\varpi}{\frac{1}{f} - \frac{1}{Li}} \tag{12}$$

[0176] Among the variables and constants in equations (11) and (12), f is fixed when the second HOE **107** is designed, and ω can be set as desired by the photographer, and corresponds to the distance (that is, the distance determined by distance measurement) that allows the distance Li to the virtual image to coincide with the distance to the subject. Accordingly, by substituting these values into equation (11), the position L1 of the LCD **104** that allows the virtual image to be displayed at a distance equal to the distance to the subject can be determined. By further substituting the above values into equation (12), the size X1 of the photographic frame displayed on the LCD **104** that allows the visual angle of the photographic frame to coincide with the photographic field angle can be determined.

[0177] **FIG. 32** illustrates an example of the configuration in which the LCD **104** is driven in the optical axis direction by an actuator **162**, which serves as virtual-image distance adjusting means. In this example, as the actuator **162**, a known actuator, such as an electromagnetic motor, an ultra sonic motor (USM), or an electrostatic actuator, is used for changing the distance L1. The LCD **104** is disposed so that it can be moved in the optical axis direction of the condenser lens **103**, and a rack **161**, which serves as virtual-image distance adjusting means, for displacing the LCD **104** in the optical axis direction, is provided on, for example, a frame member for supporting the LCD **104**. A pinion gear **162***a* fixed to the rotational axis of the actuator **162** is meshed with the rack **161** so as to transmit a driving force. By rotating the actuator **162** by a desired amount, the LCD **104** can be shifted in the optical axis direction by a desired amount. With this configuration, the distance L1 is changed so that the distance Li to the virtual image VI can coincide with the distance to the subject. When the distance L1 is changed by using this structure, the size of the photographic frame displayed on the LCD **104** has to be changed by the LCD driver **105**, which serves as the visual-angle adjusting means, so that X1 expressed by equation (12) can be satisfied.

[0178] In the example shown in **FIG. 32** and also in the example shown in **FIG. 33**, which is described below, in response to a change in the magnification (angle 2ω of the subject) by changing the position of the virtual image, the size of an image displayed on the LCD **104** is corrected by using the LCD driver **105**, which serves as visual-angle adjusting means, so that the magnification can be constant. More specifically, the size of the image displayed on the LCD **104** is corrected so that the ratio of the distance L1 from the position of the photographic frame **151** displayed on the LCD **104** to the second HOE **107** to the length X1 of the diagonal line of the photographic frame **151** displayed on the LCD **104** can be constant.

[0179] **FIG. 33** illustrates an example of the configuration in which the image of the LCD **104** is linearly formed and the position of the linear image is changed in the optical axis direction. In this example, an image forming lens **163**, which is an image optical system, is disposed on the optical path of

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light passing through the LCD **104**. By the image forming lens **163**, the image of the LCD **104** is formed linearly at a position **164** on the optical path between the image forming lens **163** and the second HOE **107**. The image forming lens **163** is disposed so that it is movable in the optical axis direction, and a rack **165**, which serves as virtual-image distance adjusting means, for displacing the image forming lens **163** in the optical axis direction is provided on, for example, a lens frame for supporting the image forming lens **163**. As in the rack **161**, a pinion gear **166***a* fixed to the rotational axis of the actuator **166**, which serves as virtual-image distance adjusting means, is meshed with the rack **165** so as to transmit a driving force. By rotating the actuator **166** by a desired amount, the image forming lens **163** is moved in the optical axis direction so that the position **164** on the linear image forming plane can be shifted in the optical axis direction by a desired amount. By using this structure, the distance L1 is changed so that the distance Li to the virtual image VI can be equal to the distance to the subject. The distance L1 in the principle described with reference to **FIG. 31** corresponds to the distance from the position **164** on the linear image forming plane to the second HOE **107** in **FIG. 33**. As stated above, the size of the photographic frame displayed on the LCD **104** is also changed.

[**0180**] In this example, the distance from the eye to the virtual image VI of the photographic frame is adjusted in accordance with the subject distance. In this case, however, the subject distance is changed every time the photographer changes his/her view to another subject, and the position of the photographic frame has to be changed every moment. Thus, unless the photographic frame is continuously adjusted with high precision, the photographer may feel visually awkward. Additionally, frequent adjustment of the photographic frame increases power consumption. Thus, the position of the photographic frame may be adjusted in several levels (for example, three levels) in a range from "very near" to "infinite".

[**0181**] A description is now given, with reference to **FIGS. 34 through 36**, of the adjustment to the positions of the pupil and a virtual image observed via the second HOE **107** in the pupil-distance direction. **FIG. 34** illustrates an example of the configuration in which the position of the first HOE **106** in the pupil-distance direction is changed by an actuator. **FIG. 35** illustrates an example of the configuration in which the position of the first HOE **106** in the pupil-distance direction is changed mechanically. **FIG. 36** is a circuit diagram illustrating the electrical configuration of the mechanical configuration shown in **FIG. 35**.

[**0182**] To allow the photographer to observe a virtual image displayed by the second HOE **107** at a correct position with respect to a subject, the positional relationship between the second HOE **107** and the pupil P should be adjusted. Since the position of the pupil varies depending on the individuals, a mechanism for allowing a photographer to make positional adjustments is useful. **FIG. 34** illustrates an example of such a mechanism.

[**0183**] The first HOE **106**, which is a reflective optical member, is attached to, for example, a rack **169**, which forms pupil-distance adjusting means, provided with teeth in the pupil-distance direction (horizontal direction in parallel with the line connecting the two eyes). A pinion gear **170***a* fixed to the rotational axis of an actuator **170**, which forms the pupil-distance adjusting means, is meshed with the rack **169** so as to transmit a driving force. By rotating the actuator **170** by a predetermined amount, the first HOE **106** can be moved in the pupil-distance direction.

[**0184**] Similarly, the LCD **104**, which forms horizontal projection means, is attached to, for example, a rack **167**, which forms the pupil-distance adjusting means, provided with teeth in the pupil-distance direction. A pinion gear **168***a* fixed to the rotational axis of an actuator **168**, which forms the pupil-distance adjusting means, is meshed with the rack **167** so as to transmit a driving force. By rotating the actuator **168** by a desired amount, the LCD **104** can be moved in the pupil-distance direction.

[**0185**] If only the first HOE **106** is shifted in the pupil-distance direction, the distance L1 shown in **FIG. 31** is changed. Thus, in the example shown in **FIG. 34**, in cooperation with the first HOE **106**, the LCD **104** is also moved in the same direction by the same amount so that the distance L1 remains constant.

[**0186**] The second HOE **107** is formed longer than that shown in **FIG. 14** in the pupil-distance direction so that it can cover the range in which the first HOE **106** is moved in the pupil-distance direction and that the image on the LCD **104** can be observed as a virtual image regardless of the position of the first HOE **106** (i.e., so that the image displayed on the LCD **104** can be projected on the pupil P).

[**0187**] As the actuator **168** or **170**, a pulse motor, which is an electromagnetic motor, is used, and the amount by which the first HOE **106** or the LCD **104** is driven can be determined by counting drive pulses from a predetermined reference position. Alternatively, a known encoder may be used for detecting the driving amount. For example, a plate member provided with many slits at regular intervals in the direction in which the first HOE **106** or the LCD **104** is moved is disposed so that it can be moved integrally with the first HOE **106** or the LCD **104**. Across this plate member, an LED is provided on one surface and a light-receiving device for receiving light from the LED via the slits is provided on the other surface so as to count the number of pulses output from the light-receiving device, thereby detecting the distance by which the first HOE **106** or the LCD **104** is moved.

[**0188**] The position of the see-through image display optical system with respect to the pupil P can be adjusted by driving the actuator **168** or **170** by the operation on an electrical switch. Alternatively, a sensor for detecting the position of the pupil P may be provided, and the second CPU **112** or the first CPU **111** controls the actuator **168** or **170** according to the output of the sensor, thereby automatically adjusting the position of the see-through image display optical system.

[**0189**] **FIG. 35** illustrates an example of the configuration in which the position of the first HOE **106** in the pupil-distance direction is mechanically changed so as to adjust the relative position of the second HOE **107** with respect to the pupil.

[**0190**] The first HOE **106** is fixed to a slider **171**, which is a support member, and the slider **171** is supported by guide members **172** fixed to the frame **13** so that it is movable in the pupil-distance direction within a predetermined range. The slider **171** is provided with a knob **171***a* that allows the photographer to move the slider **171** in the pupil-distance direction.

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[0191] An electrical segment **174** is attached to the slider **171**, and the distal end of the electrical segment **174** is a projecting contact **174***a*. The contact **174***a* has elasticity in the direction in which it is away from the slider **171**. Accordingly, when a force is not applied, the contact **174***a* is positioned away from the slider **171**, and when a force is applied, the contact **174***a* is moved to be close to the slider **171** with elasticity.

[0192] A substrate **173** is fixed to the frame **13** such that it faces the contact **174***a*. The substrate **173** is provided with a plurality of recesses disposed along the movement of the slider **171** at regular intervals on the bottom surface facing the slider **171**, and electrical contacts **175***b* (in **FIG. 35**, three contracts **175***b***1**, **175***b***2**, and **175***b***3** are shown) are provided on the bottom surfaces of the recesses.

[0193] When the contact **174***a* is engaged with one of the recesses, it touches the contact **175***b* provided on the bottom of the corresponding recess and is electrically connected to the contact **175***b*. In this case, a clicking feeling is generated by the engagement of the contact **174***a* and the recess so that the photographer is informed that the slider **171** is moved to a predetermined position. Then, the position of the first HOE **106** in the pupil-distance direction can be detected according to with which one of the contacts **175***b***1**, **175***b***2**, and **175***b***3** the contact **174***a* is electrically connected.

[0194] The configuration of an electrical detection circuit including the contacts **174***a* and **175***b* is described below with reference to **FIG. 36**.

[0195] The contact **174***a* is connected to a power source Vcc and can be electrically connected to one of the plurality of contacts **175***b***1**, **175***b***2**, and **175***b***3** (which are collectively referred to as the "contacts **175***b*"). The contacts **175***b***1**, **175***b***2**, and **175***b***3** are grounded via resistors **176**R**1**, **176**R**2**, and **176**R**3** (which are collectively referred to as the "resistors **176**R"), respectively, and are electrically connected to other terminals **177***c***1**, **177***c***2**, and **177***c***3** (which are collectively referred to as the "terminals **177***c*"), respectively.

[0196] With this configuration, the potential of the terminal **177***c* electrically connected to the terminal **175***b* which touches the contact **174***a* becomes the supply voltage Vcc, and the potentials of the other terminals **177***c* become equal to the ground potential. Accordingly, by detecting the potential of the terminals **177***c*, the position of the first HOE **106** can be detected.

[0197] Based on the detected position of the first HOE **106**, the position of the LCD **104** (for example, see **FIG. 34**) or the position of the linear image forming plane of the LCD **104** can be corrected, thereby maintaining the virtual image in the photographic frame at a fixed position.

[0198] In the above-described example, by relatively moving the contact **174***a* with respect to the contacts **175***b*, which are separately disposed, the position of the first HOE **106** is adjusted and detected in a stepwise manner. However, the position of the first HOE **106** may be continuously adjusted and detected. To achieve this modification, the following configuration may be considered. The position of the slider **171** is continuously changed with respect to the guide members **172**, and a thin-film resistor is printed on the substrate **173** along the sliding direction of the slider **171**, and also, the contact **174***a* slides on the thin-film resistor while maintaining electrical contact therewith. In this case, by detecting the resistance between the contact **174***a* and one of the terminals of the thin-film resistor, the position of the first HOE **106** which is continuously changing can be detected.

[0199] As stated above, the mechanical adjustment of the position of the first HOE **106** in the pupil-distance direction is manually performed by using the knob **171***a*. This eliminates a high level control and simplifies the configuration. It is sufficient to adjust the position of the first HOE **106** only once unless the photographer is changed.

[0200] With this configuration, the relative position between the pupil and the principal ray from the second HOE **107** can be adjusted without changing the external appearance of the camera **1**, thereby making it possible to precisely project the photographic frame on the photographer's pupil.

[0201] A first example of the configuration of and near a hinge unit **200** is described below with reference to **FIGS. 37 through 42**. **FIG. 37** is a plan view, partially in section, illustrating the structure of a connecting portion including the front portion **11**, the hinge unit **200**, and the temple **12**. **FIG. 38** is a vertical sectional view illustrating the connecting portion between the front portion **11** and the hinge unit **200** when viewed from the left side of **FIG. 37**. **FIG. 39** is a sectional view illustrating a fixed portion formed of the front portion **11**, the hinge unit **200**, and the screw **23**. **FIG. 40** illustrates the connecting portion between the hinge unit **200** and the temple **12** when viewed from the left side to substantially the right side of **FIG. 37**. **FIGS. 41 and 42** are a front view and a plan view, respectively, illustrating an electrical contact provided on a projection **181** of the temple **12**.

[0202] The hinge unit **200** includes the hinge **24** and connects the temple **12** and the front portion **11** (or frame **13**).

[0203] In the camera **1**, as stated above, the photographer specifies a photographic frame indicating the photographic range, and performs a photographing operation with a field angle corresponding to the visual angle of the specified photographic frame, and thus, the parallax correction is necessary. The parallax is caused by a horizontal positional deviation between the visual axis of the photographer and the optical axis or by an angular deviation between the visual axis and the optical axis. Between the two deviations, the influence of the angular deviation is much larger, and thus, an adjusting mechanism (adjusting means) for precisely correcting the angular deviation is provided.

[0204] In the camera **1**, as shown in **FIG. 3**, the left and right temples **12** are substantially perpendicular to the front portion **11** when the head-mounted unit **2** is in use, and when the head-mounted unit **2** is not in use, the temples **12** are foldable inward toward the front portion **11** via the hinges **24** and **25**. In the example shown in **FIGS. 37 through 42**, the hinge unit **200** including the right hinge **24** when the first image pickup device **30** is attached to the right temple **12**, as shown in **FIGS. 2 through 5**, is described.

[0205] In the state in which the temple **12** is opened at the maximum angle (i.e., substantially perpendicularly) with respect to the front portion **11**, the maximum opening angle (substantially 90°) between the see-through image display portion **6** and the first image pickup device **30** of the front

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portion **11** can be relatively adjusted (finely adjusted) in the pitch (vertical) direction and the yaw (horizontal direction). Accordingly, the optical axis of the first photographing optical system **31** of the first image pickup device **30** attached to the temple **12** can be adjusted to be in parallel with the visual axis.

[**0206**] The hinge **24** of the hinge unit **200** is formed as a knee joint and is configured as follows, as shown in **FIG. 40**. An angular U-shaped bearing **193** with a cylindrical screw hole **193***a* disposed at the front portion **11** is combined with a bearing **194** provided with a cylindrical hole **194***a* disposed at the temple **12** such that the screw hole **193***a* and the hole **194***a* pass through each other. A shaft **191**, which serves as a connecting pin, is inserted into the holes **193***a* and **194***a*. In **FIG. 40**, the portion corresponding to the temple **12** is hatched.

[**0207**] As shown in **FIG. 37**, the temple **12** in the hinge unit **200** includes the projection **181**, which serves as adjusting means, at the right side of **FIG. 37**, and the front portion **11** in the hinge unit **200** includes a projection **182**, which serves as the adjusting means, at the right side of **FIG. 37** such that the abutting surfaces of the projections **181** and **182** face each other. In the projection **182** of the hinge unit **200**, a screw hole **182***a* substantially parallel with the optical axis of the first photographing optical system **31** when the camera **1** is in use is punched, and the bis **32** is screwed into the screw hole **182***a*. When the bis **32** is screwed until it is extended from the screw hole **182***a* of the projection **182**, and the extended end of the bis **32** abuts against the projection **181** of the temple **12**. With this configuration, the maximum opening angle of the temple **12** when the head-mounted unit **2** is in use is restricted, and the optical axis of the first photographing optical system **31** attached to the temple **12** can be finely adjusted in the yaw direction.

[**0208**] Such a fine and precise adjustment is performed when the temple **12** is disposed at a predetermined position (in this case, when it is opened at the maximum angle). Accordingly, the temple **12** should not be used when it is not sufficiently opened with respect to the front portion **11**. Accordingly, means for detecting whether the temple **12** is opened at the maximum angle is provided, as shown in **FIGS. 41 and 42**, and if the temple **12** is not opened at the maximum angle, the alarm information **156** shown in **FIG. 23** is given.

[**0209**] More specifically, as shown in **FIGS. 41 and 42**, an insulator **211** is disposed on the surface of the projection **181** facing the projection **182**, and a linear electrical contact **109***b* and an angular U-shaped electrical contact **109***a* disposed in parallel with the contact **109***b* across the insulator **211** are embedded in the insulator **211**. A distal end **109***a***1**, which is a U-shaped portion, of the contact **109***a* floats from the surface of the projection **181** (surface of the insulator **211**) with elasticity, and when an urging force is applied to the surface of the projection **181**, the distal end **109***a***1** of the contact **109***a* touches the contact **109***b*, thereby establishing an electrical connection therebetween.

[**0210**] With this configuration, when the temple **12** is opened, the end of the bis **32** touches the distal end **109***a***1** of the contact **109***a*. When the temple **12** is opened at the maximum angle, the contact **109***a* touches the contact **109***b* by being pressed against the end of the bis **32**. When the temple **12** is not opened at the maximum angle, the contact **109***a* is away and insulated from the contact **109***b*. In this manner, it can be determined whether the temple **12** is opened at the maximum angle.

[**0211**] The contacts **109***a* and **109***b* is connected to the second CPU **112** provided in the controller/recorder **4**, as shown in **FIG. 12**, via the cable connecting terminal **12** shown in **FIG. 2** or **4**.

[**0212**] Referring back to **FIG. 37**, a mechanism for adjusting (rotation adjustment) the front portion **11** in the pitch direction with respect to the hinge unit **200** is described below.

[**0213**] The front portion **11** is configured such that an exterior member **196** corresponding to the right side end of **FIG. 37** is formed in an angular U shape in the vertical section shown in **FIG. 38** along the line parallel with the optical axis of the first photographing optical system **31** when the camera **1** is in use. The upper portion of the exterior member **196** in **FIG. 37** is opened. Inside the exterior member **196**, a wall **199** shown in **FIG. 37** and a wall-shaped spring support member **206** raised from the inner bottom surface of the exterior member **196** shown in **FIG. 38** are provided. Then, the end of the hinge unit **200** is inserted into a space formed by the exterior member **196** and the wall **199** from the opening of the U-shaped exterior member **196**.

[**0214**] The hinge unit **200** has an exterior member **197**, which is a structural member having a space inside, and two shafts **201** and **202** forming adjusting means are fixed to the exterior member **196** so that the end of the hinge unit **200** inserted into the space of the front portion **11** passes through the exterior member **197** in the pupil-distance direction.

[**0215**] The shaft **201** is fixed at both ends to the exterior member **196** of the front portion **11** such that it is inserted into a cylindrical sheath **203** forming the adjusting means. The sheath **203** is fixed at both ends to the exterior member **197** of the hinge unit **200**. With this arrangement, the shaft **201** can be relatively rotated with respect to the sheath **203** while being in coaxial with the sheath **203**.

[**0216**] Coil springs **204** and **205**, which form a part of adjusting means, for generating an urging force to unwind the springs, are attached around the sheath **203**. One end of each of the springs **204** and **205** is supported by the spring support member **206**, and the other ends of the springs **204** and **205** are supported by the bottom surface of the exterior member **197** of the hinge unit **200**. With this arrangement, a rotating force toward the bottom surface of the exterior member **196** of the front portion **11** is applied to the bottom surface of the exterior member **197** of the hinge unit **200** around the shaft **201**.

[**0217**] The shaft **202** is fixed at both ends to the exterior member **196** of the front portion **11** and is slidably inserted into a guide hole **207**, which forms apart of the adjusting means, punched in the exterior member **197** of the hinge unit **200**. The guide hole **207** is formed as an arc-like elongated hole.

[**0218**] The screw **23** is fixed to the outer side of the exterior member **197** of the hinge unit **200** around the shaft **201** via a boss **208**. A guide hole **209**, which forms a part of the adjusting means, formed as an arc-like elongated hole around the shaft **201** is punched in the exterior member **196**

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of the front portion **11**. The screw **23** is tightly screwed into the boss **208** from the external side of the right surface of the front portion **11** so that it passes through the guide hole **209**. The screw **23** is used for fixing the relative rotational position between the front portion **11** and the hinge unit **200**.

[**0219**] A screw hole **198** is formed on the bottom surface of the exterior member **196** of the front portion **11**, and the screw **22** is screwed into the screw hole **198**. The end of the screw **22** abuts against the bottom surface of the exterior member **197** of the hinge unit **200** such that it presses against the exterior member **197**.

[**0220**] The operation for adjusting the front portion **11** in the pitch direction with respect to the hinge unit **200**, i.e., with respect to the first image pickup device **30** attached to the hinge unit **200** is as follows.

[**0221**] The screw **23** is unscrewed to a degree such that the front portion **11** and the hinge unit **200** can be relatively rotated.

[**0222**] Then, when the screw **22** is screwed, the bottom surface of the hinge unit **200** is rotated upward around the shaft **201** against the urging force of the springs **204** and **205**. When the screw **22** is unscrewed, the bottom surface of the hinge unit **200** is rotated downward around the shaft **201** by the urging force of the springs **204** and **205**. By rotating the screw **22** in this manner, the position of the front portion **11** in the pitch direction is adjusted to a desired position.

[**0223**] Then, the screw **23** is tightly screwed so that the adjusted position of the front portion **11** can be fixed.

[**0224**] The operation for adjusting the relative tilt between the see-through image display portion **6** and the first image pickup device **30** by using the above-described adjusting mechanism (adjusting means) can be performed in a factory when the camera **1** is manufactured or by the photographer himself/herself using the camera **1**. In either case, the adjustment can be conducted in the same manner.

[**0225**] When the adjustment is conducted when the camera **1** is manufactured, it can be performed in the following manner. A bright point light source, for example, is disposed at a position at infinity, and this point light source is photographed by the first image pickup device **30** and is displayed by the see-through image display portion **6** in a see-through manner. Then, the adjustment in the pitch direction is conducted by using the screws **22** and **23** or the adjustment in the yaw direction is conducted by using the bis **32** as described above so that the image of the point light source substantially directly incident on the pupil is overlapped with the electronic image of the point light source observed by the pupil via the second HOE **107**. This adjustment may be performed by directly observing the image by a human. Alternatively, a monitor camera may be disposed at the position of the pupil, and the adjustment can be performed based on an image picked up by the monitor camera.

[**0226**] If the photographer himself/herself conducts the adjustment, a suitable subject at a distance can be used for performing the adjustment in a manner similar to the above-described manner.

[**0227**] The subject used for adjustment does not have to be positioned at infinity, and it may be positioned substantially at infinity where the influence of errors can be ignored.

[**0228**] The configuration in which the electrical components of the front portion **11** are electrically connected to the electrical components of the temple **12** (first image pickup device **30**) is described with reference to **FIGS. 37 through 40**.

[**0229**] As shown in **FIG. 37**, an electrical circuit board **184** disposed on the front portion **11** is electrically connected to one end of a flexible printed board **185**. The flexible printed board **185** is disposed from the inside of the front portion **11** to the inside of the hinge unit **200**, and the other end of the flexible printed board **185** is connected to a plurality of contacts **187** shown in **FIG. 40**. The contacts **187** are provided on a wall **195** which is set in the hinge unit **200**, and are connected with the flexible printed board **185** by a connecting portion **186**.

[**0230**] The bearing **194** provided for the temple **12**, which is relatively rotated with respect to the bearing **193** of the front portion **11**, is provided with a plurality of conductors **188**, which are arc-like coaxial contacts along the peripheral surface in the axial direction. The conductors **188**, which are associated with the corresponding contacts **187**, are embedded in an insulator, and the surface exposed from the insulator is, for example, gold-plated. The conductors **188** may be gold-plated on the entire surface.

[**0231**] With this configuration, even if the front portion **11** and the temple **12** are relatively rotated, an electrical connection between the contacts **187** and the conductors **188** can be maintained.

[**0232**] The contacts **187** are connected on the peripheral surface of the bearing **194** to one end of a flexible printed board **190** via a connecting portion **189**. The other end of the flexible printed board **190** is connected to an electrical circuit board (not shown) within the first image pickup device **30** attached to the temple **12**, and is electrically connected to the controller/recorder **4** via the cable **3**.

[**0233**] With this configuration, signals for driving the LED drivers **101** and **108** and the LCD driver **105** of the see-through image display portion **6** disposed on the frame **13** are transmitted from the second CPU **112** of the controller/recorder **4**, and conversely, audio signals collected from the first microphone **17** and the second microphone **18** of the frame **13** are transmitted to the second CPU **112**.

[**0234**] A description is now given, with reference to **FIGS. 43A, 43B**, and **44**, of a second example of the configuration in which the first image pickup device **30** is attached to the side surface of the frame **13** so that the angle of the first image pickup device **30** is adjustable in the pitch direction and in the yaw direction. **FIGS. 43A and 43B** are a plan view and a right side view, respectively, illustrating the configuration in which the first image pickup device **30** is attached to the frame **30**. **FIG. 44** is a right side view illustrating the configuration of holes formed in the frame **13** for attaching the first image pickup device **30**.

[**0235**] The frame **13** and the temple **12** are connected to each other via a hinge **24A**, as shown in **FIG. 43A**, so that the temple **12** is foldable with respect to the frame **13**. The hinge **24A** is disposed via a somewhat long joint portion **229** extended from the frame **13** at a position slightly farther away from the front portion **11** than the above-described hinge **24**. Unlike the hinge **24**, the hinge **24A** is not provided with electrical contacts or a flexible printed board.

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[0236] A base **220**, which serves as the adjusting means, formed generally in an L shape when viewed from the front is connected to the side surface of the joint portion **229**. The base **220** includes a portion **220***a* along the side surface of the joint portion **229** and a portion **220***b* raised from the side surface of the joint portion **229** substantially at right angles.

[0237] In the joint portion **229**, as shown in **FIG. 44**, a hole **223**, which forms pitch-direction adjusting means, is punched in the forward and an arch-like elongated hole **224**, which forms the pitch-direction adjusting means, is punched in the backward. Bises **221** and **222**, which form the pitch-direction adjusting means, are screwed into the portion **220***a* of the base **220** via the holes **223** and **224**, respectively, thereby fixing the base **220** to the joint portion **229**.

[0238] In the portion **220***b* of the base **220**, as shown in **FIG. 43A**, a hole **227**, which forms yaw-direction adjusting means, is punched in the forward, and an arc-like elongated hole **228**, which forms the yaw-direction adjusting means, is punched in the backward. As shown in **FIG. 43B**, bises **225** and **226**, which form the yaw-direction adjusting means, are screwed into the bottom surface of the first image pickup device **30** via the holes **227** and **228**, respectively, thereby fixing the first image pickup device **30** to the base **220**. A cable **230**, which is extended from the rear surface of the first image pickup device **30**, is folded toward the subject and is connected to the electrical circuits within the frame **13**.

[0239] With this configuration, the bises **221** and **222** are slightly unscrewed, and in this state, the position of the bis **222** in the elongated hole **224** is changed. Then, the base **220** is rotated around the bis **221**, and the angle of the base **220** in the pitch direction and also the angle of the first image pickup device **30** attached to the base **220** in the pitch direction can be adjusted. After adjusting the base **220** and the first image pickup device **30** to desired positions, the bises **221** and **222** are screwed tight.

[0240] Similarly, the bises **225** and **226** are slightly unscrewed, and in this state, the position of the bis **226** in the elongated hole **228** is changed. Then, the base **220** is rotated around the bis **225**, and the angle of the base **220** in the yaw direction and also the angle of the first image pickup device **30** connected to the base **220** in the yaw direction can be adjusted. After adjusting the base **220** and the first image pickup device **30** to desired positions, the bises **225** and **226** are screwed tight.

[0241] According to the second example of the configuration, the angle adjustment in the pitch direction and in the yaw direction between the see-through image display portion **6** and the first image pickup device **30** can be performed. Additionally, since the first image pickup device **30** is fixed to the front portion **11** via the base **220**, the image pickup device **30** is not folded with respect to the front portion **11** even if the temple **12** is folded. Thus, the generation of an angular deviation between the first image pickup device **30** and the see-through image display portion **6** is smaller than that in the first example of the configuration shown in **FIGS. 37 through 39**. Additionally, the adjusting mechanism is simpler than that of the first example, and can be formed less expensively.

[0242] In the above-described second example, the relative angle in the yaw direction between the first image pickup device **30** and the base **220** is adjusted, and the relative angle in the pitch direction between the joint portion **229** on the side surface of the frame **13** and the base **220** is adjusted. Conversely, by changing the mounting position of the first image pickup device **30** on the base **220**, the relative angle in the pitch direction between the first image pickup device **30** and the base **220** may be adjusted, and by changing the mounting position of the frame **13** on the base **220**, the relative angle in the yaw direction between the joint portion **229** on the side surface of the frame **13** and the base **220** may be adjusted.

[0243] The operation of the above-described camera **1** is described below with reference to **FIGS. 45 and 46**. A combination of the flowcharts of **FIGS. 45 and 46** indicates the entire operation of the camera **1**.

[0244] When the camera **1** is powered on or when the system is reset, in step **S1**, the photographic frame indicating the photographic range corresponding to the standard lens (having a field angle of 50°) is displayed, as shown in **FIG. 17**, in a see-through manner by the see-through image display portion **6**.

[0245] Then, in step **S2**, it is determined whether the temple **12** is opened at the maximum angle by checking whether the contacts **109***a* and **109***b* provided on the projection **181** of the temple **12** are closed.

[0246] If it is determined in step **S2** that the contacts **109***a* and **109***b* are not closed, the process proceeds to step **S3** in which the alarm information **156** is indicated by the see-through image display portion **6**.

[0247] If it is determined in step **S2** that the contacts **109***a* and **109***b* are closed, or after the alarm information **156** is indicated in step **S3**, the process proceeds to step **S4**. In step **S4**, the timer contained in the first CPU **111** is checked to determine whether a predetermined time has elapsed.

[0248] If the outcome of step **S4** is YES, the process proceeds to step **S5** in which the input statuses of various switches, such as the first operation switch **113** shown in **FIG. 9** or the second operation switch **131** shown in **FIG. 11** are monitored.

[0249] The timer used in step **S4** restarts counting when the process proceeds to step **S5** after the lapse of the predetermined time. In this manner, by checking the input statuses of the switches at regular time intervals while checking the timer, the load on the first CPU **111** can be reduced, and also, the erroneous operations of the switches caused by the chattering can be prevented. The timers used in steps **S11**, **S18**, and **S23**, which are described below, serve the function similar to the function of the timer in step **S4**.

[0250] If it is determined in step **S4** that the predetermined time has not elapsed or after step **S5**, it is determined in step **S6** whether the exposure correction has been performed.

[0251] If the exposure correction has been performed, the process proceeds to step **S7** in which the corrected exposure amount is indicated as the information **152**, as shown in **FIG. 19**.

[0252] If it is determined in step **S6** that the exposure correction has not been performed or after step **S7**, the process proceeds to step **S8**. In step **S8**, it is determined whether the camera **1** is set in the view mode (V) in which the camera **1** displays the image picked up by the image

pickup device **30** in a see-through manner or in the frame mode (F) in which only the photographic frame indicating the photographic range is displayed. The setting of this mode can be performed by the operation of the F/V switch **72**, as stated above.

[**0253**] When it is determined in step S**8** that the camera **1** is set in the frame mode (F), it is determined in step S**9** whether the camera **1** is set in the auto mode (A) or the manual mode (M). The setting of this mode can be performed by the operation of the A/M switch **71**, as stated above.

[**0254**] In the auto mode (A), when the focal distance of the first photographing optical system **31** reaches a predetermined value, the image picked up by the image pickup device **30** is automatically enlarged and is displayed in a see-through manner even if the camera **1** is set in the frame mode (F). With this arrangement, in a telephotographing operation, details of a subject can be easily checked without a troublesome operation, and also, when the focal distance is a regular value (less than the above-described predetermined value), only a photographic frame indicating the photographic range is displayed, thereby making the photographer comfortable to perform a photographing operation even for a long time.

[**0255**] In the manual mode (M), a determination as to whether the image is displayed in a see-through manner is manually performed, and normally, only the photographic frames are displayed in the manual mode (M).

[**0256**] If it is determined in step S**9** that the manual mode (M) is selected, the process proceeds to step S**10** in which the information **155**"MANU" is indicated, as shown in **FIG. 22**.

[**0257**] Then, in step S**11**, the timer is checked to determine whether a predetermined time has elapsed.

[**0258**] If the outcome of step S**11** is YES, the process proceeds to step S**12** in which the distance measurement is conducted to measure the distance from the camera **1** to the subject based on the principle shown in **FIG. 27**.

[**0259**] Then, in step S**13**, a value for correcting the parallax caused by a deviation between the range observed by the photographer and the photographic range observed by the image pickup device **30** is calculated based on the subject distance obtained in step S**12**.

[**0260**] Then, in step S**14**, the display of the photographic frame is updated based on the corrected parallax calculated in step S**13** so that the photographic frame can be displayed at a correct position. According to this process, even when the subject distance is changed, the photographic range can be displayed precisely.

[**0261**] If it is determined in step S**9** that the camera **1** is set in the auto mode (A), it is determined in step S**15** whether the focal distance is greater than a predetermined value a, i.e., whether the camera **1** is set in the tele mode (T).

[**0262**] If the focal distance is found to be smaller than or equal to the predetermined value a, the process proceeds to step S**11**. If the focal distance is found to be greater than the predetermined value a, or if it is determined in step S**8** that the camera **1** is set in the view mode (V), the process proceeds to step S**16**. In step S**16**, the electronic image picked up by the first image pickup device **30** is superimposed on the subject in a see-through manner by the see-through image display portion **6**.

[**0263**] After step S**16** or step S**14**, or if it is determined in step S**11** that the predetermined time has not elapsed, it is determined in step S**17** whether the photographic frame is increased by operating the wide switch **75***b* of the remote controller **5**, and more precisely, whether the visual angle of the photographic frame when viewed from the photographer is increased (when the distance to a virtual image is increased even if the photographic frame displayed as the virtual image is increased, the visual angle does not always become greater, and when the position of the virtual image remains the same, it can be safely said that "the photographic frame is increased").

[**0264**] If it is determined in step S**17** that the photographic frame is increased, it is determined in step S**18** by checking the timer whether a predetermined time has elapsed.

[**0265**] If it is found in step S**18** that the predetermined time has elapsed, it is determined in step S**19** whether the focal distance f of the first photographing optical system **31** is further to be decreased even though it has reached the adjustable lower limit k**1**.

[**0266**] If the outcome of step S**19** is YES, the process proceeds to step S**20** in which the alarm information **157** is indicated, as shown in **FIG. 24**.

[**0267**] If the focal distance f has not reached the lower limit k**1**, the process proceeds to step S**21** in which the variator lens **82** of the first photographing optical system **31** is driven to decrease the focal distance f so that the photographic range set by the photographer can be implemented.

[**0268**] If it is determined in step S**17** that the photographic frame is not increased, it is determined in step S**22** whether the photographic frame is decreased, and more precisely, whether the visual angle of the photographic frame when viewed from the photographer is decreased.

[**0269**] If the result of step S**22** is YES, it is determined in step S**23** by checking the timer whether a predetermined time has elapsed.

[**0270**] If the predetermined time has elapsed, it is determined in step S**24** whether the focal distance f of the first photographing optical system **31** is further to be increased even though it has reached the adjustable upper limit k**2**.

[**0271**] If the focal distance f has not reached the upper limit k**2**, the process proceeds to step S**25** in which the variator lens **82** of the first photographing optical system **31** is driven to increase the focal distance f so that the photographic range set by the photographer can be implemented. If it is found in step S**24** that the focal distance f is further to be increased, the process proceeds to step S**26** in which the alarm information **158** is indicated, as shown in **FIG. 25**.

[**0272**] If it is determined in step S**22** that the photographic frame is not decreased, or if it is determined in step S**18** or S**23** that the predetermined time has not elapsed, or after step S**20**, S**21**, S**25**, or S**26**, it is determined in step S**27** whether the record mode is set by operating the record switch **74** contained in the second operation switch **131** of the remote controller **5** (or the first operation switch **113**).

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[0273] If the record mode is set, the process proceeds to step S28 in which the information 154"REC" is indicated in a see-through manner, as shown in FIG. 21, and in step S29, the recording operation is started.

[0274] After step S29 or if it is determined in step S27 that the record mode is not set, it is determined in step S30 whether a still-image photographing operation is performed by the release switch 73 contained in the second operation switch 131 of the remote controller 5 (or the first operation switch 113).

[0275] If the outcome of step S30 is YES, the process proceeds to step S31 in which a still image is recorded. Then, in step S32, the information 159"REL" indicating that a still image has been recorded is displayed in a see-through manner, as shown in FIG. 26.

[0276] After step S32 or if it is found in step S30 that the still-image photographing operation by using the release switch 73 is not performed, the process returns to step S4, and the above-described operation is repeated.

[0277] If the position of the virtual image is changed as described with reference to FIGS. 31 and 32, the flowcharts of FIGS. 45 and 46 are changed as follows.

[0278] That is, in this case, before displaying a photographic frame, three steps (1) through (3) are executed, which are not contained in the flowcharts of FIGS. 45 and 46:

[0279] (1) measure (distance measurement) the distance Li to the subject;

[0280] (2) determine L1 and X1 by substituting the subject distance Li calculated in step (1) into equation (11) and equation (12), and drive the actuator 162 so that the photographic frame is set at the determined position L1; and

[0281] (3) drive the LCD 104 by the LCD driver 105 to satisfy the diagonal line X1 calculated in step (2) and adjust the size of the photographic frame.

[0282] More specifically, steps (1) through (3) are executed before steps S1 and S14 of the flowchart in FIG. 45. For step S14, however, distance measurement is executed in step S12 before S14, and thus, the value calculated in step S12 can be used instead of executing distance measurement in step (1).

[0283] If the position of the virtual image is changed by the configuration shown in FIG. 33, processing similar to the above-described processing can be performed.

[0284] According to the first embodiment, even if the focal distance (zoom magnification) of the first photographing optical system is changed, the photographer can easily check the photographic range while substantially directly observing the subject to be photographed. Thus, the photographer can behave as naturally as other people without feeling bothered by the photographing operation.

[0285] The photographer can set the focal distance of the photographic lens after checking a photographic range and a pattern to be set while substantially directly observing the entire subject. This allows the photographer to set a pattern more easily compared to the related art in which the pattern should be checked while changing the focal distance. It is thus possible to provide an ergonomically new head-mounted camera which implements a photographing operation with a new concept, which is different from a known photographing operation in which a zoom operation and the field angle setting are performed at the same time.

[0286] Since the head-mounted unit, the remote controller, and the controller/recorder are separately provided, the head-mounted unit and the remote controller, which serve as a photographing operation unit, become lighter. This makes the photographer comfortable even over a long use of the camera. By using a HOE as display means, the head-mounted unit can further be lighter and smaller.

[0287] When the visual angle of the photographic frame is to be further increased even though it has reached the upper limit of the field angle of the first image pickup device and when the visual angle of the photographic frame is to be further decreased even though it has reached the lower limit of the field angle of the first image pickup device, alarm information is indicated. This allows the photographer to easily check the adjustable field angle, and the photographer does not have to repeat unnecessary operations by wrongly recognizing such situation as failures. Since the alarm information is indicated by the see-through image display portion, the provision of separate alarm means is not necessary, thereby reducing the cost and the size of the head-mounted unit.

[0288] The parallax caused by a deviation between the range within the photographic frame observed by the photographer and the photographic range picked up by the first image pickup device is corrected based on the distance to the subject measured by distance-measurement means. Thus, even if the subject distance is changed, in particular, even when close-up photographing is performed, the photographic range can be precisely identified.

[0289] Additionally, the frame mode in which the photographic frame is displayed as a virtual image or the view mode in which the photographed image is displayed as a virtual image can be switched. Accordingly, even if the photographic range becomes smaller during a telephotographing operation, details of a subject can be easily checked. In particular, in the auto mode, in a telephotographing operation having a focal distance exceeding a predetermined value, the photographed image is automatically displayed, and thus, the photographer can check details of the subject without a troublesome operation.

[0290] When the head-mounted unit is not in use, the temples can be folded along the front portion, and thus, the head-mounted unit can be stored easily.

[0291] In the configuration in which the first image pickup device can be folded together with the temples, the head-mounted unit can be more easily stored. When the temples are not opened at a predetermined angle, alarm information is given. This prevents the photographer from performing a photographing operation without realizing that the optical axis and the visual axis do not coincide with each other. In other words, the photographing operation can be performed such that the optical axis and the visual axis are exactly the same. Since the alarm information is given by the see-through image display portion, the provision of separate alarm means is not necessary, thereby reducing the cost and the size of the head-mounted unit.

[0292] In the configuration in which both the first image pickup device and the see-through image display portion are provided in the front portion, the optical axis of the first image pickup device is not changed by opening or closing the temples. Accordingly, once the optical axis and the visual axis are adjusted, a deviation therebetween is not generated.

[0293] When the first image pickup device is attached to the front portion via the base, the optical axis can be adjusted finely by using the base.

[0294] An image signal is digitized before being output from the first image pickup device, and thus, when the image signal is transmitted to the controller/recorder, which is separately disposed from the first image pickup device, the influence of external noise can be reduced.

[0295] Since an image signal output from the first image pickup device is raw image data, the provision of a digital signal processing circuit for the first image pickup device is not necessary, thereby making the head-mounted unit lighter and smaller.

[0296] An adjusting mechanism for finely adjusting the optical axis to coincide with the visual axis is provided. With this adjusting mechanism, individual units can be adjusted when they are manufactured, or the units can be adjusted by the individual users. Thus, the head-mounted unit can deal with wide usage modes. By providing this adjusting mechanism on the base, an inexpensive adjusting mechanism with very little deviation can be formed.

[0297] Adjustment can be performed independently in the pitch direction and in the yaw direction, thereby making it possible to adjust a positional deviation between the optical axis and the visual axis.

[0298] By changing the distance from the photographer's pupil to a virtual image, the virtual image can be superimposed on a subject, thereby allowing the photographer to clearly observe both the virtual image and the subject. In this case, even when the position of the virtual image is changed, the visual angle concerning the virtual image is adjusted to be constant. Thus, the photographic range and the photographic frame always coincide with each other.

[0299] Distance measurement is performed to measure the distance to a subject, and based on this distance, the position of the virtual image is automatically adjusted by using an actuator. Thus, the subject and the virtual image can be clearly observed at the same time without the need to perform an extra operation.

[0300] The central position of a virtual image to be projected can be adjusted in the pupil-distance direction. Thus, according to the different position of the pupil of each photographer, required information can be given to the photographer. To implement the adjustment in the pupil-distance direction, a reflective member for reflecting light to be output in the pupil-distance direction is moved in the pupil-distance direction. Accordingly, the adjustment can be conducted without changing the external appearance of the head-mounted unit. This adjustment can be automated by using an actuator, or fine-adjustment can be performed by counting pulses. If the adjustment is performed manually, the configuration is simplified and the cost can be reduced without causing a troublesome operation.

Second Embodiment

[0301] A second embodiment of the present invention is described below with reference to **FIGS. 47 through 50**. **FIGS. 47, 48**, and **49** are a front view, a plan view, and a right side view, respectively, illustrating a head-mounted unit **2**A. **FIG. 50** is a block diagram illustrating the configuration of an electronic circuit of the camera, mainly the elements different from those shown in **FIG. 12**.

[0302] In the second embodiment, elements similar to those described in the first embodiment are designated with the same reference numerals, and a detailed explanation is thus omitted.

[0303] In a head-mounted camera, the image pickup device is disposed on each of the left and right temples **12** so that a three-dimensional image observed with the two eyes can be picked up and recorded. In the first embodiment, the first image pickup device **30** is disposed on the left-eye temple **12**. In the second embodiment, however, in addition to the first image pickup device **30**, a second image pickup device **30**R, which is configured similar to the first image pickup device **30**, is disposed on the right-eye temple **12**.

[0304] In the head-mounted unit **2**A in the second embodiment, as shown in **FIGS. 47 through 49**, the second image pickup device **30**R provided with a second photographing optical system **31**R is disposed on the right-eye temple **12**, and the temple **12** is foldable with respect to the front portion **11** by a hinge **24**R, which is configured similarly to the hinge **24** at the left eye, except that the hinge **24**R is horizontally symmetrical with the hinge **24**. On the head-mounted unit **2**A, an adjusting mechanism (adjusting means) for adjusting the angle in the pitch direction and in the yaw direction between the second image pickup device **30**R and the see-through image display portion **6** is disposed. Screws **22**R and **23**R and a bis **32**R contained in the angle adjusting mechanism are exposed, as shown in **FIG. 47**, so that they are adjustable.

[0305] In the camera using the head-mounted unit **2**A, the subject distance is measured by triangular distance measurement performed using the left and right image pickup devices **30** and **30**R, and thus, the projector light-emitting portion **16** disposed in the first embodiment is not provided.

[0306] The circuit within the second image pickup device **30**R is connected to the circuit within the first image pickup device **30** via the frame **13**, and the cable connecting terminal **21** to be connected to the head-mounted unit **2**A is provided only for the first image pickup device **30**. Accordingly, control signals transmitted from the controller/recorder **4** to the second image pickup device **30**R and image signals transmitted from the second image pickup device **30**R to the controller/recorder **4** are transmitted via the cable **3**.

[0307] The configuration of the camera including the second image pickup device **30**R is shown in **FIG. 50**.

[0308] The second image pickup device **30**R includes the following elements. A second photographing optical system **31**R forms an optical subject image. A low-pass filter **86**R removes unnecessary high-frequency components from light passing through the second photographing optical system **31**R. A CCD **87**R converts the optical subject image formed by the second photographing optical system **31**R via the

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low-pass filter **86**R into an electric signal and outputs it. A CDS/AGC circuit **88**R, which serves as signal processing means for performing processing, such as removing noise and amplification, on the signal output from the CCD **87**R. An A/D conversion circuit **89**R, which serves as signal processing means, converts the analog image signal output from the CDS/AGC circuit **88**R into a digital image signal. A CCD driver **91**R controls the driving of the CCD **87**R. A timing generator **90**R supplies timing control signals to the CDS/AGC circuit **88**R, the A/D conversion circuit **89**R, and the CCD driver **91**R. A diaphragm shutter driver **96**R, which serves as a drive circuit, controls the driving of a diaphragm shutter **84**R, which is described below, contained in the second photographing optical system **31**R. A USM driver **95**R, which serves as a drive circuit, selectively drives USMs (Ultra Sonic Motor) **92**R, **93**R, and **94**R, which are described below, contained in the second photographing optical system **31**R.

[**0309**] More specifically, the second photographing optical system **31**R includes a front lens **81**R, a variator lens **82**R for changing the focal distance, a compensator lens **83**R for correcting a deviation of the focus position in accordance with a change in the focal distance, a diaphragm shutter **84**R serving as both a diaphragm function and a shutter function, a focus lens **85**R for adjusting the focus, and the USMs **92**R, **93**R, and **94**R for driving the variator lens **82**R, the compensator lens **83**R, and the focus lens **85**R, respectively.

[**0310**] The timing generator **90**R, the USM driver **95**R, and the diaphragm shutter driver **96**R are controlled by the second CPU **112** of the controller/recorder **4**.

[**0311**] The digital image data output from the A/D conversion circuit **89**R of the second image pickup device **30**R is input into the DSP circuit **115** of the controller/recorder **4** and is also input into the AF processing circuit **122** of the controller/recorder **4**.

[**0312**] That is, the digital image data from the first image pickup device **30** and the digital image data from the second image pickup device **30**R are input into the AF processing circuit **122**. The AF processing circuit **122** calculates the distance to the subject based on the two image data having a parallax by using, for example, the known triangular distance measurement principle.

[**0313**] Accordingly, in a see-through image display portion **6**A of this camera, the LED driver **108**, the projector LED **16***a*, and the condenser lens **16***b* provided for the see-through image display portion **6** are not disposed.

[**0314**] The other features of the configuration, the operation, and the adjusting method are similar to those of the first embodiment, and an explanation thereof is thus omitted.

[**0315**] According to the second embodiment, advantages similar to those obtained by the first embodiment can be achieved. Additionally, the same subject can be picked up by the first image pickup device **30** and the second image pickup device **30**R so that three-dimensional image can be recorded.

Third Embodiment

[**0316**] A third embodiment of the present invention is described below in detail with reference to **FIGS. 51 through 53**. **FIGS. 51 through 53** are a front view, a plan view, and a right side view, respectively, illustrating a head-mounted unit **2**B. In the third embodiment, elements similar to those of the first and second embodiments are designated with the same reference numerals, and an explanation thereof is thus omitted.

[**0317**] In the head-mounted unit **2**B of the camera of the third embodiment, the first image pickup device **30** is divided into a camera portion **30**A and a camera circuit **30**B, and the camera portion **30**A is disposed at, for example, the central portion between the left and right eyes of the frame **13**.

[**0318**] That is, in the upper central portion of the frame **13**, elements required for generating an electronic image from an optical image, such as the first photographing optical system **31**, the low-pass filter **86**, and the CCD **87**, are mounted.

[**0319**] In the left-eye temple **12**, the camera circuit **30**B, including elements, such as the CDS/AGC circuit **88**, the A/D conversion circuit **89**, the timing generator **90**, the CCD driver **91**, the USM driver **95**, and the diaphragm shutter driver **96**, for controlling the camera portion **30**A or processing image signals output from the camera portion **30**A are disposed.

[**0320**] In accordance with the provision of the camera portion **30**A at the central portion of the frame **13**, the projector light-emitting portion **16** used for measuring the subject distance by using the triangular distance measurement is provided in the camera circuit **30**B at the side of the subject.

[**0321**] The other features of the configuration and the operation are similar to those of the first embodiment.

[**0322**] According to the third embodiment, advantages similar to those obtained by the first embodiment are achieved. Additionally, since the camera portion **30**A including the photographing optical system is disposed at the central portion between the left and right eyes of the frame **13**, the horizontal parallax between the observation range and the image pickup range can be significantly reduced. The see-through image display portion **6** and the camera portion **30**A of the first image pickup device **30** can be integrally provided in the front portion **11**. Thus, once the difference between the visual angle and the optical angle of the first photographing optical system **31** is adjusted, it is not generated.

Fourth Embodiment

[**0323**] A fourth embodiment of the present invention is described in detail below with reference to **FIGS. 54 through 56**. **FIGS. 54, 55**, and **56** are a front view, a plan view, and a right side view, respectively, illustrating a head-mounted unit. In the fourth embodiment, elements similar to those of the first, second, and third embodiments are designated with the same reference numerals, and an explanation thereof is thus omitted.

[**0324**] In the head-mounted unit **2**C of the fourth embodiment, eyesight-correcting lenses are attached to the frame **13**, which serves as support means. Also, a first image pickup device **30**C, which serves as image pickup means, corresponding to the first image pickup device **30**, is fixed on the frame **13** via the base **220**, such as that shown in **FIGS.**

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43A and 43B, so that it is adjustable. That is, the head-mounted camera **2**C is a head-mounted camera with eyesight-correcting lens. In other words, the head-mounted camera **2**C is a display device with eyesight-correcting lens in terms of an image display function.

[**0325**] Since the eyesight varies depending on the individuals, it is important to provide an eyesight-correcting function. Accordingly, it is possible that an eyesight-correcting function is provided on the transparent optical members **14** and **15** for guiding light to the second HOE **107**. In this configuration, however, since the transparent optical members **14** and **15** bend, the aberration is generated in images that can be observed by the second HOE **107**. As stated above, since the eyesight varies depending on the individuals, it is impossible to correct all the aberration levels caused by the adjustment of the eyesight.

[**0326**] Then, in the fourth embodiment, as shown in **FIG. 54**, second HOEs **243** and **244** corresponding to the second HOE **107** and transparent optical members **241** and **242** corresponding to the transparent optical members **14** and **15** are formed to a minimal size. Additionally, an eyesight-correcting lens **238** is attached to the second HOE **243** and the transparent optical member **241** at the side of the subject, and an eyesight-correcting lens **239** is attached to the second HOE **244** and the transparent optical member **242** at the side of the subject. As the eyesight-correcting lenses **238** and **239**, regular spectacle lenses may be used, and less expensive lenses may be formed.

[**0327**] A rim **231**, which is fixing means for fixing the lenses **238** and **239**, is attached to the frame **13** with a bis **234** at the central portion, a bis **235** at the left-eye side, and a bis **236** at the right-eye side.

[**0328**] A pair of nose pads **232** for supporting the ridge of the nose is provided for the rim **231** via a pair of cringles **233**.

[**0329**] With this configuration, the bises **234**, **235**, and **236** can be unscrewed to easily remove the rim **231** and the lenses **238** and **239**. The lenses **238** and **239** can be replaced by a new pair having different eyesight, and the new pair can be fixed.

[**0330**] The first image pickup device **30**C of the fourth embodiment is attached to the joint portion **229** on the side surface of the frame **13** via the base **220** similar to that shown in **FIGS. 43A and 43B** (and **FIG. 44**). In this case, the relative position in the pitch direction and in the yaw direction between the first image pickup device **30**C and the see-through image display portion **6** can be adjusted.

[**0331**] As in the first image pickup device **30** shown in **FIG. 43A**, the cable **230** is extended at the rear surface of the first image pickup device **30**C, and is embedded in the left-eye temple **12** and is further connected to the circuit substrate in the frame **13**.

[**0332**] Although in this embodiment the eyesight-correcting lenses **238** and **239** are disposed on the transparent optical members **241** and **242** at the side of the subject, they may be disposed on the rear surface (at the side of the eyes) of the transparent optical members **241** and **242**.

[**0333**] If the rim **231** is formed of a material having a predetermined level of elasticity, only the left-eye lens **238** can be selectively (independently) detached by unscrewing or loosening the bis **235**. Similarly, the right-eye lens **239** can be selectively (independently) detached by unscrewing or loosening the bis **236**.

[**0334**] According to the fourth embodiment, advantages similar to those obtained by the first through third embodiments can be achieved. Additionally, since the eyesight-correcting lenses are disposed on the front surfaces of the transparent optical members, photographers having different eyesight levels can observe a predetermined image superimposed on a subject which is substantially directly observed (in this case, observed via the eyesight-correcting lenses).

[**0335**] A natural spectacle-type camera having aesthetically pleasant-looking appearance can be formed with a simple configuration.

[**0336**] Since the eyesight-correcting lenses can be easily removed separately from the transparent optical members, the eyesight correction can be easily performed depending on the user. Even if the eyesight of the left eye is different from the eyesight of the right eye, lenses having different eyesight can be fixed.

[**0337**] Additionally, the transparent optical members and the first image pickup device are integrally held by the frame. Accordingly, even if eyesight-correcting lenses are replaced by a new pair, the angle adjustment between the transparent optical member and the first image pickup device is not required. It is thus possible to provide an easy-to-use head-mounted camera with eyesight-correcting lenses.

[**0338**] In the foregoing embodiments, the technical concept of the present invention is applied to head-mounted cameras (image pickup devices). However, the technical concept of the present invention can be applied to head-mounted display devices displaying multi-purpose information.

[**0339**] Although in the foregoing embodiments HOEs are used as optical elements, convex lenses, concave lenses, half mirrors, and free-form optical elements formed of glass or plastics, or a combination thereof may be used.

[**0340**] As the projection means, the LED **102**, the condenser lens **103**, and the LCD **104** are used. However, other display devices, such as an electro-luminescence (EL) panel or a self-luminous plasma display, may be used.

[**0341**] When the visual angle of the photographic frame is changed, the focal distance of the photographing optical system is changed. However, instead of the optical zoom, an electronic zoom may be used, or a combination of the optical zoom and the electronic zoom may be used.

[**0342**] In the foregoing embodiment, as display examples, the photographic frames and the photographed images are used. Instead, the present invention may be used in an information display device (monitor) for, for example, a personal computer, and characters can be displayed on the monitor. In this case, the PC connecting terminal **51** is connected to a PC, and information or images from the PC can be displayed. In the above-described embodiments, the AV/S connecting terminal **50** for outputting signals to television sets is provided. Alternatively, an input terminal for inputting video signals from a video player or a DVD player may be disposed so that video images can be viewed. As

described above, the head-mounted camera can serve as a head-mounted display device in terms of the image display function. This head-mounted display device is used, not only as a finder in an image pickup device, but also as a device for viewing video images or as a portable multi-purpose information display device.

[0343] [Appended Portions]

[0344] According to the foregoing embodiments of the present invention, the following configurations can be implemented.

[0345] [Appended Portion A1]

[0346] A head-mounted camera comprising:

[0347] image pickup means including a photographing optical system in which a focal distance is changeable and an image pickup element for converting an optical subject image formed by the photographing optical system into an electric image signal;

[0348] display means for displaying a photographic frame indicating a photographic range as a virtual image so that the photographic frame is superimposed on a subject substantially directly observed by a photographer;

[0349] photographic-frame setting means for setting a visual angle of the photographic frame displayed by the display means as the virtual image and observed from the photographer; and

[0350] focal-distance setting means for setting the focal distance of the photographing optical system so that the visual angle of the photographic frame set by the photographic-frame setting means coincides with a field angle of the image pickup means.

[0351] [Appended Portion A2]

[0352] The head-mounted camera according to appended portion A1, further comprising:

[0353] alarm means for giving an alarm at least one of occasions when the visual angle of the photographic frame set by the photographic-frame setting means is to be further increased even though the field angle of the image pickup means has reached a maximum value and when the visual angle of the photographic frame is to be further decreased even though the field angle of the image pickup means has reached a minimum value.

[0354] [Appended Portion A3]

[0355] The head-mounted camera according to appended portion A2, wherein the alarm means gives an alarm by displaying information concerning the alarm on the display means.

[0356] [Appended Portion A4]

[0357] The head-mounted camera according to appended portion A1, wherein the display means comprises a holographic optical element disposed on a visual axis when the photographer observes a subject, and projection means for projecting the photographic frame on the holographic optical element.

[0358] [Appended Portion A5]

[0359] The head-mounted camera according to appended portion A1, further comprising:

[0360] distance-measurement means for finding a distance to the subject,

[0361] wherein the display means comprises correction means for correcting a parallax, which is a deviation between the range within the photographic frame observed by the photographer and a photographing range observed by the image pickup means, based on the distance to the subject found by the distance-measurement means.

[0362] [Appended Portion A6]

[0363] The head-mounted camera according to appended portion A1, further comprising:

[0364] switching means for switching between the photographic frame and a photographed image corresponding to the electric image signal obtained by the image pickup means so that the selected photographic frame or the photographed image is displayed by the display means as a virtual image.

[0365] [Appended Portion A7]

[0366] The head-mounted camera according to appended portion A6, wherein the switching means automatically controls the photographed image to be displayed as a virtual image when the focal distance of the photographing optical system is greater than or equal to a predetermined value.

[0367] [Appended Portion A8]

[0368] The head-mounted camera according to appended portion A1, further comprising:

[0369] a head-mounted unit to be mounted on the head of the photographer, including a front portion positioned at the front side of the head and temples positioned at the lateral sides of the head,

[0370] wherein the display means is disposed on the front portion.

[0371] [Appended Portion A9]

[0372] The head-mounted camera according to appended portion A8, wherein the temples are foldable with respect to the front portion, and the temples are folded along the front portion when the head-mounted unit is not in use.

[0373] [Appended Portion A10]

[0374] The head-mounted camera according to appended portion A8, wherein the image pickup means is disposed on the front portion.

[0375] [Appended Portion A11]

[0376] The head-mounted camera according to appended portion A10, wherein the image pickup means is disposed on the front portion at a position corresponding to a portion between the left and right eyes of the photographer.

[0377] [Appended Portion A12]

[0378] The head-mounted camera according to appended portion A8, wherein the image pickup means is disposed on at least one of the temples.

[0379] [Appended Portion A13]

[0380] The head-mounted camera according to appended portion A12, wherein the temples are foldable with respect to the front portion, and the temples are folded along the front portion when the head-mounted unit is not in use.

[0381] [Appended Portion A14]

[0382] The head-mounted camera according to appended portion A13, further comprising:

[0383] alarm means for giving an alarm when the temples are not located at a predetermined foldable position when the head-mounted unit is in use.

[0384] [Appended Portion A15]

[0385] The head-mounted camera according to appended portion A14, wherein the alarm means gives an alarm by displaying information concerning the alarm on the display means.

[0386] [Appended Portion A16]

[0387] The head-mounted camera according to appended portion A8, wherein the head-mounted unit comprises the image pickup means, the head-mounted camera further comprising:

[0388] a remote controller, separately disposed from the head-mounted unit, for communicating with the head-mounted unit to control an operation of the head-mounted unit; and

[0389] a main body, separately disposed from the head-mounted unit, for communicating with the head-mounted unit to receive an image picked up by the image pickup means, the main body including recording means for recording the received image.

[0390] [Appended Portion B1]

[0391] A head-mounted camera comprising:

[0392] a head-mounted unit being mounted on a head, including image pickup means for performing image capturing to generate an analog image signal, and display means for displaying information; and

[0393] a controller/recorder for controlling the display means and the image pickup means and also for recording the image signal generated by the image pickup means; and

[0394] connecting means for electrically connecting the head-mounted unit and the controller/recorder,

[0395] wherein the head-mounted unit comprises signal processing means for processing the analog image signal generated by the image pickup means and also for converting the analog image signal into a digital image signal, and

[0396] the digital image signal output from the signal processing means is transmitted to the controller/recorder via the connecting means.

[0397] [Appended Portion B2]

[0398] The head-mounted camera according to appended portion B1, wherein the digital image signal output from the signal processing means and transmitted to the controller/recorder via the connecting means is raw image data which is not subjected to other signal processing after being converted from the analog image signal to the digital image signal by the signal processing means.

[0399] [Appended Portion B3]

[0400] The head-mounted camera according to appended portion B1, wherein the display means displays a photographic frame indicating a photographic range so that the photographic frame is superimposed on a subject substantially directly observed by a photographer, and

[0401] the image pickup means includes a photographing optical system in which a focal distance is changeable and an image pickup element for converting a subject image formed by the photographing optical system into the analog image signal, the image pickup means performing photographing after automatically setting the focal distance of the photographing optical system so that a field angle of the image pickup means coincides with a visual angle of the photographic frame displayed by the display means and viewed from the photographer.

[0402] [Appended Portion C1]

[0403] An adjusting device for a head-mounted camera, comprising:

[0404] image pickup means for picking up an image of a subject;

[0405] display means being integrally formed with the image pickup means, for displaying a photographic frame indicating a photographic range so that the photographic frame is superimposed on a subject substantially directly observed by a photographer; and

[0406] adjusting means for adjusting a relative angle between the image pickup means and the display means so that an optical axis of the image pickup means and a visual axis passing through the center of the photographic frame displayed by the display means are parallel with each other.

[0407] [Appended Portion C2]

[0408] The adjusting device for the head-mounted camera according to appended portion C1, wherein the adjusting means comprises yaw-direction adjusting means for adjusting a relative deviation in the yaw direction between the optical axis of the image pickup means and the visual axis passing through the center of the photographic frame displayed by the display means, and pitch-direction adjusting means for adjusting a relative deviation in the pitch direction between the optical axis of the image pickup means and the visual axis passing through the center of the photographic frame displayed by the display means.

[0409] [Appended Portion C3]

[0410] The adjusting device for the head-mounted camera according to appended portion C2, further comprising:

[0411] a head-mounted unit being mounted on the head of the photographer, including a front portion positioned at the front side of the head to which the display means and the image pickup means are attached, and temples positioned at the lateral sides of the head; and

[0412] a base for mounting the image pickup means on the front portion so that the direction of the image pickup means with respect to the front portion is adjustable, the base serving as at least one of the yaw-direction adjusting means and the pitch-direction adjusting means by adjusting a relative mounting angle between the base and the front portion and serving as the other one of the yaw-direction adjusting means and the pitch-direction adjusting means by adjusting a relative mounting angle between the base and the image pickup means.

[0413] [Appended Portion C4]

[0414] The adjusting device for the head-mounted camera according to appended portion C2, further comprising:

[0415] a head-mounted unit being mounted on the head of the photographer, including a front portion positioned at the front side of the head, to which the display means is attached, temples positioned at the lateral sides of the head, to which the image pickup means is attached, and a hinge unit for allowing the temples to be foldable with respect to the front portion and the temples to be folded along the front portion when the head-mounted unit is not in use,

[0416] wherein the yaw-direction adjusting means adjusts a relative deviation in the yaw direction by restricting an opening angle of the temples with respect to the front portion when the head-mounted unit is in use, and the pitch-direction adjusting means adjusts a relative deviation in the pitch direction by adjusting a mounting angle of the hinge unit with respect to the front portion.

[0417] [Appended Portion C5]

[0418] An adjusting method for a head-mounted camera which comprises: image pickup means for picking up an image of a subject; display means for displaying a photographic frame indicating a photographic range so that the photographic frame is superimposed on a subject substantially directly observed by a photographer, wherein the adjusting method adjusts a relative angle between the image pickup means and the display means so that an optical axis of the image pickup means and a visual axis passing through the center of the photographic frame displayed by the display means are parallel with each other.

[0419] [Appended Portion C6]

[0420] The adjusting method for the head-mounted camera according to appended portion C5, wherein, in the adjusting step, a relative deviation in the yaw direction between the image pickup means and the display means and a relative deviation in the pitch direction between the image pickup means and the display means are adjusted.

[0421] [Appended Portion D1]

[0422] A head-mounted camera with eyesight-correcting lenses, comprising:

[0423] image pickup means for performing image capturing of a subject; and

[0424] display means for displaying a predetermined image of the subject subjected to the image capturing performed by the image pickup means,

[0425] the display means comprising:

[0426] optical elements disposed in front of the eyes of a photographer, for displaying the predetermined image so that the predetermined image is superimposed on the subject substantially directly observed by the photographer; and

[0427] projection means for projecting the predetermined image on the optical elements,

[0428] the head-mounted camera further comprising:

[0429] support means for integrally supporting the image pickup means and the display means;

[0430] the eyesight-correcting lenses separately formed from the optical elements; and

[0431] attaching means for detachably attaching the eyesight-correcting lenses to the support means so that the eyesight-correcting lenses are disposed on a line of sight of the photographer observing via the optical elements.

[0432] [Appended Portion D2]

[0433] The head-mounted camera according to appended portion D1, wherein the eyesight-correcting lenses comprises a right-eye lens and a left-eye lens, which are separately formed, and the attaching means detachably attaches the right-eye lens and the left-eye lens independently.

[0434] [Appended Portion D3]

[0435] The head-mounted camera according to appended portion D1, wherein the eyesight-correcting lenses are eyesight-correcting lenses for a pair of spectacles.

[0436] [Appended Portion D4]

[0437] The head-mounted camera according to appended portion D1, wherein the predetermined image projected on the optical elements is a photographic frame indicating a photographic range of the image pickup means.

[0438] [Appended Portion E1]

[0439] A display device comprising:

[0440] an optical element for displaying an image containing predetermined information as a virtual image so that the image is superimposed on a subject substantially directly observed by an observer;

[0441] projection means for projecting the image displayed by the optical element on the optical element;

[0442] virtual-image distance adjusting means for adjusting a distance from the optical element to the virtual image displayed by the optical element; and

[0443] visual-angle adjusting means for maintaining the visual angle concerning the virtual image to be constant regardless of the distance from the optical element to the virtual image.

[0444] [Appended Portion E2]

[0445] The display device according to appended portion E1, wherein the virtual-image distance adjusting means adjusts the distance from the optical element to the virtual

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image so that the distance becomes substantially equal to a distance from the optical element to the subject.

[0446] [Appended Portion E3]

[0447] The display device according to appended portion E2, further comprising:

[0448] distance-measurement means for finding the distance from the optical element to the subject,

[0449] wherein the virtual-image distance adjusting means adjusts the distance from the optical element to the virtual image by using the distance from the optical element to the subject found by the distance-measurement means.

[0450] [Appended Portion E4]

[0451] The display device according to appended portion E1, wherein the projection means comprises a display element for generating the image containing the predetermined information, and

[0452] the virtual-image distance adjusting means adjusts the distance from the optical element to the virtual image by adjusting the distance between the optical element and the display element.

[0453] [Appended Portion E5]

[0454] The display device according to appended portion E1, wherein the projection means comprises a display element for generating the image containing the predetermined information, and an image-forming optical system for forming the image generated by the display element on an optical path between the display element and the optical element, and

[0455] the virtual-image distance adjusting means adjusts the distance from the optical element to the virtual image by adjusting a position at which the image is formed by the image-forming optical system.

[0456] [Appended Portion E6a]

[0457] The display device according to appended portion E4, wherein the visual-angle adjusting means adjusts the visual angle concerning the virtual image to be constant by adjusting the size of the image generated on the display element.

[0458] [Appended Portion E6b]

[0459] The display device according to appended portion E5, wherein the visual-angle adjusting means adjusts the visual angle concerning the virtual image to be constant by adjusting the size of the image generated on the display element.

[0460] [Appended Portion E7]

[0461] An image pickup device comprising:

[0462] display means for displaying a photographic frame indicating a photographic range as a virtual image so that the photographic frame is superimposed on a subject substantially directly observed by a photographer;

[0463] distance-measurement means for finding a distance to the subject;

[0464] virtual-image distance adjusting means for adjusting a distance from the display means to the virtual image displayed by the display means so that the distance becomes substantially equal to the distance to the subject found by the distance-measurement means;

[0465] a photographing optical system for forming an optical image of the subject;

[0466] an image pickup element for picking up the optical image of the subject formed by the photographing optical system within the photographic range corresponding to the photographic frame so as to generate image data; and

[0467] recording means for recording the image data generated by the image pickup element.

[0468] [Appended Portion E8]

[0469] The image pickup device according to appended portion E7, further comprising:

[0470] visual-angle adjusting means for adjusting the visual angle concerning the virtual image so that the visual angle becomes constant regardless of the distance from the display means to the virtual image.

[0471] [Appended Portion E9]

[0472] The image pickup device according to appended portion E7, wherein the display means is used by being mounted on the head of the photographer.

[0473] [Appended Portion F1]

[0474] A head-mounted display device comprising:

[0475] an optical element for displaying an image as a virtual image so that the image is superimposed on a subject substantially directly observed by an observer;

[0476] projection means for projecting the image displayed by the optical element on the optical element; and

[0477] pupil-distance adjusting means for adjusting, in a pupil-distance direction of the observer, a relative position of the image projected on the optical element by the projection means with respect to a pupil of the observer.

[0478] [Appended Portion F2]

[0479] A head-mounted camera comprising:

[0480] an optical element for displaying a photographic frame indicating a photographic range as a virtual image so that the photographic frame is superimposed on a subject substantially directly observed by a photographer;

[0481] projection means for projecting the photographic frame displayed by the optical element on the optical element;

[0482] pupil-distance adjusting means for adjusting, in a pupil-distance direction of the photographer, a relative position of the photographic frame projected on the optical element by the projection means with respect to a pupil of the photographer; and

[0483] image pickup means for picking up an image of the subject within the photographic range indicated by the photographic frame.

[0484] [Appended Portion F3]

[0485] The head-mounted camera according to appended portion F2, wherein the projection means comprises horizontal projection means for projecting light concerning the photographic frame in the pupil-distance direction, and a reflective optical member for reflecting the light projected by the horizontal projection means in a vertical direction orthogonal to the pupil-distance direction so as to project the light on the optical element, and

[0486] the pupil-distance adjusting means moves the reflective optical member in the pupil-distance direction so as to adjust, in the pupil-distance direction of the photographer, a relative position of the photographic frame projected on the optical element by the projection means with respect to the pupil of the photographer.

[0487] [Appended Portion F4]

[0488] The head-mounted camera according to appended portion F3, wherein the pupil-distance adjusting means comprises an actuator for moving the reflective optical member in the pupil-distance direction.

[0489] [Appended Portion F5]

[0490] The head-mounted camera according to appended portion F3, wherein the pupil-distance adjusting means further comprises a support member for supporting the reflective optical member so that the reflective optical member is movable in the pupil-distance direction, and the reflective optical member is moved in the pupil-distance direction by manually moving the support member.

[0491] Having described the preferred embodiments of the invention referring to the accompanying drawings, it should be understood that the present invention is not limited to those precise embodiments and various changes and modifications thereof could be made by one skilled in the art without departing from the spirit or scope of the invention as defined in the appended claims.

What is claimed is:

1. A head-mounted camera comprising:

image pickup means including a photographing optical system in which a focal distance is changeable and an image pickup element for converting an optical subject image formed by the photographing optical system into an electric image signal;

display means for displaying a photographic frame indicating a photographic range as a virtual image so that the photographic frame is superimposed on a subject substantially directly observed by a photographer;

photographic-frame setting means for setting a visual angle of the photographic frame displayed by the display means as the virtual image and observed from the photographer; and

focal-distance setting means for setting the focal distance of the photographing optical system so that the visual angle of the photographic frame set by the photographic-frame setting means coincides with a field angle of the image pickup means.

2. The head-mounted camera according to claim 1, further comprising:

alarm means for giving an alarm at least one of occasions when the visual angle of the photographic frame set by the photographic-frame setting means is to be further increased even though the field angle of the image pickup means has reached a maximum value and when the visual angle of the photographic frame is to be further decreased even though the field angle of the image pickup means has reached a minimum value.

3. The head-mounted camera according to claim 2, wherein the alarm means gives an alarm by displaying information concerning the alarm on the display means.

4. The head-mounted camera according to claim 1, wherein the display means comprises a holographic optical element disposed on a visual axis when the photographer observes a subject, and projection means for projecting the photographic frame on the holographic optical element.

5. The head-mounted camera according to claim 1, further comprising:

distance-measurement means for finding a distance to the subject,

wherein the display means comprises correction means for correcting a parallax, which is a deviation between the range within the photographic frame observed by the photographer and a photographing range observed by the image pickup means, based on the distance to the subject found by the distance-measurement means.

6. The head-mounted camera according to claim 1, further comprising:

switching means for switching between the photographic frame and a photographed image corresponding to the image signal obtained by the image pickup means so that the selected photographic frame or the photographed image is displayed by the display means as a virtual image.

7. The head-mounted camera according to claim 6, wherein the switching means automatically controls the photographed image to be displayed as a virtual image when the focal distance of the photographing optical system is greater than or equal to a predetermined value.

8. The head-mounted camera according to claim 1, further comprising:

a head-mounted unit to be mounted on the head of the photographer, including a front portion positioned at the front side of the head and temples positioned at the lateral sides of the head,

wherein the display means is disposed on the front portion.

9. The head-mounted camera according to claim 8, wherein the temples are foldable with respect to the front portion, and the temples are folded along the front portion when the head-mounted unit is not in use.

10. The head-mounted camera according to claim 8, wherein the image pickup means is disposed on the front portion.

11. The head-mounted camera according to claim 10, wherein the image pickup means is disposed on the front portion at a position corresponding to a portion between the left and right eyes of the photographer.

12. The head-mounted camera according to claim 8, wherein the image pickup means is disposed on at least one of the temples.

13. The head-mounted camera according to claim 12, wherein the temples are foldable with respect to the front portion, and the temples are folded along the front portion when the head-mounted unit is not in use.

14. The head-mounted camera according to claim 13, further comprising:

alarm means for giving an alarm when the temples are not located at a predetermined foldable position when the head-mounted unit is in use.

15. The head-mounted camera according to claim 14, wherein the alarm means gives an alarm by displaying information concerning the alarm on the display means.

16. The head-mounted camera according to claim 8, wherein the head-mounted unit comprises the image pickup means, the head-mounted camera further comprising:

a remote controller, separately disposed from the head-mounted unit, for communicating with the head-mounted unit to control an operation of the head-mounted unit; and

a main body, separately disposed from the head-mounted unit, for communicating with the head-mounted unit to receive an image picked up by the image pickup means, the main body including recording means for recording the received image.

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Appendix FFF

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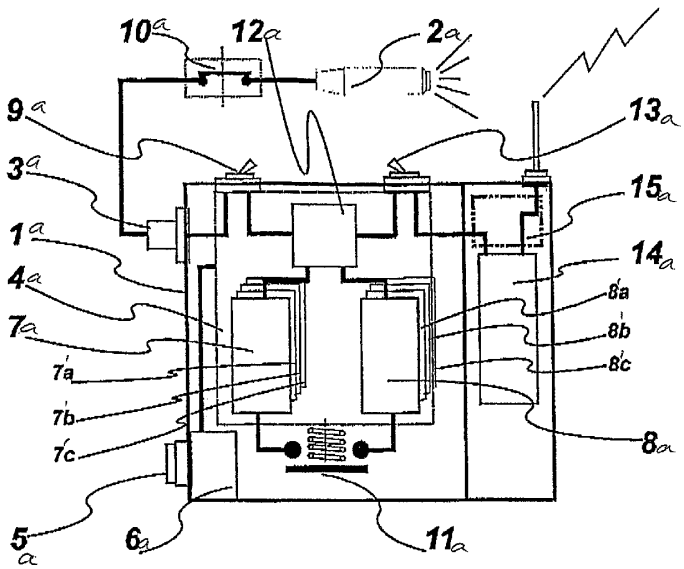
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(54) Title: MULTIMEDIA DATA RECORDING APPARATUS

(54) Titre : APPAREIL D'ENREGISTREMENT DE DONNEES MULTIMEDIA



(57) Abstract: The invention relates to a multimedia data recording apparatus which is associated with a multimedia data capture device. The inventive apparatus comprises: data storage means for storing data delivered by the multimedia data capture device, and a unit for processing said data for the conversion thereof into a format suitable for the storage of same in the data storage means. According to the invention, the data storage means comprise: first data storage means for the temporary and continuous storage of the data delivered by the multimedia data capture device, and second data storage means for the permanent storage of the data stored temporarily in the aforementioned first storage means.

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En ce qui concerne les codes à deux lettres et autres abréviations, se référer aux "Notes explicatives relatives aux codes et abréviations" figurant au début de chaque numéro ordinaire de la Gazette du PCT.

(**57**) **Abrégé :** La présente invention concerne un appareil d'enregistrement de données multimédia associé à un dispositif de prise de données multimédia, cet appareil comprenant des moyens de mémorisation des données délivrées par le dispositif de prise de données multimédia et une unité de traitement desdites données en vue de leur conversion dans un format adapté pour leur stockage dans les moyens de mémorisation. Conformément à l'invention, les moyens de mémorisation comportent des premiers moyens de mémorisation temporaire et en continu des données délivrées par le dispositif de prise de données multimédia et des deuxièmes moyens de mémorisation permanente de données stockées temporairement dans lesdits premiers moyens de mémorisation.

APPAREIL D'ENREGISTREMENT DE DONNEES MULTIMEDIA.

La présente invention est relative à un appareil d'enregistrement de données multimédia ainsi qu'à diverses applications de cet appareil.

I/ Art antérieur :

On connaît des appareils d'enregistrement de données multimédia, notamment d'images et/ou de sons, comprenant un dispositif de prise de vues et/ou de sons, des moyens de mémorisation des données délivrées par le dispositif de prise de vues et/ou de sons et une unité de traitement desdites données en vue de leur conversion dans un format adapté pour leur stockage dans les moyens de mémorisation.

Ces appareils d'enregistrement assurent en continu l'enregistrement d'images et/ou de sons relatifs à une scène située dans le champ du dispositif de prise de vues et/ou de sons dès que la commande d'enregistrement est enclenchée.

La présente invention résulte de la constatation que, dans des scènes de la vie quotidienne, ou de manifestations sportives ou culturelles, certaines séquences relatives à un événement particulier présentent un intérêt plus grand que d'autres.

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De par leur nature, les appareils d'enregistrement connus permettent l'enregistrement de tous les évènements d'une scène, à condition qu'ils aient été mis en service au bon instant. Ils présentent toutefois un certain nombre d'inconvénients, notamment en raison du fait qu'ils enregistrent nécessairement des événements de moindre intérêt et qu'ils nécessitent l'emploi de moyens de mémorisation de très grande capacité et en raison du fait que certains évènements appréciés après-coup et de grand intérêt, échappent à l'opérateur du fait d'un manque d'appréciation, de vigilance, d'anticipation,...

Le but de l'invention est de pallier ces inconvénients et de fournir un appareil d'enregistrement d'images et/ou de sons permettant l'enregistrement d'événements sélectionnés par un utilisateur et relatifs à des séquences antérieures à une séquence de mémorisation etc, en utilisant des moyens de mémorisation de faibles capacités.

Un autre but de l'invention est de fournir des applications spécialement adaptées pour l'utilisation d'un tel appareil.

Elle a donc pour objet un appareil d'enregistrement d'images et/ou de sons, caractérisé en ce que les moyens de mémorisation comportent des premiers moyens de mémorisation temporaire et en continu de données délivrées par le dispositif de prise de vues et/ou de sons et des deuxièmes moyen de mémorisation permanente de données stockées temporairement dans lesdits premiers moyens de mémorisation, et en ce qu'il comporte des moyens de transfert sélectif de données desdits premiers moyens de mémorisation vers lesdits deuxièmes moyens de mémorisation, en vue de l'enregistrement permanent d'au moins une séquence relative à une scène captée par le dispositif de prise de vues et/ou de son et mémorisée temporairement dans les premiers moyens de mémorisation.

L'invention peut en outre comporter une ou plusieurs caractéristiques suivantes :

- les premiers moyens de mémorisation sont constitués par une mémoire vive notamment de type FIFO

- les deuxièmes moyens de mémorisation sont constitués par un ensemble modulable de mémoires vives adaptées chacune à la mémorisation de séquences relatives à une même scène

- l'unité de traitement de données comporte un convertisseur analogique-numérique relié à un circuit de compression de données en vue de leur mémorisation dans lesdits premiers moyens de mémorisation ;

- l'appareil d'enregistrement comporte en outre des moyens de lecture des données mémorisées dans lesdits deuxièmes moyens de mémorisation et un organe de présentation à un utilisateur desdites données lues par lesdits moyens de lecture

- les moyens de lecture comportent un circuit de décompression des données lues par lesdits moyens de lecture en vue de leur présentation à l'utilisateur ;

- l'appareil d'enregistrement comporte en outre des moyens de pilotage desdits moyens de transfert actionnables manuellement par un utilisateur assistant à ladite scène captée préalablement par le dispositif de prise de vues et/ou de sons en vue de l'enregistrement de ladite au moins une scène ;

- l'arrêt du transfert de données étant provoqué manuellement par l'utilisateur, l'appareil d'enregistrement comporte des moyens de retard de l'arrêt dudit transfert desdites données des premiers moyens de mémorisation vers lesdits deuxièmes moyens de mémorisation

- l'appareil d'enregistrement comporte en outre des moyens automatiques de pilotage des moyens de transfert en vue de l'enregistrement automatique de ladite au moins une scène.

L'invention concerne également des applications qui résultent d'analyses spécifiques à chaque application d'un boîtier conforme à l'invention.

De fait, ces applications peuvent être utilisées en combinaison ou indépendamment l'une de l'autre.

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1ère application de l'invention :

Un premier aspect de l'invention résulte d'une constatation propre à ce premier aspect, décrit en détail ci-dessous :

On connaît des appareils d'enregistrement d'images et/ou de sons, du type caméras, caméscopes,... équipés et disposants de moyens périphériques de retransmission VHF, UHF et autres formats pour télédiffusion de longue portée.

En la matière, les applications les plus connues concernent le monde de la télévision et de la radio, pratiqué aussi bien en amateur que professionnel, notamment à des fins de loisirs, voire de surveillance.

La récupération de ces informations par des téléspectateurs et/ou auditeurs et/ou autre professionnels nécessitent des appareils spécifiques tels que téléviseurs, magnétoscopes, magnétophones, caméscopes, cassettes aux formats divers, mémoires flash, ordinateurs et disque durs centralisés ou décentralisés qui permettent la visualisation voire l'enregistrement des séquences émises, en consommant des quantités plus ou moins importantes de supports d'enregistrement.

On connaît tout aussi bien des moyens de communication radio et téléphones de nouvelles générations capables d'émettre et de recevoir des informations d'images et/ou de sons à partir d'une commande intégrée ou déportée, manuelle et/ou automatique.

Il arrive que les supports d'enregistrements soient saturés, conservés voire effacés cycliquement, épisodiquement, afin de permettre l'enregistrement de nouvelles séquences suivant le même procédé, afin de combler les espaces jugés après-coup inintéressants, déjà visualisés ou auditionnés, voire inutiles devant la surabondance des enregistrements réalisés.

D'autre part, ainsi que nous l'avons vu, ces moyens d'enregistrement nécessitent des infrastructures lourdes autant en terme de moyens techniques constituant la chaîne de communication, que d'appareils spécifiques d'enregistrement,

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voire de ressources humaines et machines complexes associées pilotant, voire mixant les informations et données émanant de chacun de ces appareils spécifiques.

Dans une utilisation régulière, il arrive fréquemment, qu'un événement échappe à l'attention de la source habilitée à son enregistrement du fait d'un manque d'attention, de vigilance, d'appréciation, d'anticipation, de préparation.

Ceci est d'autant plus frustrant lorsque les moyens étaient en place, susceptibles d'être mobilisés et/ou opérationnels mais non en fonction sur le lieu et au moment précis où l'événement apprécié intéressant après-coup, s'est produit.

Compte tenu des moyens financiers mobilisés voire des enjeux économiques, le fait de ne posséder aucune trace d'un événement jugé après-coup important voire digne d'intérêt accentue la frustration sinon la colère.

Par ailleurs, dans le cas de mobilité de la caméra, et/ou mobilité de la personne susceptible de délivrer une information pertinente, la complexité des moyens à mobiliser s'accentue, sans obtenir de certitude sur la pertinence et l'intérêt de l'information que l'on va collecter.

Du fait des moyens extrêmement lourds et importants à mobiliser, des choix sur l'opportunité de d'affecter des moyens pour surveillance et/ou contrôle sont bien souvent décidés sur des critères essentiellement financiers.

Au-delà de l'aspect financier, la transmission de séquences vidéo de mobile à mobile impose rapidement la plus grande sélectivité de l'information en regard des moyens de transmission et de stockage requis.

Il s'agit donc, dans un souci d'optimisation des moyens et d'efficacité, de communiquer des informations pertinentes lorsqu'il s'agit d'échanger de mobile à mobile.

La pertinence d'une information s'appréciant souvent après-coup, et comme tel, digne d'intérêt, on ne dispose pas de moyens d'une mise en œuvre simple, capables de ne recueillir que

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l'essentiel sur lesdites circonstances de cet accident au passé immédiat.

Le but de cette première application de l'invention est de répondre aux insatisfactions énumérées, pallier ces inconvénients et de fournir, dans un volume restreint, donc aisément transportable et donc mobile, voire en position fixe et d'une installation aisée, un appareil d'enregistrement et de transmission d'images et /ou de sons capables d'enregistrer et de transmettre des évènements et séquences relatifs à des faits antérieurs à une décision d'enregistrement, donc appréciés comme pertinents pour les avoir vécus et/ou vus, en utilisant des moyens de mémorisation de capacités adaptées à ces instants furtifs préliminaires et précédents la décision d'enregistrement en vue de les transmettre vers des interlocuteurs susceptibles d'être mobiles.

C'est pourquoi, ce premier aspect de l'invention concerne un système comprenant un appareil d'enregistrement d'images et/ou de sons, tel que précédemment défini, permettant à un opérateur de déclencher une capture d'une séquence vidéo en tout ou partie antérieure au déclenchement de la capture, notamment une séquence vidéo représentant les instants ayant précédé et suivi la chute d'un randonneur en montagne ou l'agression d'une personne dans un train.

Le système d'enregistrement comprenant :

- un premier terminal équipé de moyens de capture vidéo, notamment un téléphone mobile intégrant une caméra vidéo. Les moyens de capture vidéo sont destinés à capter des séquences vidéo, notamment des séquences relatives à un objet de surveillance tel qu'une personne ou un lieu déterminés.

Le premier terminal comprend :

- des premiers moyens de mémorisation, destinés à mémoriser de manière continue et temporaire les séquences vidéo ainsi captées. Les premiers moyens de mémorisation comportent une zone mémoire volatile d'une capacité appropriée à la mémorisation de fractions glissantes et de durée déterminée des

séquences vidéo ainsi captées. La mémorisation est notamment effectuée selon une procédure FIFO (première entrée première sortie).

Le premier terminal comprend en outre :

- un organe de commande permettant de :

• sélectionner une séquence vidéo particulière parmi les séquences vidéo ainsi mémorisées par les premiers moyens de mémorisation, notamment les images des instants ayant précédé et suivi la chute d'un randonneur en montagne ou l'agression d'une personne dans un train,

• transférer la séquence vidéo particulière vers des seconds moyens de mémorisation du premier terminal, destinés à mémoriser de manière permanente, en tout ou partie, la séquence vidéo particulière ainsi sélectionnée.

Le premier terminal comprend en outre :

- un premier module d'émission et de réception, notamment de type téléphonique, pour connecter le premier terminal à un réseau de communication, notamment à un réseau de téléphonie mobile.

Le système d'enregistrement comprend en outre un second terminal, notamment un téléphone mobile, distant du premier terminal. Le second terminal comporte :

- un second module d'émission et de réception, notamment de type téléphonique, pour connecter le second terminal au premier terminal, notamment via le réseau de téléphonie mobile.

Le premier module d'émission et de réception émet vers le second module d'émission et de réception du second terminal, via le réseau de communication, la séquence vidéo particulière ainsi mémorisée.

Le système d'enregistrement comprenant en outre des moyens de lecture, notamment situés dans le second terminal, permettant de visionner la séquence vidéo particulière ainsi mémorisée par les seconds moyens de mémorisation.

Ainsi, la capture de la séquence vidéo particulièrement intéressante est commandée à distance, mémorisée puis transférée via le réseau de communication dans la perspective d'être visionnée et analysée à distance.

De préférence, le système d'enregistrement comprend en outre :

- des moyens de connexion pour connecter le premier terminal à un capteur, notamment un capteur de température, un capteur de pression, une alarme de bâtiment,
- des moyens de réception, associés aux moyens de connexion, destinés à recevoir du capteur une information d'alerte, notamment le déclenchement d'une alarme de bâtiment, une alerte liée à une température ou à une pression anormale,
- des moyens de commande, activés de manière automatique par les moyens de réception, en fonction de l'information d'alerte. Les moyens de commande permettent de :
  - sélectionner automatiquement une seconde séquence vidéo particulière parmi les séquences vidéo ainsi mémorisées par les premiers moyens de mémorisation, notamment une séquence vidéo débutant une minute avant et se terminant une minute après la réception de ladite information d'alerte,
  - commander un transfert de la seconde séquence vidéo particulière vers les seconds moyens de mémorisation.

Ainsi, la mémorisation de la seconde séquence vidéo particulière est effectuée de manière automatique, en liaison avec la survenance d'un événement particulier.

Des applications diverses sont envisageables telles que la transmission d'une séquence vidéo de faits antérieurs à un incident sur un site isolé fixe et/ou mobile vers le possesseur d'un téléphone mobile équipé pour recevoir des séquences vidéo.

Une autre application directe est étayée, dans le cas d'actes odieux d'agression de personnes et/ou d'enfants, voire d'enlèvements, sans que l'on ne puisse recueillir d'indices au

plus tôt, gage d'intervention rapide et efficace des secours et chargés de police.

Ainsi, dans ce cas de figure, le porteur d'un appareil objet de l'invention, victime d'une agression, ou un témoin équipé de cet appareil et à proximité de cet événement, par une action immédiate de commande d'enregistrement sur ledit appareil, provoquera dans un premier temps la capture des images et sons des instants précédents les faits, et donc des circonstances et acteurs présents dans le champs de vision de la caméra dont est doté l'appareil.

Un module d'émission de téléphonie mobile intégré ou périphérique à l'appareil, récupèrera ces informations pour les transmettre aussitôt vers un autre téléphone mobile capables de lire ces séquences vidéo en vue d'une réaction immédiate.

A ce dispositif serait couplé, un module d'émission téléphonique, voire de réception, semblable à ceux implantés dans les téléphones portables communément utilisés de nos jours par une importante catégorie de professionnels et de particuliers dans le monde.

Cette particularité de saisie sélective de faits et circonstances antérieurs à un événement déclaré, répond à l'omniprésence de l'information susceptible d'être collectée, et de la pertinence du contenu de cette information.

2ième application de l'invention :

L'invention concerne également une deuxième application de l'invention qui résulte de l'analyse suivante :

Les appareils existants destinés à provoquer une intervention dans l'urgence se caractérise majoritairement aujourd'hui par des dispositifs électromécaniques, voire informatiques, dont la fonction essentielle est de stopper au plus vite, voire immédiatement la fonction en cours, en vue de protéger l'intégrité des biens et des personnes potentiellement menacées par les risques encourus et/ou environnants.

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Ces appareils sont parfois relayés, dès leur mise en œuvre, par des sirènes et autres gyrophares destinés à une information sonore et visuelle.

En la matière, les applications les plus connues concernent les bornes d'appel et boîtiers de commande d'appel et/ou d'arrêt d'urgence, intégrant généralement, soit un bouton poussoir du type coup de poing, soit une commande par poignée, à pousser ou à tirer.

Ces dispositifs sont implantés généralement en des endroits à risques potentiels importants dans le domaine public ou privé, et, du fait de leur fonction, se doivent d'être visibles et accessibles à tout public.

Compte tenu des conséquences, des perturbations engendrées par les dysfonctionnements directs et indirects qui s'ensuivront, des moyens à engager et/ou engagés dans cette intervention d'urgence, des responsabilités encourues, il est souhaitable d'identifier la personne ayant activé cet arrêt d'urgence, afin de disposer d'un témoignage sur le bien-fondé de cette action.

Du fait de l'accessibilité ouverte à tout public, il arrive fréquemment que des actes de vandalisme et/ou de sabotage et autres actions intempestives soient commis par des personnes malintentionnées, qui actionnent sans motif ces dispositifs d'arrêt d'urgence.

Ces actes de malveillance, menés sournoisement dans l'intention de nuire, demeurent dans l'anonymat, et engendrent les conséquences déjà citées, doublées d'insatisfactions notables de la part des personnes entraînées dans ces perturbations.

Il en est ainsi principalement des dispositifs de commande d'arrêt d'urgence dans le transport ferroviaire particulièrement.

L'objet de l'application de l'invention décrite ci-après, vise à procurer par une séquence vidéo, l'environnement immédiat du boîtier d'où provient la commande d'arrêt d'urgence,

avec, pour particularité essentielle, de communiquer ces informations dans le temps antérieur immédiat précédant l'action engendrée.

Cette application concerne un système comprenant un appareil d'enregistrement d'images et/ou de sons tel que précédemment défini permettant de capturer et de restituer une séquence vidéo retraçant les circonstances du déclenchement d'un dispositif d'alerte, notamment le déclenchement d'une commande d'arrêt d'urgence d'un train.

Le système d'enregistrement comprend :

- des moyens de capture vidéo, notamment une caméra vidéo, destinés à capter des séquences vidéo représentant le dispositif d'alerte et/ou son environnement immédiat,
- des premiers moyens de mémorisation, destinés à mémoriser de manière continue et temporaire les séquences vidéo ainsi captées. Les premiers moyens de mémorisation comportant une zone mémoire volatile d'une capacité appropriée à la mémorisation de fractions glissantes et de durée déterminée des séquences vidéo ainsi captées. La mémorisation est notamment effectuée selon une procédure FIFO (première entrée première sortie).

Le système d'enregistrement comprend en outre :

- des moyens de connexion pour connecter le dispositif d'enregistrement au dispositif d'alerte, notamment à une commande d'arrêt d'urgence d'un train,
- des moyens de détection, associés aux moyens de connexion, pour détecter un actionnement du dispositif d'alerte, notamment l'actionnement par un voyageur de la commande d'arrêt d'urgence d'un train,
- des moyens de commande, activés de manière automatique par les moyens de détection, en fonction de l'actionnement du dispositif d'alerte. Les moyens de commande permettent de :
  - sélectionner une séquence vidéo particulière parmi les séquences vidéo ainsi mémorisées par les premiers moyens de

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mémorisation, notamment une séquence vidéo débutant une minute avant et se terminant une minute après l'actionnement du dispositif d'alerte,

• commander un transfert de la séquence vidéo particulière vers des seconds moyens de mémorisation, destinés à mémoriser de manière permanente, en tout ou partie, la séquence vidéo particulière ainsi sélectionnée.

Le système d'enregistrement est associé à des moyens de lecture permettant à un opérateur de visionner la séquence vidéo particulière ainsi mémorisée par les seconds moyens de mémorisation.

Ainsi, le seul déclenchement du dispositif d'alerte provoque la mémorisation automatique d'une séquence vidéo, retraçant les circonstances du déclenchement du dispositif d'alerte, la séquence vidéo pouvant être visionnée et analysée, notamment dans le cadre d'une enquête.

On disposera ainsi, de séquences vidéo identifiant les personnes, voire les faits, à l'origine de l'action d'arrêt d'urgence.

On connaît des équipements vidéo aptes à enregistrer des séquences sur divers supports.

Ces séquences sont enregistrées en temps réels, lorsque l'appareil, la caméra en l'occurrence, est en fonction et/ou programmé, pour des évènements au fur et à mesure de leur déroulement, en consommant des quantités plus ou moins importantes de supports d'enregistrement.

L'enregistrement étant réalisé en continu, on dispose rapidement de séquences enregistrées volumineuses et inutiles.

Il arrive que ces supports d'enregistrements soient effacés périodiquement afin de permettre l'enregistrement de nouvelles séquences suivant le même procédé, révélant de ce fait l'inutilité et la surabondance des enregistrements réalisés.

La récupération de ces informations par des personnels qualifiés nécessitent des appareils spécifiques tels que moniteurs, magnétoscopes, magnétophones, caméscopes, cassettes

aux formats divers, mémoires flash, ordinateurs et disque durs centralisés ou décentralisés... qui permettent la visualisation des séquences enregistrées, en consommant du temps d'opérateur et des quantités plus ou moins importantes de supports d'enregistrement.

Il se trouve que ces installations et équipements ne se prêtent pas à la mobilité des moyens lorsqu'il s'agit de transport ferroviaire par exemple, à la dynamique requise pour une intervention expresse et sur place dès l'appel d'urgence lancé, à une intégration aisée voire discrète dans l'entourage immédiat des diverse bornes d'appel.

Le bien-fondé d'une action de commande d'arrêt d'urgence s'appréciant après-coup, et l'identification de la personne à l'origine de la commande constituant une pièce à conviction, l'invention ci-après s'attache à fournir un moyen vidéo d'une mise en œuvre simple, capable de ne recueillir que l'essentiel sur lesdites circonstances de cette demande d'arrêt d'urgence.

Le but de cette application de l'invention est de répondre aux insatisfactions énumérées, pallier ces inconvénients et de fournir, dans un volume restreint, facile à implanter, un appareil d'enregistrement et /ou de sons capables d'enregistrer des évènements et séquences relatifs à des faits antérieurs à une décision d'enregistrement, et donc susceptibles d'être appréciés comme pertinents.

L'objet de cette application de l'invention utilise, de façon sélective, des moyens de mémorisation de capacités adaptées à ces instants furtifs préliminaires et précédents la décision d'enregistrement, donc de commande d'arrêt d'urgence, en vue de leur exploitation par des personnes habilitées.

Cette application de l'invention est donc adaptée à une intégration dans tout environnement utilisant des arrêts d'urgence tels que décrits, et apporte particulièrement une réponse dans l'environnement ferroviaire autant sur la

sélectivité, la pertinence, l'efficacité de mise en œuvre, la compacité et l'économie de coûts directs et indirects induits.

Ainsi, dans ce cas d'utilisation, la commande d'arrêt d'urgence, relayée à l'appareil objet de l'invention, provoquera dans un premier temps, la capture des images et sons des instants précédents les faits, et donc des circonstances et acteurs présents dans le champs de vision de la caméra dont est doté l'appareil.

Cette particularité de saisie sélective de faits et circonstances antérieurs à un événement déclaré, répond notamment à l'omniprésence de l'information susceptible d'être collectée, à l'économie d'espace d'enregistrement et du traitement des données, et à la pertinence du contenu de cette information.

3ième application de l'invention :

Cette application de l'invention résulte de l'analyse suivante :

Sur des lieux de travail appréciés à risques pour les biens et les personnes, il est disposé diverses sortes de panneaux de mises en garde destinés à sensibiliser le personnel travaillant dans cet environnement, ainsi qu'à leur rappeler l'attention soutenue à laquelle ce personnel est astreint.

Les appareils existants destinés à provoquer une intervention dans l'urgence se caractérisent majoritairement aujourd'hui par des dispositifs mécaniques, électromécaniques, voire informatiques, dont la fonction essentielle est de stopper au plus vite, voire immédiatement la fonction ou l'opération en cours, en vue de protéger l'intégrité des biens et des personnes potentiellement menacées par les risques encourus et/ou environnants.

Ces appareils sont parfois relayés, dès leur mise en œuvre, par des sirènes et autres gyrophares destinés à une information sonore et visuelle.

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En la matière, les applications les plus connues concernent les bornes d'appel et boîtiers de commande d'appel et/ou d'arrêt d'urgence, intégrant généralement, soit un bouton poussoir du type coup de poing, soit une commande par poignée, à pousser ou à tirer.

Ces dispositifs sont implantés généralement en des endroits à risques potentiels importants dans les ateliers, aires de stockage, autres laboratoires et salles d'essais.

Lorsqu'un accident se produit, on se trouve bien souvent démuni d'explications sur les circonstances exactes à l'origine de cet accident, sachant par ailleurs que tout témoignage humain en la matière, peut être sujet à caution et interprétations diverses, laissant place à la fragilité et au doute.

Ceci est bien souvent insupportable dans la recherche des responsabilités qui peuvent impliquer dramatiquement les personnels concernés, les cadres et autres dirigeants pour défaillance dans leur dispositif de prévention, systèmes d'intervention, outils de production....

Ces éventuelles interpellations peuvent, dans le cas d'extensions des dégâts en dehors du périmètre de l'usine, avoir les conséquences les plus lourdes, en application de la législation du moment et des coûts à supporter par les compagnies d'assurance.

Ainsi, afin de se doter d'informations, il est possible de s'équiper en caméras de surveillance, qu'il faudra démultiplier dans le(s) secteur(s) concerné(s), et engager des investissements très lourds en infrastructures d'exploitation directes et indirectes, ce qui oblige à la plus grande sélectivité face à l'investissement prévisible.

On pourrait envisager donc d'équiper lesdites zones sensibles et/ou dangereuses, d'enregistrement de type connu, tels que caméras et utilisant des bandes d'enregistrement et/ou supports numériques, dont le fonctionnement est adapté à

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l'instant, sans distinction de la nécessité ou non d'enregistrer.

Ces séquences sont enregistrées en temps réels, lorsque l'appareil, la caméra en l'occurrence, est en fonction et/ou programmée, pour des évènements au fur et à mesure de leur déroulement, en consommant des quantités plus ou moins importantes de supports d'enregistrement.

L'enregistrement étant réalisé en continu, on dispose rapidement de séquences enregistrées volumineuses, inutiles, et onéreuses.

Il arrive que ces supports d'enregistrements soient effacés périodiquement afin de permettre l'enregistrement de nouvelles séquences suivant le même procédé, révélant de ce fait l'inutilité et la surabondance des enregistrements réalisés.

La récupération de ces informations par des personnels qualifiés nécessite des appareils spécifiques tels que moniteurs, magnétoscopes, magnétophones, caméscopes, cassettes aux formats divers, mémoires flash, ordinateurs et disques durs centralisés ou décentralisés... qui permettent la visualisation des séquences enregistrées, en consommant du temps d'opérateur et des quantités plus ou moins importantes de supports d'enregistrement.

Le bien-fondé de l'enregistrement d'une séquence s'appréciant après-coup, l'invention ci-après s'attache à fournir un moyen vidéo d'une mise en œuvre simple, capable de ne recueillir que l'essentiel sur lesdites circonstances de cet enregistrement.

L'objet de l'application de l'invention décrite ci-après, vise à procurer par une séquence vidéo, l'environnement immédiat du boîtier d'où provient une information d'enregistrement, avec, pour particularité essentielle, de communiquer ces informations dans le temps antérieur immédiat précédant l'action engendrée.

Cette application de l'invention concerne un système comprenant un appareil d'enregistrement d'images et/ou de sons

tels que précédemment défini permettant à un opérateur de capturer et de restituer une séquence vidéo retraçant les circonstances d'un événement survenu sur un lieu de travail, notamment un accident ou une explosion survenus sur un lieu de travail, une intrusion malveillante dans une usine ou dans un entrepôt.

Le système d'enregistrement comprend :

- des moyens de capture vidéo, notamment des caméras vidéo, destinés à capter des séquences vidéo relatives au lieu de travail, notamment les images d'un poste de travail d'un salarié,

- des premiers moyens de mémorisation, destinés à mémoriser de manière continue et temporaire les séquences vidéo ainsi captées. Les premiers moyens de mémorisation comportent une zone mémoire volatile d'une capacité appropriée à la mémorisation de fractions glissantes et de durée déterminée des séquences vidéo ainsi captées. La mémorisation est notamment effectuée selon une procédure FIFO (première entrée première sortie).

Le système, ou dispositif, d'enregistrement comprend en outre :

- un organe de commande, actionné par l'opérateur, permettant de :

• sélectionner une séquence vidéo particulière parmi les séquences vidéo ainsi mémorisées par les premiers moyens de mémorisation, notamment les images d'un accident ou d'une explosion survenus sur ledit lieu de travail,

• commander un transfert de la séquence vidéo particulière vers des seconds moyens de mémorisation, destinés à mémoriser de manière permanente, en tout ou partie, la séquence vidéo particulière ainsi sélectionnée.

Le dispositif d'enregistrement est associé à des moyens de lecture permettant à l'opérateur de visionner la séquence vidéo particulière ainsi mémorisée par les seconds moyens de mémorisation.

Ainsi, la séquence vidéo particulièrement intéressante, retraçant les circonstances d'un événement survenu sur un lieu de travail, notamment un accident survenu sur un lieu de travail, une intrusion malveillante dans une usine ou dans un entrepôt, est mémorisée dans la perspective d'être visionnée et analysée a posteriori.

De préférence, le dispositif d'enregistrement comprend en outre :

- des moyens de connexion pour connecter le dispositif d'enregistrement à un capteur, notamment un capteur de température, un capteur de pression, une alarme de bâtiment,
- des moyens de réception, associés aux moyens de connexion, destinés à recevoir du capteur une information d'alerte, notamment le déclenchement d'une alarme de bâtiment, une alerte liée à une température ou à une pression anormale,
- des moyens de commande, activés de manière automatique par les moyens de réception, en fonction de l'information d'alerte. Les moyens de commande permettant de :
  - sélectionner automatiquement une seconde séquence vidéo particulière parmi lesdites séquences vidéo ainsi mémorisées par les premiers moyens de mémorisation, notamment une séquence vidéo débutant une minute avant et se terminant une minute après la réception de l'information d'alerte,
  - commander un transfert de la seconde séquence vidéo particulière vers les seconds moyens de mémorisation.

Ainsi, la mémorisation la seconde séquence vidéo particulière est effectuée de manière automatique, en liaison avec la survenance d'un événement particulier.

On disposera ainsi, de séquences vidéo identifiant les circonstances, les faits, les personnes présentes, la chronologie des évènements ayant précédés voire provoqués l'accident.

L'objet de cette application de l'invention utilise, de façon sélective, des moyens de mémorisation de capacités adaptées à ces instants furtifs préliminaires et précédents la

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décision d'enregistrement, donc de circonstances d'un accident, en vue de leur exploitation par des personnes habilitées.

Ainsi, dans ce cas d'utilisation, une commande extérieure des plus diverses (boutons poussoirs, détecteurs de chocs, d'ouverture, de pression, température, dépassement de seuil d'appareils de mesure, présence inopportune et durable d'objets et/ou de formes non reconnues...) relayée à l'appareil objet de l'invention, provoquera dans un premier temps, la capture des images et sons des instants antérieurs aux faits, et donc des circonstances et acteurs présents dans le champs de vision de la caméra dont est doté l'appareil.

Cette particularité de saisie sélective de faits et circonstances antérieures à un événement déclaré, répond notamment à l'omniprésence de l'information susceptible d'être collectée, à l'économie d'espace d'enregistrement et du traitement des données, et à la pertinence du contenu de cette information, à son exploitation immédiate et disponible, aux moindres coûts d'exploitation directs et indirects, ainsi qu'aux demandes éventuelles de services d'enquêtes policières et compagnies d'assurance.

4ième application de l'invention :

Cette application de l'invention résulte de l'analyse suivante :

On connaît des appareils d'enregistrement et de lecture d'images et/ou de sons, du type comprenant un poste d'accueil de supports enregistrés, des objectifs, capteurs et circuits électroniques adaptés en vue de l'enregistrement, des moyens de lecture adaptés au format des dits supports, des circuits électroniques adaptés au décodage et retranscription des images et sons vers un écran et haut-parleur, en vue de la lecture et de l'audition de leur contenu.

Il s'agit en l'occurrence et principalement de magnétoscopes, caméscopes, baladeurs vidéo et autres

ordinateurs, pour des fonctions plus ou moins étendues suivant la vocation de l'appareil, fonctions qui débutent depuis la séquence de vision de l'image et récupération du son, jusqu'à l'enregistrement et la lecture des séquences mémorisées.

La technologie numérique actuelle utilise à des fins de photographies et d'enregistrement vidéo, des mémoires flash extractibles, en vue de l'exploitation éventuelle de leur contenu par transfert adapté vers des supports informatiques (disques durs d'ordinateurs, disquette ou CD-Rom), ou par impression vers des supports papiers.

Pour la lecture et copies de mémoires flash extractibles, certains appareils sont dotés d'un slot d'accueil afin de permettre la mise en configuration mécanique et électronique de ladite mémoire flash afin d'engager la dite lecture.

Dans un autre cas de figure, la mémoire peut rester intégrée à l'appareil de type natif, et le transfert pour lecture et ou copie s'opère via connexions adaptées du type USB, IEEE 1394, RS 232…. vers des appareils du même type acceptant ces formats.

Ces appareils assurent la lecture du support enregistré introduit dans l'appareil, suivant une séquence unique de lecture, une séquence programmée ou une séquence aléatoire.

Les enregistrements réalisés présentent parfois des passages fastidieux, inintéressants voire redondants, ce qui génère une surconsommation d'espaces mémoires au coût financier non négligeable, ainsi que du temps d'opérateur si l'on souhaite apporter des modifications sur les supports enregistrés.

La sélection des passages pour copie éventuelle ou pour montages vidéo divers requiert, soit un appareil dédié externe du même type, soit un ordinateur doté d'une carte électronique spécifique et d'un logiciel de retouche parfois fourni avec ledit caméscope et/ou appareil photo numérique.

Cela passe par des opérations d'interconnexions, de raccordements au secteur, de mise en état de lecture pour un appareil tandis que l'autre se doit d'être en état d'enregistrement avant de lancer la commande commune de démarrage de séquence.

Ceci requiert de l'attention, de la concentration et la répétitivité des tâches devient rapidement fastidieuses et rébarbatives.

Quant à la réalisation du montage vidéo et de la synchronisation d'une bande son, cela relève de compétences averties en informatique et logiciel spécifique.

Il est aussi fréquent de posséder de multiples enregistrements que l'on entrepose, classe, stocke çà et là, en des endroits ou meubles divers agencés en conséquence, de même qu'il arrive que les conditionnements propres à chacun de ces supports d'enregistrement se trouvent soit éparpillés, soit comprenant des contenus différents de leur packaging initial.

Une autre insatisfaction résulte du fait de la lourdeur des tâches à exécuter depuis la recherche du support d'enregistrement que l'on souhaite visionner et ou entendre, son extraction de sa pochette ou cassette, de son insertion dans le lecteur adapté, du rangement de la pochette en attendant la fin de la séquence visionnée et/ou auditionnée jusqu'au rangement suivant processus inverse.

La prolifération d'appareils numériques dotés de mémoires et supports d'enregistrement extractibles les plus divers et en des dimensions les plus variées accentue et accentuera sans nul doute cette prolifération d'inconvénients.

Le but de cette application de l'invention est de pallier ces inconvénients et de fournir un système d'enregistrement et de lecture d'images et/ou de sons aux capacités et fonctionnalités étendues et intégrées, autant en matière de lecture, que d'enregistrement intégral ou sélectif, que de capacités d'accueils et de classement de blocs mémoire,

que de mobilité, et d'ouvertures vers des appareils traitant de données de teneur multimédia.

Cette application de l'invention concerne un système, ou dispositif, mobile de lecture et d'enregistrement permettant de partager de manière conviviale et d'archiver des données multimédia. Les données multimédia proviennent d'une pluralité de supports d'enregistrements, notamment de type mémoires flash extractibles. Le dispositif mobile de lecture et d'enregistrement comprend :

- des moyens de lecture des données multimédia provenant de la pluralité de supports d'enregistrements,
- des moyens de visualisation des données multimédia, associés aux moyens de lecture, notamment un écran de visualisation et des haut-parleurs,
- des moyens d'enregistrement des données multimédia, notamment sur des supports de type mémoires flash extractibles.

Les moyens d'enregistrement comportent :

- des moyens de duplication permettant de dupliquer tout ou partie des données multimédia, et/ou
- des moyens de duplication sélective permettant de mémoriser a posteriori et de manière sélective les données multimédia.

Le dispositif mobile de lecture et d'enregistrement comprend en outre :

- des interfaces d'entrée et/ou des interfaces de sorties destinées à connecter le dispositif mobile de lecture et d'enregistrement à des appareils périphériques, notamment à des équipements informatiques, à des magnétoscopes, à des appareils photo numériques.

Le dispositif mobile de lecture et d'enregistrement comprend en outre :

- des moyens d'archivage, notamment extractibles, des données multimédia. Les moyens d'archivage se présentent sous la forme d'emplacements intégrés au dispositif mobile de lecture et d'enregistrement, notamment sous la forme d'emplacements de

rangement destinés à recevoir des supports d'enregistrement, notamment des mémoires flash extractibles.

Le dispositif mobile de lecture et d'enregistrement comprend en outre :

- des moyens de transport, notamment une poignée de transport, destinés à permettre une mobilité aisée du dispositif mobile de lecture et d'enregistrement.

Ainsi, le dispositif mobile de lecture et d'enregistrement peut être utilisé comme un boîtier mobile universel de lecture et de stockage de vidéos, de photos, de musique.

Cet appareil, selon l'invention, permettrait, et ce, dans un seul équipement :

- de recevoir une ou plusieurs mémoires flash vidéo de type extractibles en vue de leur lecture et/ou leur enregistrement,
- d'être connectable à tout appareil aux entrées et sorties vidéo communément utilisées (S-vidéo, USB,IEEE 1394...),
- de lire et d'écouter sur écran et hauts parleurs intégrés les enregistrements contenus dans ces mémoires flash lues,
- de réaliser des copies de tout ou partie desdites mémoires flash,
- de réaliser des copies sélectives suivant un principe de capture à posteriori desdites mémoires flash,
- d'accueillir une ou plusieurs mémoires flash de type extractibles en vue de leur enregistrement,
- d'accueillir lesdites mémoires flash dans des supports extractibles et adaptés à leur format, constituant de ce fait des coffrets de classement et/ou de rangement extractibles eux aussi,
- de disposer d'une poignée pour faciliter sa mobilité et son transport afin de partager en famille et/ou entre amis des enregistrements appréciés.

5ième application de l'invention :

Cette application de l'invention résulte de l'analyse suivante :

Il existe actuellement, exclusivement sur feux tricolores, des appareils photos couplés à une cellule, dont la vocation n'est pas de connaître les circonstances d'un éventuel accident. Celui-ci déclenche une photographie du véhicule irrespectueux de la signalisation du moment en vue de son exploitation par les forces de police ou un central informatique en vue d'une verbalisation du contrevenant.

Ainsi, dans le cas d'un accident de la circulation, pour autant que l'on souhaite connaître les circonstances et établir les responsabilités de chacun, cet équipement s'avère inadapté. Ceci s'avère encore plus flagrant si cet accident met en cause notamment des piétons et cyclistes.

Il est surprenant de noter que les arrêts obligatoires de type « STOP », sont totalement dépourvus de ce type d'équipement laissant apparaître-là, un vide probablement lié aux infrastructures.

On pourrait envisager d'équiper lesdits carrefours et autres intersections d'appareils d'enregistrement de type connu, tels que caméras et utilisant des bandes d'enregistrement et/ou supports numériques, dont le fonctionnement est adapté à l'instant, sans distinction de la nécessité ou non d'enregistrer.

Ces séquences sont enregistrées en temps réels, lorsque l'appareil, la caméra en l'occurrence, est en fonction et/ou programmée, pour des évènements au fur et à mesure de leur déroulement, en consommant des quantités plus ou moins importantes de supports d'enregistrement.

L'enregistrement étant réalisé en continu, on dispose rapidement de séquences enregistrées volumineuses et inutiles.

Il arrive que ces supports d'enregistrements soient effacés périodiquement afin de permettre l'enregistrement de

nouvelles séquences suivant le même procédé, révélant de ce fait l'inutilité et la surabondance des enregistrements réalisés.

La récupération de ces informations par des personnels qualifiés nécessitent des appareils spécifiques tels que moniteurs, magnétoscopes, magnétophones, caméscopes, cassettes aux formats divers, mémoires flash, ordinateurs et disque durs centralisés ou décentralisés... qui permettent la visualisation des séquences enregistrées, en consommant du temps d'opérateur et des quantités plus ou moins importantes de supports d'enregistrement.

Le bien-fondé de l'enregistrement d'une séquence s'appréciant après-coup, l'invention ci-après s'attache à fournir un moyen vidéo d'une mise en œuvre simple, capable de ne recueillir que l'essentiel sur lesdites circonstances de cet enregistrement.

L'objet de l'application de l'invention décrite ci-après, vise à procurer par une séquence vidéo, l'environnement immédiat sous couverture de caméras du carrefour routier et/ou de la zone sous signalisation sensible de type « STOP », avec, pour particularité essentielle, de communiquer ces informations uniquement si nécessaire, informations portant sur le temps antérieur immédiat précédant l'accident provoqué.

Cette application de l'invention concerne un système, ou dispositif, muni d'un appareil d'enregistrement d'images et/ou de sons tel que précédemment défini permettant à un opérateur de capturer et de restituer une séquence vidéo retraçant les circonstances d'un événement survenu dans un environnement déterminé, notamment un accident entre deux véhicules à un carrefour routier, un panneau "stop" non-respecté par un automobiliste.

Le dispositif d'enregistrement comprend :

- des moyens de capture vidéo, notamment des caméras vidéo, destinés à capter des séquences vidéo relatives à l'environnement déterminé, notamment les images d'un carrefour dangereux,

- des premiers moyens de mémorisation, destinés à mémoriser de manière continue et temporaire les séquences vidéo ainsi captées. Les premiers moyens de mémorisation comportent une zone mémoire volatile d'une capacité appropriée à la mémorisation de fractions glissantes et de durée déterminée des séquences vidéo ainsi captées. La mémorisation est notamment effectuée selon une procédure FIFO (première entrée première sortie).

Le dispositif d'enregistrement comprend en outre :

- un organe de commande permettant de :

• sélectionner une séquence vidéo particulière parmi les séquences vidéo ainsi mémorisées par les premiers moyens de mémorisation, notamment les images d'un accident entre deux véhicules à un carrefour routier, le franchissement d'un panneau "stop" non-respecté par un automobiliste,

• commander un transfert de la séquence vidéo particulière vers des seconds moyens de mémorisation, destinés à mémoriser de manière permanente, en tout ou partie, la séquence vidéo particulière ainsi sélectionnée. L'organe de commande pouvant être actionné de manière manuelle par l'opérateur et/ou de manière programmée en cas de réalisation d'une condition prédéterminée, notamment en cas de présence prolongée d'un véhicule dans le champ des moyens de capture vidéo.

Le dispositif d'enregistrement est associé à des moyens de lecture permettant à l'opérateur de visionner la séquence vidéo particulière ainsi mémorisée par les seconds moyens de mémorisation.

Ainsi, la séquence vidéo particulièrement intéressante retraçant les circonstances d'un accident ou d'une infraction au code de la route est mémorisée dans la perspective d'être visionnée et analysée a posteriori.

On disposera ainsi, de séquences vidéo pertinentes, identifiant les circonstances, la chronologie des faits, les véhicules incriminés, les personnes dans ce champ de caméras... qui permettront de délimiter les responsabilités de chacun pour

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leur propre besoin vis-à-vis des forces de police ainsi que vis-à-vis des compagnies d'assurance.

L'objet de l'invention utilise, de façon sélective, des moyens de mémorisation de capacités adaptées à ces instants furtifs préliminaires et précédant la commande d'enregistrement, et relatifs aux circonstances de l'accident, en vue de leur exploitation par des personnes habilitées.

Cette invention est donc adaptée à une intégration dans tout environnement routier notamment, et apporte particulièrement une réponse par un moyen inexistant à ce jour, sur la sélectivité, la pertinence, l'efficacité de mise en œuvre, la compacité et l'économie de coûts directs et indirects induits.

Cette particularité de saisie sélective de faits et circonstances antérieurs à un événement déclaré, répond notamment à l'omniprésence de l'information susceptible d'être collectée, à l'économie d'espace d'enregistrement et du traitement des données, et à la pertinence et à l'optimisation du contenu de cette information.

Pour clarifier le fonctionnement, on considèrera que :

- une caméra est en action continue et de façon passive,
- les informations émanant de cette caméra sont enregistrées dans un premier registre de mémoires considérées comme temporaires, qui, lorsque la capacité de mémorisation est atteinte, écrasent les premières informations entrées au profit des dernières entrantes,
- lorsqu'un événement est considéré pertinent et digne d'être enregistré sur un support permanent, un contact automatique ou manuel, répondant aux critères initiaux de pertinence, déclenchera le transfert des informations préalablement enregistrées dans le premier registre de mémorisation cité, pour leur mémorisation vers des seconds registres de mémoires à caractère permanent,

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- la lecture de ces moyens de mémorisation apportera des réponses aux questions sur les circonstances et responsabilités notamment.

6ième application de l'invention :

Cette application de l'invention résulte de l'analyse suivante :

On connaît des appareils d'enregistrement d'images et/ou de sons, du type comprenant des ports d'entrées des données collectées par une caméra et divers micros, des moyens électroniques de codage et formatage des données collectées en vue de leur enregistrement sur les supports adaptés, un poste d'accueil de supports à enregistrer ou enregistrés, des circuits électroniques adaptés au décodage et retranscription des images et sons vers un écran et haut-parleur, en vue de la lecture et de l'audition de leur contenu.

Il s'agit-là, particulièrement et pour exemples, en ce qui concerne la surveillance, d'appareils tels que boîtes noires embarquées dans des véhicules et/ou avions, qui après décodage permettent quelquefois, par l'étude de données enregistrées, d'identifier les équipements défaillants ou les variations importantes de mesures diverses, préliminaires à un incident et/ou accident.

Ces appareils assurent notamment l'enregistrement sur divers supports, de séquences en temps réels, lorsque l'appareil est en fonction et/ou programmé, pour des évènements au fur et à mesure de leur diffusion ou de leur déroulement, en consommant des quantités plus ou moins importantes de supports d'enregistrement.

Il arrive que ces supports d'enregistrements soient effacés périodiquement afin de permettre l'enregistrement de nouvelles séquences suivant le même procédé, révélant de ce fait l'inutilité et la surabondance des enregistrements réalisés.

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Dans la réalité, et malgré ces équipements et dispositions, il arrive fréquemment, qu'un accident demeure inexpliqué sur ses circonstances réelles, surtout lors de faits et paramètres externes à tout dispositif de mesure implanté, ce qui génère des hypothèses et scénarii les plus divers, insatisfaisants psychologiquement, matériellement, voire lourds de conséquences dans le cas de recherche de responsabilités.

Il en est ainsi par exemple lors d'un acte terroriste, lors d'un accident, en vue de la compréhension et de la reconstitution des faits, sur leur chronologie, sur l'identification des acteurs et auteurs, sur la réaction des agressés et victimes, etc.

Ces circonstances s'avèrent souvent et après-coup, digne d'intérêt, sans que l'on dispose de moyens capables de ne recueillir que l'essentiel sur lesdites circonstances précédents et/ou à l'origine de cet accident.

Le but de cette application de l'invention est de pallier ces inconvénients et de fournir un système muni d'un appareil d'enregistrement d'images et /ou de sons, tel que précédemment défini, capable d'enregistrer des évènements et séquences relatifs à des faits antérieurs à une décision d'enregistrement, en utilisant des moyens de mémorisation de capacités adaptées à ces instants furtifs préliminaires et précédents l'accident ou l'incident.

L'invention concerne un système, ou dispositif de surveillance embarqué dans un véhicule permettant à un opérateur de capturer et de restituer une séquence vidéo particulière relative à un incident survenu dans le véhicule, notamment un accident d'autocar ou un détournement d'avion.

Le dispositif de surveillance comprend :

- des moyens de capture vidéo, notamment des caméras vidéo, destinés à capter des séquences vidéo se déroulant à l'intérieur du véhicule,

- des premiers moyens de mémorisation, destinés à mémoriser de manière continue et temporaire les séquences vidéo

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ainsi captées. Les premiers moyens de mémorisation comportant une zone mémoire volatile d'une capacité appropriée à la mémorisation de fractions glissantes et de durée déterminée des séquences vidéo ainsi captées. La mémorisation est notamment effectuée selon une procédure FIFO (première entrée première sortie).

Le dispositif de surveillance comprend en outre :

- un organe de commande permettant de :

• sélectionner une séquence vidéo particulière parmi les séquences vidéo ainsi mémorisées par les premiers moyens de mémorisation, notamment l'instant d'un accident d'autocar ou l'entrée en scène de pirates de l'air,

• commander un transfert de la séquence vidéo particulière vers des seconds moyens de mémorisation, destinés à mémoriser de manière permanente, en tout ou partie, la séquence vidéo particulière ainsi sélectionnée. L'organe de commande peut être actionné de manière manuelle par l'opérateur et/ou de manière programmée en cas de réalisation d'une condition prédéterminée, notamment en cas de dépressurisation de la cabine d'un avion ou en cas de dépassement d'un seuil de température dans le véhicule.

Le dispositif de surveillance est associé à des moyens de lecture permettant à l'opérateur de visionner la séquence vidéo particulière ainsi mémorisée par les seconds moyens de mémorisation.

Ainsi, la séquence vidéo particulièrement intéressante contenant la scène d'un incident survenu dans le véhicule est mémorisée dans la perspective d'être visionnée et analysée a posteriori.

7ième application de l'invention :

Cette application de l'invention résulte de l'analyse suivante :

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On connaît des appareils d'enregistrement d'images et/ou de sons, du type comprenant des ports d'entrées des données collectées par une caméra, téléviseur et autres micros, des moyens électroniques de codage et formatage des données collectées en vue de leur enregistrement sur les supports adaptés, un poste d'accueil de supports à enregistrer ou enregistrés, des circuits électroniques adaptés au décodage et retranscription des images et sons vers un écran et haut-parleur, en vue de la lecture et de l'audition de leur contenu.

Il s'agit-là, particulièrement et pour exemples, en ce qui concerne le monde du multimédia, d'appareils tels que magnétoscopes, caméscopes, appareils photographiques numériques, et téléphones mobiles de nouvelles générations intégrant notamment des fonctionnalités d'enregistrement d'images et de séquences vidéo.

Ces appareils assurent notamment l'enregistrement sur divers supports, de séquences en temps réel, lorsque l'appareil est en fonction et/ou programmé, pour des séquences au fur et à mesure de leur diffusion ou de leur déroulement.

Dans la vie quotidienne, il arrive fréquemment, qu'un évènement ou une séquence retienne particulièrement notre attention, à partir de critères propres à chacun d'entre nous.

Il en est ainsi par exemple et notamment devant une séquence télévisée telle que reportage d'actualité, film, évènements en direct...

Nul n'étant devin, il nous est impossible de déclarer notre intérêt avant d'avoir vécu ou visualisé une séquence ou un événement.

Dans le cas d'une retransmission télévisée par exemple, il est tout aussi fréquent que notre magnétoscope ne soit pas en fonction au moment où une séquence nous interpelle, ce qui provoque une insatisfaction voire un agacement plus ou moins marqué, du fait de l'impossibilité de revivre cette information ou cette séquence furtive et passagère qui a capté

notre attention, et qui mériterait à nos yeux une rediffusion immédiate, voire un enregistrement pour diverses raisons.

Le but de l'invention est de pallier ces inconvénients et de fournir un système muni d'un appareil d'enregistrement d'images et /ou de sons tel que précédemment défini capable d'enregistrer des évènements et séquences relatifs à des diffusions antérieures à une décision d'enregistrement, en utilisant des moyens de mémorisation de capacités adaptées à ces instants furtifs que l'on aura vécus ou visionnés et souhaités revivre et revoir.

Procédé

L'invention concerne un procédé d'enregistrement d'images et/ou de sons, notamment de séquences télévisées émises par un émetteur distant, en vue d'une rediffusion de séquences émises antérieurement à la décision d'enregistrement. Le procédé comprend les étapes suivantes :

- l'étape, pour un téléspectateur, de visualiser les séquences télévisées sur un écran d'un équipement de télévision les recevant en temps réel,
- l'étape d'enregistrer, en continu, dans une zone mémoire volatile de capacité appropriée, des tranches glissantes de durée déterminée des séquences télévisées ainsi visualisées, selon une procédure FIFO (première entrée, première sortie),
- l'étape, pour le téléspectateur, de sélectionner une séquence déterminée venant d'être diffusée et qu'il souhaite revoir.

La séquence déterminée, ainsi sélectionnée, a été préalablement enregistrée selon la procédure FIFO. Le procédé comprend en outre l'étape, pour le téléspectateur, d'actionner au moyen d'un organe de commande le transfert de la séquence déterminée de la zone mémoire vers un équipement de traitement d'image :

- soit pour rediffuser la séquence déterminée,

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- soit pour enregistrer la séquence déterminée sur un support durable et/ou amovible.

Il résulte de la combinaison des traits techniques que le téléspectateur a ainsi la possibilité de revivre des instants furtifs ayant capté son attention au cours de l'émission télévisée.

De préférence selon l'invention, la zone mémoire volatile a une capacité appropriée pour pouvoir retrouver quasi instantanément la séquence passée ayant capté l'attention du téléspectateur.

De préférence selon l'invention, la zone mémoire volatile a une capacité appropriée pour que le téléspectateur puisse actionner en toute quiétude par une action manuelle réflexe l'organe de commande, en disposant d'un temps suffisant.

De préférence selon l'invention, le procédé est tel que la zone mémoire volatile a une capacité comprise entre 10s et 30s.

Système

L'invention concerne également un système muni d'un appareil pour enregistrer des images et/ou des sons tel que précédemment défini, notamment des séquences télévisées émises par un émetteur distant, en vue d'une rediffusion de séquences émises antérieurement à la décision d'enregistrement. Le système comprend :

- un équipement de télévision recevant les séquences télévisées, en temps réel, et les diffusant sur un écran à l'usage d'un téléspectateur
- des premiers moyens de mémorisation de tranches glissantes de durée déterminée des séquences télévisées ainsi visualisées, selon une procédure FIFO (première entrée, première sortie).

Ces premiers moyens de mémorisation, mémorisant en continu, de manière temporaire, les séquences télévisées, comportent une zone mémoire volatile de capacité appropriée.

Le système selon l'invention comprend en outre un organe de commande, actionnable par le téléspectateur, pour transférer vers un équipement de traitement d'image une séquence déterminée sélectionnée par le téléspectateur, parmi les séquences venant d'être diffusée et ayant été préalablement enregistrée selon la procédure FIFO dans les premiers moyens de mémorisation.

L'équipement de traitement d'image comporte :

* des deuxièmes moyens de mémorisation destinés à mémoriser de manière permanente, en totalité ou en partie, la séquence déterminée ainsi transférée, et/ou

* des moyens pour rediffuser la séquence déterminée.

Il résulte de la combinaison des traits techniques que le téléspectateur a ainsi la possibilité de revivre des instants furtifs ayant capté son attention au cours de l'émission télévisée.

De préférence selon l'invention, le système est tel que les premiers moyens de mémorisation et/ou les deuxièmes moyens de mémorisation sont amovibles.

De préférence selon l'invention, la zone mémoire volatile a une capacité appropriée pour pouvoir retrouver quasi instantanément la séquence passée ayant capté l'attention du téléspectateur,

De préférence selon l'invention, la zone mémoire volatile a une capacité appropriée pour que le téléspectateur puisse actionner en toute quiétude par une action manuelle réflexe l'organe de commande, en disposant d'un temps suffisant.

De préférence selon l'invention, la zone mémoire volatile a une capacité comprise entre 10s et 30s.

8ième application de l'invention :

Cette application de l'invention résulte de l'analyse suivante :

Les appareils de vision dont il est fait état comprennent généralement une optique adaptée et/ou adaptable à

la vision de l'opérateur, ainsi que divers systèmes et/ou adaptations optiques destinés à aider la vision pour des conditions générales ou particulières.

Les conditions générales concernent généralement les lunettes de vue et jumelles compensant les déficiences optiques de tout un chacun, tandis que les conditions particulières s'entendent, pour les jumelles notamment, dans le cas où une démultiplication de puissance et de performances sont nécessaires pour l'observation à distance (grossissement, champ visuel...), et autres équipements adaptés à l'environnement du type infrarouge pour vision nocturne, ambiance agressive, etc...

On assiste aujourd'hui à l'intégration de l'électronique dans des équipements de vision, notamment à des fins de performances qualitatives voire quantitatives.

Dans certains équipements, on trouve, en additif périphérique ou embarqué, des appareils photographiques de type argentique et récemment de type numérique.

Pour exemples, il s'agit-là, particulièrement et, en ce qui concerne les équipements destinés à l'observation, de jumelles et autres lunettes astronomiques.

Ces appareils permettent donc aux utilisateurs, de vivre leur passion de l'observation, que celle-ci s'oriente vers la nature, scrutations astrales, ou de satisfaire leur curiosité.

Pour d'autres utilisateurs que l'on qualifierait de professionnels, il peut s'agir d'un équipement nécessaire à l'observation pour des cas de recherches scientifiques, de services de renseignements divers à des fins d'enquêtes et autres filatures.

Dans le cas d'une utilisation avec appareil photographique en complément ou intégré aux jumelles particulièrement, et lorsqu'une prise de vue est souhaitée par l'utilisateur, divers modes sont proposés, à savoir : photo par photo, en rafale, trois par trois ou autre, réalisation d'une mini séquence vidéo, utilisation d'un retardateur...

Les jumelles avec appareil photo numérique sont dotées d'une mémoire interne de quelques méga octets, en vue de stocker une quantité plus ou moins importante d'images, suivant que l'on travaille en basse ou haute résolution.

Ces images peuvent ensuite être visualisées et téléchargées sur un ordinateur via un connecteur dédié à cet usage.

En pratique, l'utilisateur peut se trouver confronté à divers problèmes et insatisfactions, à savoir :

- rester éminemment concentré sur sa « cible », afin de saisir par l'image, l'instant tant attendu et convoité, ce qui est susceptible de générer une réelle fatigue oculaire, voire une lassitude,
- être saisi par le doute, sur ce qu'il a cru voir et/ou apercevoir, sans avoir eu le temps de déclencher une photographie,
- opérer des photographies en rafale, afin de minimiser le risque de rater l'évènement propice tant attendu,
- consommer inutilement des espaces mémoires et/ou de la pellicule,
- révéler et/ou transférer une quantité importante d'images, qu'il devra ensuite visionner, sélectionner au travers de critères spécifiques, ce qui nécessitera encore des moyens et du temps,
- regretter d'avoir « raté » ce qui lui a échappé du fait de la soudaineté de l'évènement, de sa brièveté, de son aspect inattendu et imprévisible, du fait de son inattention et/ou dérangement par une cause extérieure, du fait de sa fatigue oculaire ou physique consécutive aux longues périodes d'observation pour des faits sans intérêt,
- éprouver un fort mécontentement en regard de tous les préparatifs, artifices éventuels, moyens et temps engagés pour cette période d'observation.

En regard des moyens mobilisés, des préparatifs, artifices, autres déguisements et camouflages, du temps

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consacré, voire des risques encourus, l'insatisfaction peut être profonde si l'évènement spécifique tant attendu échappe, ce d'autant plus si celui-ci est susceptible de conforter une hypothèse de travail, de libérer le doute, de délivrer une preuve tangible.

Le but de cette application de l'invention est de pallier ces inconvénients et de fournir un système muni d'un appareil d'enregistrement d'images et /ou de sons tel que précédemment défini capable d'enregistrer des évènements et séquences relatifs à des faits antérieurs à une décision d'enregistrement, en utilisant des moyens de mémorisation de capacités adaptées à ces instants furtifs préliminaires et précédant les faits appréciés après-coup, intéressants.

Cette application de l'invention concerne un système, ou dispositif, muni d'un appareil d'enregistrement de séquences d'images et/ou de sons captées au moyen d'un instrument de vision, notamment de type jumelles, tel que précédemment défini. Le dispositif d'enregistrement est destiné à permettre à un opérateur d'enregistrer des événements et des séquences relatifs à des faits antérieurs à une décision d'enregistrement de l'opérateur. Le dispositif comprend :

- un instrument de vision, notamment de type jumelles, permettant de capter des séquences d'images et/ou de sons,

- un équipement électronique, recevant les séquences d'images et/ou de sons de l'instrument de vision, via des connecteurs.

L'équipement électronique comprend :

- des premiers moyens de mémorisation, destinés à mémoriser de manière continue les séquences d'images et/ou de sons en provenance de l'instrument de vision. Les premiers moyens de mémorisation comportent une zone mémoire volatile d'une capacité appropriée à la mémorisation de fractions glissantes et de durée déterminée des séquences d'images et/ou de sons ainsi reçues. La mémorisation est notamment effectuée selon la procédure FIFO (première entrée-première sortie).

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L'équipement électronique comprend en outre:

- un organe de commande permettant de :

• sélectionner une séquence particulière parmi les séquences d'images et/ou de sons ainsi mémorisées par les premiers moyens de mémorisation, notamment un instant furtif, parfois inattendu et soudain vu au travers de l'instrument de vision,

• commander un transfert de la séquence particulière vers des seconds moyens de mémorisation, destinés à mémoriser de manière permanente, en tout ou partie, la séquence particulière ainsi sélectionnée. L'organe de commande est actionné manuellement par l'opérateur et/ou de manière préprogrammée en cas de réalisation d'une condition déterminée, notamment en cas de présence devant un capteur de l'instrument de vision et/ou en fonction d'un paramètre déclenchant, adapté à une condition d'observation déterminée.

De préférence, le dispositif d'enregistrement de séquences d'images et/ou de sons est tel que l'équipement électronique est connecté à des moyens de lecture externes et/ou à des moyens de lecture intégrés à l'instrument de vision. Les moyens de lecture permettent à l'opérateur de visionner la séquence particulière ainsi mémorisée par les seconds moyens de mémorisation.

Ainsi, la séquence, appréciée après-coup comme étant digne d'intérêt et contenant l'instant furtif tant attendu durant l'observation, est mémorisée afin d'être visionnée, analysée et reproduite à des fins spécifiques aux objectifs de l'observation effectuée au moyen de l'instrument de vision.

L'invention concerne un équipement électronique permettant à un utilisateur de capturer une séquence de photographie et/ou de vidéo particulière, vécue au travers d'une paire de jumelles, appareils photographiques, caméras et autres moyens de vision et/ou d'observation.

L'équipement électronique comprend notamment :

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- des connecteurs nécessaires à l'entrée des données émanant de l'équipement d'observation,

- des interfaces de traitement de ces données pour leur conversion en un format adapté si nécessaire,

- des premiers moyens de mémorisation, destinés à mémoriser de manière continue les séquences vidéo émanant de l'équipement d'observation. Les premiers moyens de mémorisation comportant une zone mémoire volatile d'une capacité appropriée à la mémorisation de fractions glissantes et de durée déterminée des séquences vidéo ainsi captées. La mémorisation est notamment effectuée selon la procédure FIFO (première entrée-première sortie).

L'équipement électronique comprend en outre :

- un organe de commande permettant de :

• sélectionner une séquence vidéo particulière parmi les séquences vidéo ainsi mémorisées par les premiers moyens de mémorisation, notamment l'instant furtif, parfois inattendu et soudain, vu au travers de l'équipement d'observation,

• commander un transfert de la séquence vidéo particulière vers des seconds moyens de mémorisation, destinés à mémoriser de manière permanente, en tout ou partie, la séquence vidéo particulière ainsi sélectionnée. L'organe de commande peut être actionné manuellement par l'opérateur et/ou de manière programmée en cas de réalisation d'une condition déterminée, notamment en cas de présence devant un capteur et/ou autre dispositif déclenchant, adapté à la condition d'observation souhaitée.

L'équipement électronique peut être relié à des moyens de lecture externes, voire à ceux existant sur l'équipement d'observation permettant à l'opérateur de visionner la séquence vidéo particulière ainsi mémorisée par les seconds moyens de mémorisation.

Ainsi, la séquence vidéo appréciée après-coup digne d'intérêt et contenant l'instant furtif tant attendu durant l'observation, est mémorisée afin d'être visionnée, analysée et

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reproduite à des fins spécifiques aux objectifs de cette observation.

D'autres caractéristiques et avantages ressortiront de la description suivante, données uniquement à titre d'exemple et faite en référence aux dessins annexés sur lesquels

- la figure 1a est une vue générale d'un appareil d'enregistrement selon l'invention ;
- la figure 2a est un schéma synoptique de l'appareil de la figure 1
- la figure 3a est un organigramme de fonctionnement de l'appareil d'enregistrement ; et
- la figure 4a est un organigramme de gestion de l'accès aux deuxièmes moyens de mémorisation,
- la figure 1b est une vue générale d'une architecture d'un appareil d'enregistrement selon l'invention, avec caméra déportée et module d'émission/réception téléphonique intégré;
- la figure 2b est une vue générale d'une architecture d'un appareil d'enregistrement selon l'invention, avec caméra déportée et appareil d'émission/réception téléphonique raccordable ;
- la figure 3b est une vue générale d'une architecture d'un appareil d'enregistrement selon l'invention, avec caméra intégrée et module d'émission/réception téléphonique intégré;
- la figure 4b est une vue générale d'une architecture d'un appareil d'enregistrement selon l'invention, avec caméra intégrée et appareil d'émission/réception téléphonique raccordable ;
- la figure 1c est une vue générale d'une architecture d'un appareil d'enregistrement selon l'invention, avec caméra déportée ;
- la figure 2c est une vue générale d'une architecture d'un appareil d'enregistrement selon l'invention, avec caméra intégrée ;
- la figure 1d est un croquis imageant des symboles de lieux d'utilisation susceptibles d'être sous surveillance ;

- la figure 2 d...
- la figure 1e est une vue générale extérieure d'un appareil d'enregistrement et de lecture 1 selon l'invention ;
- la figure 2e est une vue en plan d'une architecture fonctionnelle possible selon l'invention ;
- La figure 1f est un croquis imageant l'implantation sur feux tricolores et collision entre deux véhicules ;
- la figure 2f est une vue générale d'une architecture d'un appareil d'enregistrement selon l'invention, avec caméra intégrée ;
- la figure 1g est un croquis imageant une attaque terroriste dans un véhicule tel que autocar et avion, et où un appareil d'enregistrement 1 selon l'invention, avec caméra déportée ou intégrée serait implanté;
- la figure 2g est une vue générale d'une architecture d'un appareil d'enregistrement selon l'invention, avec caméra intégrée;
- la figure 3g est une vue générale d'une architecture d'un appareil d'enregistrement selon l'invention, avec caméra déportée ;
- la figure 1h est une vue générale d'une architecture d'un appareil d'enregistrement selon l'invention ;
- la figure 2h est une vue de la façade d'un appareil d'enregistrement selon l'invention ;
- les figures 1i, 1i, 1i représentent trois équipements schématisant des appareil de vision conforme à l'invention ;
- la figure 2i est une vue générale d'un boîtier portatif ;
- la figure 3i est une vue générale d'une architecture électronique d'un boîtier de capture 1 selon l'invention. Ce boîtier est destiné à assurer l'enregistrement de séquences fournies par des appareils de vision déportés et susceptibles d'être portés par un utilisateur.

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Sur la figure 1a on a représenté une vue en élévation d'un dispositif d'enregistrement d'images et/ou de sons selon l'invention, désigné par la référence générale 10a. Il est destiné à assurer l'enregistrement d'images et/ou de sons fournis par un dispositif de prise de vues et/ou de sons 12a et à la lecture des données enregistrées.

A ce stade, il convient de souligner qu'un tel dispositif de prise de vue peut être une caméra, un microphone, mais aussi un câble ou un récepteur d'images ou de sons transmis par une caméra ou un microphone déporté par rapport au dispositif.

Sur cette figure 1, le dispositif de prise de vues et/ou de sons est représenté par une caméra de type connu associée, le cas échéant, à des moyens de prise de sons non représentés.

La description qui va suivre s'applique à la mémorisation d'images captées par la caméra 12a, mais peut bien entendu s'appliquer également à la mémorisation des sons captés par les moyens de prise de sons.

L'appareil d'enregistrement comporte, disposés dans un boîtier 14a, une unité centrale de commande 16a, représentée en pointillés, assurant la commande de l'enregistrement de données d'images délivrées par la caméra 12a, à laquelle sont reliés des moyens de mémorisation de données d'images ; un afficheur 18a pour la visualisation de données d'images fournies par la caméra 12a ou stockées dans les moyens de mémorisation ; ainsi qu'un ensemble de touches de commande, tel que 20a, actionnables manuellement par un utilisateur.

Selon l'invention, les moyens de mémorisation sont constitués par des premiers moyens de mémorisation temporaire et en continu de données d'images délivrées par la caméra 12a, représentés en pointillé sur cette figure 1a et désignés par la référence numérique 22a, et des deuxièmes moyens de mémorisation permanente 24a de données stockées temporairement dans ces premiers moyens de mémorisation.

Les premiers moyens de mémorisation 22a sont des moyens de mémorisation volatiles. Ils sont constitués par une mémoire RAM 22a de type"FIFO" assurant en continu un stockage temporaire des données d'images délivrées par la caméra 12a.

De façon classique, la mémoire RAM FIFO 22a est constituée par un ensemble de registres assurant en continu le stockage des données d'images selon un ordre "premier entré-premier sorti".

Lorsque la mémoire RAM FIFO 22a est pleine, la mémorisation d'une nouvelle donnée d'images provoque le décalage du contenu des registres, de sorte que des données d'images premièrement enregistrées soient délivrées en sortie ou écrasées en cas de dépassement de la capacité de la mémoire.

En variante, ces premiers moyens de mémorisation 22a sont constitués par un disque de type "CD ROM" réinscriptible, ou une carte classique de type PCMCIA.

Les deuxièmes moyens de mémorisation 24a sont des moyens de mémorisation permanente. Ils sont constitués par un ensemble modulable de cartes à mémoire 24a de type RAM statique, venant se fixer sur le boîtier 14a, et assurant un stockage permanent de données d'images sélectionnées par un utilisateur et mémorisées dans les premiers moyens de mémorisation.

Ces deuxièmes moyens de mémorisation permanente 24a ont une capacité de mémorisation supérieure à celle des premiers moyens de mémorisation 22a, peuvent être constitués par des moyens de mémorisation réinscriptibles.

En variante, ces deuxièmes moyens de mémorisation sont constitués par des disques de type "CD ROM" ou des cartes classiques de type PCMCIA.

La description de l'unité centrale de commande 16a va maintenant être faite en référence à la figure 2a.

Elle comporte un micro-contrôleur 26a associé à un algorithme de pilotage et de gestion du fonctionnement de l'appareil d'enregistrement, sous la commande de signaux

délivrés par les touches 20, comme cela sera décrit en détail par la suite.

Le micro-contrôleur 26a est relié aux deuxièmes moyens de mémorisation 24a et aux touches de commande 20 (non représentées sur cette figure 2a).

On voit également sur la figure 2a que l'appareil d'enregistrement 10a comporte une unité de traitement de données constituée par une carte vidéo 28a assurant la réception des données d'images délivrées par la caméra 12a et leur conversion dans un format adapté pour leur mémorisation dans la mémoire RAM "FIFO" 22a.

A cet effet, la carte vidéo 28a comporte un convertisseur analogique-numérique et un circuit de compression de données, non représentés et de type connu.

Par ailleurs, un circuit d'interface 30a, relié au micro-contrôleur 26a, est interposé entre la mémoire RAM FIFO 22a et les mémoires RAM statiques 24a en vue de la transmission des données stockées dans la mémoire volatile 22a vers la mémoire permanente 24a sous la commande du micro-contrôleur 26a.

Le circuit d'interface 30a est constitué par un circuit logique à portes ET assurant un ET logique entre les données délivrées en sortie de la RAM FIFO 22a et un signal E de commande d'enregistrement positionné à un niveau haut pour provoquer l'enregistrement, et à un niveau bas pour provoquer l'arrêt de l'enregistrement.

On conçoit donc que dès que le signal de commande d'enregistrement E est positionné à un niveau haut, les données d'images délivrées par la mémoire RAM FIFO 22a sont présentées en entrées des mémoires RAM statiques 24a.

On voit en outre sur la figure 2a que le microcontrôleur 26a fournit sur une entrée CE de chaque mémoire permanente 24a un signal de validation de mémoiresV1 à V4, en vue de leur sélection.

Par ailleurs, le signal de commande d'enregistrement E est présenté sur l'entrée R/W de chaque mémoire RAM statique 24a, après avoir été inversé par un inverseur 35a.

Ainsi dès que le signal de commande E est à un niveau haut, les mémoires permanentes 24a sont positionnées selon un mode d'écriture. De même, lorsque ce signal E est à un niveau bas, les mémoires 24a sont positionnées selon un mode de lecture.

Chaque mémoire RAM statique 24a est reliée à un oscillateur 32a approprié et de type classique, assurant l'adressage de chaque mémoire RAM statique 24a en synchronisme avec les données délivrées en sortie du circuit d'interface 30a.

Enfin, chaque mémoire permanente 24a est reliée en sortie à un circuit d'interface 34 de type classique assurant en particulier la décompression des données délivrées en sortie de ces RAM statiques 24a en vue de leur présentation sur l'afficheur 18a.

On voit en outre sur la figure 2a que le microcontrôleur 26a reçoit en entrée des signaux de commande en provenance des touches de commande 20a.

Le micro-contrôleur 26a reçoit en particulier un signal Enr de commande de l'enregistrement des données d'images stockées dans les premiers moyens de mémorisation 22. Il délivre, en réponse, le signal E de commande d'enregistrement décrit précédemment.

Le micro-contrôleur reçoit également en entrée un signal N de commande de la gestion de l'accès aux deuxièmes moyens de mémorisation 24a. Il délivre en réponse les signaux V1 à V4 de sélection des mémoires RAM statiques 24a, décrit précédemment.

Le micro-contrôleur 26a reçoit en outre des signaux de commande du mode de lecture du contenu des mémoires RAM statiques 24a, constitués par exemple par des signaux Ar d'avance rapide, RR de retour rapide, P de commande de pause et L de commande de lecture.

Le fonctionnement de l'appareil d'enregistrement dont la structure vient d'être décrite va maintenant être exposé en référence aux figures 3a et 4a.

En se référant tout d'abord à la figure 3a, lors d'une première étape 40a, les données d'images délivrées par la caméra 12a sont délivrées en entrée du circuit d'interface 28a. Lors de l'étape 42a suivante, ces données d'images sont compressées puis, dans l'étape 44a, ces données compressées sont empilées successivement et en continu dans les registres de la mémoire RAM FIFO 22a.

Au cours de l'étape 46a suivante, le micro-contrôleur 26a interroge son entrée Enr afin de déterminer si un utilisateur a actionné la touche correspondante de commande de l'enregistrement. Si tel est le cas, il provoque au cours de l'étape 48a suivante la mémorisation, dans l'une des mémoires permanentes 24a, des données d'images stockées dans la mémoire volatile 22a selon la procédure qui sera décrite en référence à la figure 4a, et ce, jusqu'à ce que l'utilisateur actionne une touche correspondante d'arrêt d'enregistrement.

Pour ce faire, le micro-contrôleur 26a positionne à un niveau haut le signal de commande d'enregistrement E ce qui provoque le passage des données d'images stockées dans la mémoire RAM FIFO 22a vers une des mémoires RAM statiques 24a sélectionnée ou automatiquement vers une des mémoires 24a disponible, c'est-à-dire non pleine, et le positionnement de ces RAM dans un mode d'écriture.

Pour la sélection d'une des mémoires permanentes 24a, le micro-contrôleur 26a positionne à un niveau haut un signal de validation V1 à V4 correspondant en réponse à une action sur une touche de commande 20a respective provoquant l'émission d'un signal N spécifique.

Si tel n'est pas le cas, c'est-à-dire si au cours de l'étape 46a un utilisateur n'a pas actionné la touche de commande de l'enregistrement, au cours des étapes 50a, 52a et 54a suivantes, dans le cas où la mémoire RAM FIFO 22a est

saturée, les données d'images enregistrées en premier sont éliminées ou écrasées successivement et remplacées par des données d'images enregistrées postérieurement.

On conçoit donc que selon le fonctionnement qui vient d'être décrit, des données d'images se rapportant à un événement particulier et que l'utilisateur souhaite mémoriser sont enregistrées dans les mémoires RAM statiques 24a, postérieurement à leur stockage temporaire dans la mémoire FIFO 22a.

Il est par ailleurs à noter que l'appareil d'enregistrement fonctionne selon un premier mode de veille, étapes 40a à 46a, au cours duquel des données d'image délivrées par la caméra 12a sont stockées temporairement et en continu dans les premiers moyens de mémorisation 22a, et selon un deuxième mode d'enregistrement ou de mémorisation, étape 48a, au cours duquel des données sélectionnées et relatives à une séquence particulière d'une scène captée par la caméra 12a sont stockées de façon permanente dans les deuxièmes moyens de mémorisation 24a, et ce, après leur apparition.

Comme cela a été mentionné précédemment, la mémorisation des données d'image dans les deuxièmes moyens de mémorisation 24a est commandée par l'utilisateur en réponse à des actions sur des touches correspondantes de début d'enregistrement et d'arrêt d'enregistrement.

Ainsi, les données d'image stockées temporairement dans les premiers moyens de mémorisation 22a sont transférées vers les deuxièmes moyens de mémorisation 24a pendant l'intervalle de temps délimité par une action sur la touche du début d'enregistrement et une action sur la touche d'arrêt d'enregistrement.

Toutefois, il est possible qu'un utilisateur actionne la touche d'arrêt d'enregistrement avant que la totalité de la séquence qu'il souhaite mémoriser soit effectivement stockée dans les deuxièmes moyens de mémorisation, la partie de la séquence en transit et subsistant dans les premiers moyens de

mémorisation 22a étant alors susceptible d'être écrasée par la suite.

Pour pallier cet inconvénient, une sortie A d'autorisation d'arrêt d'enregistrement du microcontrô leur 26a est avantageusement associée à une ligne à retard 55a de type connu, par exemple de type 50A-10501, et associée à une porte ET 55'a assurant un ET logique entre cette sortie A et la sortie E. La sortie de la porte ET est connectée au circuit d'interface 30a.

Il est ainsi possible, à l'aide de la ligne à retard 55a de provoquer un retard dans la transmission de la commande d'arrêt d'enregistrement.

Ainsi, après avoir provoqué l'arrêt de l'enregistrement, les données d'image en transit dans les premiers moyens de mémorisation 22a continuent à être transférées dans les deuxièmes moyens de mémorisation 24a pendant la durée correspondant au retard engendré par la ligne à retard.

Il est également possible, en variante, pour pallier cet inconvénient, de doter le circuit d'interface 30a d'un circuit logique de reconnaissance d'un mot de code de fin d'enregistrement inséré dans les données d'image par l'unité centrale de commande 16a lors de l'action sur la touche de commande d'arrêt d'enregistrement, pour provoquer l'arrêt de l'écriture dans les deuxièmes moyens de mémorisation 24a lors de la détection de ce mot de code de fin d'enregistrement.

Il est de surcroît à noter que, à l'aide de la sélection des mémoires permanentes 24a, chacune d'elles peut être destinée à la mémorisation d'événements ou de séquences se rapportant à une même scène, ou de même nature.

Ces images peuvent ensuite être visualisées sur l'écran 18a à l'aide d'un organe de lecture approprié, non représenté. Pour ce faire, l'utilisateur sélectionne une mémoire particulière à l'aide d'une touche correspondante, ce qui provoque un positionnement correspondant d'un des signaux V1 àV4

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de validation des mémoires RAM statiques 24a. L'utilisateur actionne ensuite les touches de lecture, de pause, d'avance rapide ou de retour rapide en vue de provoquer l'affichage sélectif des données sur l'afficheur 18a.

Au cours du fonctionnement de l'appareil d'enregistrement en mode de lecture, l'entrée E est positionnée à un niveau bas, ce qui provoque un positionnement des RAM statiques 24a en mode de lecture.

La gestion de l'accès aux différentes mémoires RAM statiques 24a va maintenant être expliquée en référence à l'organigramme de la figure 4a.

Au cours d'une première étape 56a, le microcontrôleur 26 scrute son entrée N positionnée par l'utilisateur, à l'aide d'une touche de commande 20a correspondante, à l'aide de laquelle l'utilisateur positionne l'appareil en mode d'adressage manuel ou automatique, et sélectionne une des mémoires RAM statiques 24a.

Si l'adressage manuel est sélectionné, le microcontrôleur 26a lie le numéro de la mémoire statique 24a sélectionnée au cours de l'étape 58a.

Si le mode d'adressage automatique est sélectionné, le micro-contrôleur 26a oriente les données d'images vers une mémoire 24 disponible au cours de l'étape 60a.

Au cours de l'étape 62a suivante, le micro-contrôleur 26a vérifie l'état de la mémoire sélectionnée. Si la mémoire 24a sélectionnée est pleine, le micro-contrôleur vérifie l'état des autres mémoires au cours de l'étape 64a suivante.

Si toutes les autres mémoires sont pleines, un signal d'alarme est délivré au cours de l'étape 66a.

Si tel n'est pas le cas, le micro-contrôleur provoque l'adressage automatique vers une autre mémoire RAM statique disponible au cours de l'étape 68a, au cours de laquelle des données d'images sont mémorisées dans cette mémoire. Si au cours de l'étape 70a suivante cette mémoire de

stockage est pleine, le fonctionnement retourne à l'étape 64a précédente.

Si au cours de l'étape 62a la mémoire 24a de stockage sélectionnée n'est pas pleine, cette mémoire reçoit, au cours des étapes 72a,74a et 76a suivantes des données d'images extraites de la RAM FIFO 22a qui se déversent alors en continu vers la mémoire 24a sélectionnée. Au cours de cet enregistrement de données d'images, le micro-contrôleur scrute en permanence, au cours de l'étape 74a, l'état de la mémoire sélectionnée. Si cette mémoire est pleine, le fonctionnement retourne à l'étape 64 précédente.

Si tel n'est pas le cas, le chargement de cette mémoire se poursuit, et après l'enregistrement, l'appareil se met en mode de veille à l'étape 80a. On conçoit donc que dès la mise en veille de l'appareil d'enregistrement un utilisateur a la possibilité de positionner l'appareil dans le mode d'enregistrement en vue de stocker dans une mémoire permanente des données d'images relatives à un évènement d'une scène s'avérant particulièrement intéressante après l'apparition de cet évènement.

Dans l'exemple de réalisation qui vient d'être décrit, les premiers moyens de mémorisation sont constitués par une unique RAM FIFO cascadables ou d'un ensemble de mémoires RAM FIFO en série.

Il serait toutefois possible, en variante, de doter l'appareil d'un ensemble de mémoires RAM FIFO cascadables ou d'un ensemble de mémoires RAM FIFO en série et disposées en cascade en vue d'augmenter la durée de l'événement susceptible d'être récupéré pour sa mémorisation.

Il est également à noter que les mémoires permanentes étant modulables, amovibles et interchangeables, il est possible, à l'aide de cet appareil, de lire des données d'images mémorisées dans les seconds moyens de mémorisation d'un autre appareil de même type.

Cet appareil peut également être doté d'entrées et de sorties audio et/ou vidéo en vue du transfert de données et/ou de séquences en provenance d'autres appareils du même type.

Dans l'exemple de réalisation qui a été décrit, l'enregistrement est commandé par un utilisateur de façon manuelle.

Selon un autre mode de réalisation,l'enregistrement est effectué de façon automatique par le microcontrôleur 26a, à l'aide d'un algorithme approprié, selon des cycles ou périodes prédéterminés ou lors d'apparitions d'évènements particuliers.

Description de la 1ère application de l'invention :

La description de la première application de l'invention est effectuée ci-dessous à l'aide de la figure 1b on a représenté une vue de dessus d'un boîtier d'enregistrement selon l'invention, et désigné par le repère 1b.

Il est destiné à assurer l'enregistrement d'images et ou de sons fournis par une ou des caméras 2b porté(es) par un utilisateur ou installé(es) sur un site sous surveillance, isolé.

Dans la configuration selon figure 1b, la caméra s'avère déportée par rapport au boîtier d'enregistrement 1b, en vue de son port et/ou de son implantation susceptible d'offrir le maximum de champs de vision, voire de discrétion.

Pour faciliter la transportabilité de l'ensemble, voire sa discrétion, il est envisageable de parler de mini-caméra 2b, en vue de sa fixation sur vêtement, en boutonnière, bandeau, casque, casquette, monture de lunettes, et/ou tout autre lieu discret et difficilement visible et détectable.

Les architectures seront bien entendu adaptées aux milieux dans lesquels, le boîtier 1b et/ou la caméra 2b seront susceptibles d'être utilisés.

Sur cette figure 1b, les informations entrantes dans le boîtier 1b et émanant de la caméra 2b, sont recueillies sur

une prise d'entrée 3b adaptée au format de sortie de cette caméra 2b.

Le boîtier repère 1b est connecté, extérieurement, à un ou des actionneurs 10b adaptés à une commande manuelle et/ou aux circonstances génératrices d'évènements envisageables.

Il en est ainsi pour des boutons à impulsions à commandes manuelles, détecteurs automatiques de type surtension, ouverture, pression, température, présence, choc, et autres boutons poussoirs... dont les actions relayées par des équipements adaptés vers le contacteur 11b, provoqueront le transfert immédiat des séquences mémorisées dans les premiers moyens de mémorisation temporaires 7b vers les seconds moyens de mémorisation permanente 8b, dont les caractéristiques respectives sont présentées ci-après.

Cette figure 1b image, dans le même boîtier 1b, un module électronique d'émission et de réception téléphonique mobile et séquences vidéo 14b, semblable à ceux existants sur le marché et de type connu.

La description qui va suivre s'applique donc particulièrement à la mémorisation de séquences vidéo entrantes par le biais de la caméra 2b, appréciées pertinentes immédiatement et postérieurement à la séquence filmée susceptible d'intérêt, en vue de leur transmission téléphonique vers un interlocuteur équipé d'un téléphone mobile adapté à la réception de séquences vidéo.

Ce principe de fonctionnement s'avère par ailleurs tout aussi adapté, à la mémorisation de sons captés et de données diverses en vue de leur transmission suivant les mêmes principes.

L'appareil d'enregistrement comporte un circuit électronique 4b intégrant les composants nécessaires au principe de capture précédemment rappelé.

Le système d'enregistrement sera alimenté en énergie, en fonction de sa vocation de mobilité ou non, suivant les moyens conventionnels (secteur, batterie...) via une prise repère

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5b et bloc d'alimentation éventuellement intégré 6b, et se trouve opérationnel, dès son raccordement via le connecteur 3b à la caméra 2b et dès la mise en fonction de celle-ci.

S'agissant d'un équipement transportable éventuellement, il est envisageable, pour des raisons d'économies d'énergie, de doter le boîtier d'un contact de mise en fonction 9b à la discrétion de l'utilisateur.

Il est envisageable, dans une configuration étendue, via un code spécifique et relayage adapté interne à l'appareil, de commuter ce contact 9b de mise en fonction par une personne à distance équipée d'un téléphone mobile, habilitée, et désireuse de capturer une information à tout moment sur l'environnement du porteur de ce boîtier 1b.

Pour autant que ce contact 9b demeure fermé, l'appareil 1b se trouve donc, dès cet instant, dans une phase d'enregistrement en continu suivant le principe FIFO, et donc de mémorisation des séquences entrantes dans des premiers moyens de mémorisation 7b, après les fonctions de décodage/codage/ compression éventuelle desdites données entrantes via le circuit 12b.

Ces premiers moyens de mémorisations 7b sont de type volatils, et assurent en continu un stockage temporaire des données entrantes émanant desdits appareils amont.

De façon classique, la mémoire RAM FIFO 7b, est constituée par un ensemble de registres assurant en continu le stockage des données d'images selon un ordre « premier entré-premier sorti ».

Lorsque la mémoire RAM FIFO 7b est pleine, la mémorisation d'une nouvelle donnée d'images provoque le décalage du contenu des registres, de sorte que des données d'images enregistrées soient délivrées en sortie ou écrasées en cas de dépassement de la capacité de la mémoire.

En variante, ces premiers moyens de mémorisation 7b sont constitués par un disque de type « CD-ROM » réinscriptible,

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ou une carte classique PCMCIA, voire autre mémoire flash, ou espace mémoire sur un disque dur interne ou périphérique.

L'extension de ces dits premiers moyens de mémorisation 7b, en terme de capacité et/ou pour d'autres raisons fonctionnelles, telle que par exemple la poursuite de capture durant une phase de lecture, peut conduire à adjoindre à ces premiers moyens de mémorisation 7b, des moyens du même type en cascade 7'a, 7'b, 7'c...

Les deuxièmes moyens de mémorisation 8b sont des moyens de mémorisation permanente. Ils sont constitués par un ensemble modulable de cartes à mémoires 8b de type RAM statique, venant se fixer sur le circuit 4b, et assurant un stockage permanent de données d'images sélectionnées par un utilisateur et mémorisées dans les premiers moyens de mémorisation 7b.

Ces deuxièmes moyens de mémorisation permanente 8b ont une capacité de mémorisation supérieure à celle des premiers moyens de mémorisation 7b, peuvent être constitués par des moyens de mémorisation réinscriptibles.

En variante, ces deuxièmes moyens de mémorisation 8b sont constitués par un disque de type « CD-ROM » réinscriptible, ou une carte classique PCMCIA, mémoire flash, voire disque dur intégré ou périphérique.

L'extension de ces dits seconds moyens de mémorisation 8b, en terme de capacité, peut conduire à adjoindre à ces seconds moyens de mémorisation 8b, des moyens du même type en cascade 8'a, 8'b, 8'c...

A ce stade, et suivant la vocation et/ou la configuration de cet appareil, après formatage adapté dans le circuit 12b, la transmission téléphonique de ces séquences capturées, via le module d'émission 14b, peut être opérée systématiquement et donc automatiquement lors du déclenchement du contacteur 10b, ou au gré du porteur de l'appareil, par une position d'un commutateur 13b.

Ce mode de transmission sera défini par la position du commutateur 13b, qui sera ou non actionnable par le porteur de l'appareil.

De même et en variante, du fait de la pertinence de l'information appréciée après-coup par le porteur de l'appareil, la commande de transfert de données à partir des mémoires 7b vers les moyens de mémorisation permanente 8b, pourrait s'effectuer manuellement à sa convenance, par une nouvelle position du commutateur 13b.

Une autre position de ce commutateur 13b, permettrait le transfert de données directement des premiers moyens de mémorisation 7b, vers le module d'émission du téléphone intégré 14b, après formatage dans le circuit 12b.

Dans les versions intégrées à l'appareil du module d'émission et/ou de réception 14b, et telles que représentées sur la figures 1b et sur la figure 3b, le(s) numéro(s) de téléphone de correspondant(s) directement concerné(s) par le contenu des séquences captées par la caméra 2b et mémorisées en 7b et en 8b, seront programmés en vue d'une transmission directe et instantanée.

En variante et/ou en complément au module d'émission et/ou de réception 14b , il est envisageable de compléter ce module par un écran de type LCD existant et courant 15b , afin de visionner les séquences captées et mémorisées en 7b et/ou 8b, autant avant, que pendant leur transfert vers le correspondant désigné.

La figure 2b représente le boîtier tel que décrit précédemment, dans une configuration ensemble de transmission/réception déporté 17b, et doté d'un cordon de raccordement 16b afin de transférer les données issues des moyens de mémorisation 7b et 8b, en vue de leur transmission par ce téléphone mobile 17b , du type couramment répandu et capable de traiter notamment des séquences vidéo.

Dans cette configuration, les principes de capture de séquences antérieures à l'événement et de transmission de données sont de même nature que décrit précédemment.

La figure 3b représente le boîtier tel que décrit précédemment, dans une architecture intégrant la caméra 2b, l'appareil d'enregistrement 1b, et un ensemble de transmission/réception 14b, tels que décrits précédemment.

Dans cette configuration, les principes de capture de séquences antérieures à l'événement et de transmission de données sont de même nature que décrit précédemment.

La figure 4b représente le boîtier tel que décrit précédemment, dans une architecture intégrant la caméra 2b, l'appareil d'enregistrement 1b, dans une configuration ensemble de transmission/réception déporté 17b, et doté d'un cordon de raccordement 16b afin de transférer les données issues des moyens de mémorisation 7b et 8b, pour une transmission des séquences enregistrées par ce téléphone mobile 17b, du type couramment répandu et capable de traiter notamment des séquences vidéo.

Dans cette configuration, les principes de capture de séquences antérieures à l'événement et de transmission de données sont de même nature que décrit précédemment.

Description de la 2nd application de l'invention :

Sur la figure 1c on a représenté une vue de dessus d'un boîtier d'enregistrement selon l'invention, et désigné par le repère 1c. Il est destiné à assurer l'enregistrement d'images et ou de sons fournis par une ou des caméras 2c installé(es) dans la zone périphérique d'un boîtier de commande d'arrêt d'urgence.

Dans la configuration selon figure 1c, la caméra s'avère déportée par rapport au boîtier d'enregistrement 1c, en vue de son implantation susceptible d'offrir le maximum de

champs de vision, voire de discrétion, autour de la zone d'intervention.

Les architectures seront bien entendu adaptées aux milieux dans lesquels, le boîtier 1c et/ou la caméra 2c seront susceptibles d'être utilisés.

Sur cette figure 1c, les informations entrantes dans le boîtier 1 et émanant de la caméra 2c, sont recueillies sur une prise d'entrée 3c adaptée au format de sortie de cette caméra 2c.

Le boîtier repère 1c est connecté, extérieurement, à une commande d'arrêt d'urgence 10c, de type connu et cité, et positionné à l'endroit requis pour accès aisé à toute personne.

Ainsi, une action manuelle sur ce(s) boutons d'arrêt d'urgence placés dans le champs de la(les) caméra(s) du type 2c, actionnera via relayage adapté, le contacteur 11c, provoquera le transfert immédiat des séquences mémorisées dans des premiers moyens de mémorisation temporaires 7c vers des seconds moyens de mémorisation permanente 8c, dont les caractéristiques respectives sont présentées ci-après.

La description qui va suivre s'applique donc particulièrement à la mémorisation de séquences vidéo entrantes par le biais de la caméra 2c, appréciées pertinentes immédiatement et postérieurement à la séquence filmée et déclarée automatiquement d'intérêt du fait de l'action de commande d'arrêt d'urgence par une personne présente dans le champs de vision de la caméra.

Ce principe de fonctionnement s'avère par ailleurs tout aussi adapté, à la mémorisation de sons captés et de données diverses en vue de leur transmission suivant les mêmes principes.

L'appareil d'enregistrement comporte un circuit électronique 4c intégrant les composants nécessaires au principe de capture précédemment rappelé.

Le système d'enregistrement sera alimenté en énergie, en fonction de sa vocation de mobilité ou non, suivant les

moyens conventionnels (secteur, batterie...) via une prise repère 5c et bloc d'alimentation éventuellement intégré 6c, et se trouve opérationnel, dès son raccordement via le connecteur 3c à la caméra 2c.

La caméra 2c se trouve donc, dès cet instant en saisie passive de séquences vidéo et alimente en continu, par lesdites données vidéo, et par l'intermédiaire d'un circuit de compactage et de formatage 12c, un premier bloc mémoire 7c.

Tant que, selon la représentation, la commande d'arrêt d'urgence 10c se trouve en position fermée, l'appareil 1c est dans un état d'enregistrement en continu suivant le principe FIFO, et donc de mémorisation des séquences entrantes dans des premiers moyens de mémorisation 7c.

Ces premiers moyens de mémorisations 7c sont de type volatils, et assurent en continu un stockage temporaire des données entrantes émanant desdits appareils amont.

De façon classique, la mémoire RAM FIFO 7c, est constituée par un ensemble de registres assurant en continu le stockage des données d'images selon un ordre « premier entré-premier sorti ».

Lorsque la mémoire RAM FIFO 7c est pleine, la mémorisation d'une nouvelle donnée d'images provoque le décalage du contenu des registres, de sorte que des données d'images enregistrées soient délivrées en sortie ou écrasées en cas de dépassement de la capacité de la mémoire.

En variante, ces premiers moyens de mémorisation 7c sont constitués par un disque de type « CD-ROM » réinscriptible, ou une carte classique PCMCIA, voire autre mémoire flash, ou espace mémoire sur un disque dur interne ou périphérique.

L'extension de ces dits premiers moyens de mémorisation 7c, en terme de capacité et/ou pour d'autres raisons fonctionnelles, telle que par exemple la poursuite de capture durant une phase de lecture, peut conduire à adjoindre à ces premiers moyens de mémorisation 7c, des moyens du même type en cascade 7'a, 7'b, 7'c...

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Les deuxièmes moyens de mémorisation 8c sont des moyens de mémorisation permanente. Ils sont constitués par un ensemble modulable de cartes à mémoires 8c de type RAM statique, venant se fixer sur le circuit 4c, et assurant un stockage permanent de données d'images sélectionnées par un utilisateur et mémorisées dans les premiers moyens de mémorisation 7c.

Ces deuxièmes moyens de mémorisation permanente 8 ont une capacité de mémorisation supérieure à celle des premiers moyens de mémorisation 7c, peuvent être constitués par des moyens de mémorisation réinscriptibles.

En variante, ces deuxièmes moyens de mémorisation 8c sont constitués par un disque de type « CD-ROM » réinscriptible, ou une carte classique PCMCIA, mémoire flash, voire disque dur intégré ou périphérique.

L'extension de ces dits seconds moyens de mémorisation 8c, en terme de capacité, peut conduire à adjoindre à ces seconds moyens de mémorisation 8c, des moyens du même type en cascade 8'a, 8'b, 8'c...

A ce stade, et suivant la configuration de cet appareil, après formatage adapté dans le circuit 12c, la récupération des séquences enregistrées dans les seconds moyens de mémorisation 8c, peut s'opérer de diverses façons, à partir d'une connexion adaptée en 13c :

- soit par transmission filaire et ou optique vers un appareil dédié et décentralisé de type connu, tels que moniteurs, ordinateurs, magnétoscopes, et autres caméscopes et baladeurs vidéo cet appareil étant susceptible d'être implanté dans un local de service à la disposition du préposé habilité. A ce moment là, le préposé disposera donc des séquences pertinentes précédents la commande d'alarme.

- soit par lecture sur place, au moyen d'un lecteur adapté à la disposition et porté par le préposé au constat de la commande d'arrêt d'urgence. Ces appareils peuvent être du même type que ceux déjà cités.

En variante, il est concevable de décentraliser du boîtier 1c, les moyens de mémorisation permanents 8c, afin de limiter leur vulnérabilité possible face aux agressions coupables.

En variante encore, il est de même envisageable de disposer de moyens de mémorisation 7c et 8c extractibles à des fins pratiques et/ou en preuves tangibles de constats d'évènements et de faits justifiés ou de faits répréhensibles et/ou condamnables.

En variante d'exploitation, il est envisageable de n'utiliser, à la discrétion de l'utilisateur, et à des fins de lecture de contrôle éventuellement, la seule mémoire 7c par commutation d'un bouton adapté 9c. Cette position, si la commande d'arrêt d'urgence 10c n'est pas désactivée et/ou la caméra 2c hors service, provoquera progressivement et au terme de la capacité de mémorisation des mémoires 7c de type FIFO éventuellement, l'effacement des données contenues dans lesdites mémoires 7c.

Description de la 3ième application de l'invention :

On a représenté sur la figure 1d est un croquis imageant des symboles de lieux d'utilisation susceptibles d'être sous surveillance.

On peut aisément imaginer l'installation d'un tel boîtier, à proximité immédiate de la zone sensible sous surveillance, que celle-ci soit à caractère privé dans une entreprise par exemple, ou que ce soit d'une zone accessible au public en général (bâtiments, monuments divers, magasins, sites touristiques...,) zones susceptibles d'être exposées aux actes les plus divers de malveillance et attentats malheureusement.

La figure 2d est une vue générale d'une architecture d'un appareil d'enregistrement selon l'invention, avec caméra intégrée.

Sur la figure 2d on a représenté une vue de dessus d'un boîtier d'enregistrement selon l'invention, et désigné par

le repère 1d. Il est destiné à assurer l'enregistrement d'images et ou de sons fournis par une ou des caméras 2d installé(es) dans la zone périphérique d'un (de) détecteur(s) 4d adapté(s) à(aux) l'événement(s) susceptible(s) de se produire.

Dans la configuration selon figure 2d, la caméra s'avère intégrée au boîtier d'enregistrement 1d, sachant qu'une solution avec caméra 2d déportée à l'appareil 1d en vue d'une implantation susceptible d'offrir le maximum de champs de vision, voire de discrétion, autour de la zone d'intervention, demeure tout à fait envisageable.

Les architectures seront bien entendues adaptées aux milieux dans lesquels, le boîtier 1d et/ou la caméra 2d seront susceptibles d'être utilisés.

L'appareil d'enregistrement comporte un circuit électronique 3d intégrant les composants nécessaires au principe de capture précédemment rappelé.

Le système d'enregistrement sera alimenté en énergie, en fonction de son implantation, suivant les moyens conventionnels (secteur, batterie, capteurs solaires...) via une prise repère 9d et bloc d'alimentation éventuellement intégré 10d, et se trouve opérationnel, dès son alimentation en énergie.

Le boîtier repère 1d est connecté, extérieurement, à un détecteur 4d, de type spécifique, connu et cité, et positionné à l'endroit requis pour capter, par ses fonctionnalités, l'information susceptible de se produire.

La caméra 2d se trouve donc, dès cet instant en saisie passive de séquences vidéo et alimente en continu, par lesdites données vidéo, et par l'intermédiaire d'un circuit de compactage et de formatage 6d, un premier bloc mémoire temporaire 7d.

Tant que, selon la représentation, le détecteur 4d se trouve en position fermée, l'appareil 1d est dans un état d'enregistrement en continu suivant le principe FIFO, et donc de mémorisation des séquences entrantes dans des premiers moyens de mémorisation 7d.

Ces premiers moyens de mémorisations 7d sont de type volatil, et assurent en continu un stockage temporaire des données entrantes émanant desdits appareils amont.

De façon classique, la mémoire RAM FIFO 7d, est constituée par un ensemble de registres assurant en continu le stockage des données d'images selon un ordre « premier entré-premier sorti ».

Lorsque la mémoire RAM FIFO 7d est pleine, la mémorisation d'une nouvelle donnée d'images provoque le décalage du contenu des registres, de sorte que des données d'images enregistrées soient délivrées en sortie ou écrasées en cas de dépassement de la capacité de la mémoire.

En variante, ces premiers moyens de mémorisation 7d sont constitués par un disque de type « CD-ROM » réinscriptible, ou une carte classique PCMCIA, voire autre mémoire flash, ou espace mémoire sur un disque dur interne ou périphérique.

L'extension de ces dits premiers moyens de mémorisation 7d, en terme de capacité et/ou pour d'autres raisons fonctionnelles, telle que par exemple la poursuite de capture durant une phase de lecture, peuvent conduire à adjoindre à ces premiers moyens de mémorisation 7d, des moyens du même type en cascade 7'a, 7'b, 7'c...

Par un incident spécifique et identifié comme tel par le contacteur 4d, celui-ci actionnera via relayage adapté vers le contacteur 5d, le transfert immédiat des séquences mémorisées dans des premiers moyens de mémorisation temporaires 7d vers des seconds moyens de mémorisation permanente 8d.

Les deuxièmes moyens de mémorisation 8d sont donc des moyens de mémorisation permanente. Ils sont constitués par un ensemble modulable de cartes à mémoires 8d de type RAM statique, venant se fixer sur le circuit 3d, et assurant un stockage permanent de données d'images sélectionnées par un utilisateur et mémorisées dans les premiers moyens de mémorisation 7d.

Ces deuxièmes moyens de mémorisation permanente 8d ont une capacité de mémorisation supérieure à celle des premiers moyens de mémorisation 7d, peuvent être constitués par des moyens de mémorisation réinscriptibles.

En variante, ces deuxièmes moyens de mémorisation 8d sont constitués par un disque de type « CD-ROM » réinscriptible, ou une carte classique PCMCIA, mémoire flash, voire disque dur intégré ou périphérique.

L'extension de ces dits seconds moyens de mémorisation 8d, en terme de capacité, peut conduire à adjoindre à ces seconds moyens de mémorisation 8d, des moyens du même type en cascade 8'a, 8'b, 8'c...

A ce stade, et suivant la configuration de cet appareil, après formatage adapté dans le circuit 6d, la récupération des séquences enregistrées dans les seconds moyens de mémorisation 8d, peut s'opérer de diverses façons, à partir d'une connexion adaptée en 11d :

- soit par transmission filaire et ou optique vers un appareil dédié et décentralisé de type connu, tels que moniteurs, ordinateurs, magnétoscopes, et autres caméscopes et baladeurs vidéo... cet appareil étant susceptible d'être implanté dans un local de service à la disposition du préposé habilité. A ce moment là, le préposé disposera donc des séquences pertinentes précédents la mise en action du détecteur 4d.

- soit par lecture sur place, au moyen d'un lecteur adapté à la disposition et porté par le préposé au constat de l'accident déclaré. Ces appareils peuvent être du même type que ceux déjà cités.

En variante, il est concevable de décentraliser du boîtier 1d, les moyens de mémorisation permanents 8d, afin de limiter leur éventuelle vulnérabilité.

En variante encore, il est de même envisageable de disposer de moyens de mémorisation 7d et 8d extractibles à des fins pratiques et/ou en preuves tangibles de constats

d'évènements et de faits justifiés ou de faits répréhensibles et/ou condamnables.

En variante d'exploitation, il est envisageable d'utiliser, à la discrétion des préposés aux interventions, le commutateur 12d en :

- une première position, pour le transfert automatique des séquences émanant des premiers moyens de mémorisation 7d vers les seconds moyens de mémorisation 8d,
- une seconde position, et à des fins de lecture de contrôle éventuellement des seuls premiers moyens de mémorisation 7d. Cette position, si la commande du détecteur 4d n'est pas désactivée et/ou la caméra 2d hors service, provoquera progressivement et au terme de la capacité de mémorisation des mémoires 7d de type FIFO éventuellement, l'effacement des données contenues dans lesdites mémoires 7d.
- en une troisième position, la lecture du contenu des premiers moyens de mémorisation 7d et l'enregistrement simultané dudit contenu vers les seconds moyens de mémorisation 8d.

Description de la 4ième application de l'invention :

Comme décrit en figure 1e et figure 2e, et suivant une vue de face en élévation, l'appareil se présenterait principalement comme un ensemble 1e intégrant :

- un écran de visualisation 2e de séquences en lecture et/ou à enregistrer
- un tableau de commandes 3e des séquences possibles
- un(des) haut(s)-parleur(s) 4e
- un stand d'accueil 5e, éventuellement amovible, et équipé de slots 6e pour accueil de mémoires extractibles 7e préalablement enregistrées.
- un stand de réception 8e, éventuellement amovible, et équipé de slots 9e pour accueil de mémoires extractibles 10e susceptibles de supporter un nouvel enregistrement

- des interfaces d'entrées 11e adaptées aux sorties disponibles sur appareils extérieurs (ordinateurs, caméscopes, magnétoscopes, téléviseurs, baladeurs, téléphone mobile...)

- des interfaces de sorties 12e adaptées aux mêmes types d'appareils

- d'une poignée 19e pour faciliter son transport et sa mobilité.

Sur la figure 2e on a schématisé une vue de dessus fonctionnelle d'un boîtier d'enregistrement selon l'invention, et désigné par le repère 1e. Il est destiné à assurer l'enregistrement d'images et ou de sons fournis principalement par des mémoires flash mais tout aussi bien par un téléviseur, magnétoscope, caméscope, lecteurs de DVD, téléphone mobile, ordinateur connecté à Internet, décodeur de programmes TV.

Sur cette figure 2e, les informations entrantes dans le boîtier 1e et émanant des appareils cités, sont recueillies sur une prise d'entrée 11e adaptée au format de sortie de ces appareils de type connus et non représentés sur la dite figure.

En vue de leur traitement en lecture, les mémoires flash 7e sont insérées dans des slots 6e au format mécanique adapté à leur géométrie. Les informations entrantes et issues des mémoires flash 7e sont traitées dès insertion dans le stand d'accueil 5e, suivant une voie analogue à celle émanant des appareils extérieurs cités.

Les stands d'accueil 5e extractibles sont dotés de connexions internes et adaptées aux formats des mémoires flash introduites dans les slots 6e de positionnement.

Ces mêmes stands d'accueil 5e extractibles, sont dotés de connexions externes nécessaires au transfert de données des mémoires 7 vers l'unité de traitement 13e.

En variante, il est concevable de n'équiper l'appareil que de slots 6e de positionnement des mémoires 7e, c'est-à-dire de se dispenser d'un stand d'accueil 5e extractible, les fonctions de connexions des mémoires 7e pour transfert vers l'unité de traitement 13e, demeurant du même type.

En variante, le stand d'accueil pourrait être équipé d'une(de) station(s) « hote(s) », afin de couvrir les formats mécaniques et connectiques des diverses cartes mémoires existant actuellement sur le marché.

Le stand de réception 8e extractible est doté de connexions internes et adaptées aux formats des mémoires flash introduites dans les slots 9e de positionnement.

Ce même stand de réception 8e extractible, est doté de connexions externes nécessaires à la récupération de données émanant des mémoires 7e via l'unité de traitement 13e et mémoire 16e.

En variante, il est concevable de n'équiper l'appareil que de slots 9e de positionnement des mémoires 10e extractibles, c'est-à-dire de se dispenser d'un stand d'accueil 8e extractible, les fonctions de connexions des mémoires 10e pour récupération des données, demeurant du même type.

En variante, le stand de réception 5e pourrait être équipé d'une(de) station(s) « hote(s) », afin de couvrir les formats mécaniques et connectiques des diverses cartes mémoires existant actuellement sur le marché.

Un circuit électronique 13e intègrera notamment et éventuellement :

- un microprocesseur de traitement, adressage et gestion et de données entrantes et sortantes
- un circuit de compression et de décompression d'images
- un convertisseur analogique/numérique
- un gestionnaire d'écran de visualisation
- un circuit de traitement et d'amplification audio

L'appareil d'enregistrement comporte en outre un circuit électronique 14e intégrant les composants nécessaires au principe de capture précédemment rappelé.

Le boîtier étant alimenté en énergie suivant les moyens conventionnels (secteur, batterie...) et bloc d'alimentation intégrés 15e, se trouve opérationnel, après

insertion d'une mémoire flash à visualiser et/ou à enregistrer 7e, ou raccordement aux appareils amont cités, dès sa mise en fonction sur la commande appropriée sur le tableau de commande 3e.

Il est évident que les opérations de lecture et/ou d'enregistrement à partir des appareils amonts cités nécessite leur mise en service préalable.

Après passage et traitement dans le circuit électronique 13e, l'appareil se trouve donc, dès cet instant, dans une phase d'enregistrement en continu suivant le principe FIFO, et donc de mémorisation des séquences entrantes dans des premiers moyens de mémorisation 16e.

Ces premiers moyens de mémorisations 16e sont de type volatil, et assurent en continu un stockage temporaire des données entrantes émanant desdits appareils amont.

De façon classique, la mémoire RAM FIFO 16e, est constituée par un ensemble de registres assurant en continu le stockage des données d'images selon un ordre « premier entré-premier sorti ».

Lorsque la mémoire RAM FIFO 16e est pleine, la mémorisation d'une nouvelle donnée d'images provoque le décalage du contenu des registres, de sorte que des données d'images enregistrées soient délivrées en sortie ou écrasées en cas de dépassement de la capacité de la mémoire.

En variante, ces premiers moyens de mémorisation 16 sont constitués par un disque de type « CD-ROM » réinscriptible, ou une carte classique PCMCIA, voire autre mémoire flash, ou espace mémoire sur un disque dur interne ou périphérique.

L'extension de ces dits premiers moyens de mémorisation 16e, en terme de capacité et/ou pour d'autres raisons fonctionnelles, telle que par exemple la poursuite de capture durant une phase de lecture, peut conduire à adjoindre à ces premiers moyens de mémorisation 16e, des moyens du même type en cascade 16'a, 16'b, 16'c...

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Les deuxièmes moyens de mémorisation 10e sont des moyens de mémorisation permanente, extractibles et cités. Ils viennent se connecter au circuit 14e, du fait de leur insertion dans le slot concerné 9e équipant le stand de réception 8e, pour assurer un stockage permanent de données d'images sélectionnées par un utilisateur et mémorisées dans les premiers moyens de mémorisation 16e.

Ces deuxièmes moyens de mémorisation permanente 10e possèdent de préférence une capacité de mémorisation supérieure à celle des premiers moyens de mémorisation 16e, et peuvent être constitués par des moyens de mémorisation réinscriptibles.

En variante, ces deuxièmes moyens de mémorisation 10e sont constitués par un disque de type « CD-ROM » réinscriptible, ou une carte classique PCMCIA, mémoire flash, voire disque dur intégré ou périphérique.

L'extension de ces dits seconds moyens de mémorisation 10e, en terme de capacité, peut conduire à adjoindre à ces seconds moyens de mémorisation 10e, des moyens du même type en cascade 10'a, 10'b, 10'c...

Le boîtier repère 1e comporte, extérieurement, un bouton poussoir 17e aisément accessible par l'utilisateur, et dont la fonction est indiquée ci-après.

Ce même boîtier peut être équipé d'un commutateur 18e dont les positions permettront :

En une première position du commutateur 18e, une action manuelle sur ce bouton poussoir 17e provoquera, le transfert immédiat des séquences mémorisées dans les premiers moyens de mémorisation temporaires 16e vers les seconds moyens de mémorisation permanente 10e, provoquant de ce fait la capture sélective de séquences antérieures à la commande d'enregistrement, puisque les séquences auront été, dans l'instant immédiatement antérieur à la décision d'enregistrement, préalablement visualisées sur l'écran 2e.

En une seconde position du commutateur 18e, les séquences visualisées émanant des mémoires extractibles 7e,

seront intégralement recopiées et donc enregistrées dans les mémoires 10e.

Cette possibilité présente particulièrement comme variante d'architecture d'appareil de pouvoir se dispenser des premiers moyens de mémorisation temporaire 16e

En une troisième position du commutateur 18e, les séquences émanant des mémoires extractibles 7e, seront essentiellement soumises à lecture directe sur l'écran 2e.

Cette possibilité présente particulièrement comme variante d'architecture d'appareil, de transformer celui-ci en une version simple d'appareil de lecture de mémoires sur écran intégré.

A l'issue de cette capture de séquences mémorisées dans les moyens 10e, il sera possible de lire et de visionner les séquences mémorisées 10e, en extrayant ces mémoires du stand de réception 8e, pour les insérer dans le stand d'accueil 5e.

Il est de fait connu, que le tableau de commande 3e du boîtier 1e est susceptible d'incorporer les commandes de séquences communément assurées sur des appareils de cette famille, telles que déroulement image par image, marche avant et retour arrière, pause, effacement.

Description de la 5ième application de l'invention :

La figure 1f est un croquis imageant l'implantation sur feux tricolores et collision entre deux véhicules. On peut aisément imaginer l'installation d'un tel boîtier, sur un support dédié ou sur le panneau même de signalisation en place.

Par ailleurs, la figure 2f est une vue générale d'une architecture d'un appareil d'enregistrement selon l'invention, avec caméra intégrée.

Sur la figure 2f on a représenté une vue de dessus d'un boîtier d'enregistrement selon l'invention, et désigné par le repère 1f. Il est destiné à assurer l'enregistrement d'images

et ou de sons fournis par une ou des caméras 2f installé(es) équipant ce boîtier.

Dans une variante de configuration, il est envisageable de disposer d'une ou de plusieurs caméra(s) déportée(s) du boîtier d'enregistrement 1f, en vue de son(leurs) implantation(s) susceptible(s) d'offrir le maximum de champs de vision, autour de la zone sous surveillance.

Les architectures seront bien entendues adaptées aux milieux dans lesquels, le boîtier 1f et/ou la caméra 2f seront susceptibles d'être utilisés.

Le boîtier repère 1f est connecté, extérieurement, à un détecteur 4f, détecteur qui pourrait être du type :

- Bouton poussoir de type coup de poing, implanté à la portée de toute personne désireuse d'engager la procédure d'enregistrement à posteriori (témoin, acteurs, passant...),

- Contacteur couplé à un dispositif en place, tel que cellule radar, faisceau lumineux, initialement implanté pour le constat d'infraction cité précédemment.

En variante, le déclenchement de ce détecteur 4f, pourrait être activé suivant un procédé informatique connu, consistant en une présence prolongée et inhabituelle d'un objet, en l'occurrence le(s) véhicule(s) accidenté(s), dans un champs connu et mémorisé informatiquement, sous contrôle de caméras.

Ce détecteur 4f, situé dans le circuit caméra 2f - circuit électronique 6f - premiers moyens de mémorisation 7f, provoquera par son action relayée par le contact 5f, l'enregistrement des séquences émanant des premiers moyens de mémorisation temporaires 7f vers des seconds moyens de mémorisation permanents 8f.

En complément à ce dispositif de commande 4f de type coup de poing, et afin de contrecarrer d'éventuels actes de commandes intempestives d'enregistrement, il serait concevable d'équiper le boîtier objet de l'invention, d'un compteur horaire (horloge interne du circuit électronique 6f par exemple) susceptible d'effacer automatiquement toute information

enregistrée dans les seconds moyens de mémorisation 8f, si celle-ci n'a pas été récupérée dans un délai d'intervention considéré comme normal par les personnes habilitées, en cas d'accident.

La description qui va suivre s'applique donc particulièrement à la mémorisation de séquences vidéo entrantes par le biais de la caméra 2f, appréciées pertinentes immédiatement et postérieurement à la séquence filmée et déclarée automatiquement d'intérêt du fait de l'action de commande 4f.

Ce principe de fonctionnement s'avère par ailleurs tout aussi adapté, à la mémorisation de sons captés et de données diverses en vue de leur transmission suivant les mêmes principes.

L'appareil d'enregistrement comporte un circuit électronique 3f intégrant les composants nécessaires au principe de capture précédemment rappelé.

Le système d'enregistrement sera alimenté en énergie suivant les moyens conventionnels (secteur, batterie, capteurs solaires...) via une prise repère 9f et bloc d'alimentation éventuellement intégré 10f, et se trouve opérationnel, dès la mise en service de la caméra 2f.

La caméra 2f se trouve donc, dès cet instant en saisie passive de séquences vidéo et alimente en continu, par lesdites données vidéo, et par l'intermédiaire d'un circuit de compactage et de formatage 6f, un premier bloc mémoire 7f.

Tant que, selon la représentation, le détecteur 4f se trouve en position fermée, l'appareil 1f est dans un état d'enregistrement en continu suivant le principe FIFO, et donc de mémorisation des séquences entrantes dans des premiers moyens de mémorisation 7f.

Ces premiers moyens de mémorisations 7f sont de type volatil, et assurent en continu un stockage temporaire des données entrantes émanant desdits appareils amont.

De façon classique, la mémoire RAM FIFO 7f, est constituée par un ensemble de registres assurant en continu le stockage des données d'images selon un ordre « premier entré-premier sorti ».

Lorsque la mémoire RAM FIFO 7f est pleine, la mémorisation d'une nouvelle donnée d'images provoque le décalage du contenu des registres, de sorte que des données d'images enregistrées soient délivrées en sortie ou écrasées en cas de dépassement de la capacité de la mémoire.

En variante, ces premiers moyens de mémorisation 7f sont constitués par un disque de type « CD-ROM » réinscriptible, ou une carte classique PCMCIA, voire autre mémoire flash, ou espace mémoire sur un disque dur interne ou périphérique.

L'extension de ces dits premiers moyens de mémorisation 7f, en terme de capacité et/ou pour d'autres raisons fonctionnelles, telle que par exemple la poursuite de capture durant une phase de lecture, peut conduire à adjoindre à ces premiers moyens de mémorisation 7f, des moyens du même type en cascade 7'a, 7'b, 7'c...

Les deuxièmes moyens de mémorisation 8f sont des moyens de mémorisation permanente. Ils sont constitués par un ensemble modulable de cartes à mémoires 8f de type RAM statique, venant se fixer sur le circuit 4f, et assurant un stockage permanent de données d'images sélectionnées par un utilisateur et mémorisées dans les premiers moyens de mémorisation 7f.

Ces deuxièmes moyens de mémorisation permanente 8f ont une capacité de mémorisation supérieure à celle des premiers moyens de mémorisation 7f, peuvent être constitués par des moyens de mémorisation réinscriptibles.

En variante, ces deuxièmes moyens de mémorisation 8f sont constitués par un disque de type « CD-ROM » réinscriptible, ou une carte classique PCMCIA, mémoire flash, voire disque dur intégré ou périphérique.

L'extension de ces dits seconds moyens de mémorisation 8f, en terme de capacité, peut conduire à adjoindre à ces

seconds moyens de mémorisation 8f, des moyens du même type en cascade 8'a, 8'b, 8'c...

A ce stade, et suivant la configuration de cet appareil, après formatage adapté dans le circuit 6f, la récupération des séquences enregistrées dans les seconds moyens de mémorisation 8f, peut s'opérer de diverses façons, à partir d'une connexion adaptée en 11f :

- soit par transmission filaire et ou optique vers un appareil dédié et décentralisé de type connu, tels que moniteurs, ordinateurs, magnétoscopes, et autres caméscopes et baladeurs vidéo, cet appareil étant susceptible d'être implanté dans un local de service à la disposition du personnel habilité. A ce moment là, la personne habilitée disposera donc des séquences pertinentes relatives aux circonstances et à la chronologie du déroulement de l'accident.

- soit par lecture sur place, au moyen d'un lecteur adapté à la disposition et porté par la personne habilitée au constat des faits. Ces appareils peuvent être du même type que ceux déjà cités.

En variante, il est concevable de décentraliser du boîtier 1f, les moyens de mémorisation permanents 8f, afin de limiter leur accès et éventuelle vulnérabilité.

En variante encore, il est de même envisageable de disposer de moyens de mémorisation 7f et 8f extractibles à des fins pratiques et/ou en preuves tangibles de constats d'évènements et de faits justifiés ou de faits répréhensibles et/ou condamnables.

En variante d'exploitation, il est envisageable d'utiliser, à la discrétion des préposés aux interventions, le commutateur 12f en :

- une première position, pour le transfert automatique des séquences émanant des premiers moyens de mémorisation 7f vers les seconds moyens de mémorisation 8f,

- une seconde position, et à des fins de lecture de contrôle éventuellement des seuls premiers moyens de

mémorisation 7f. Cette position, si la commande du détecteur 4f n'est pas désactivée et/ou la caméra 2f hors service, provoquera progressivement et au terme de la capacité de mémorisation des mémoires 7f de type FIFO éventuellement, l'effacement des données contenues dans lesdites mémoires 7f,

- en une troisième position, la lecture du contenu des premiers moyens de mémorisation 7f et l'enregistrement simultanée dudit contenu vers les seconds moyens de mémorisation 8f.

Description de la 6ième application de l'invention :

Sur la figure 2g on a représenté une vue de dessus d'un boîtier d'enregistrement selon l'invention, et désigné par le repère 1g. Il est destiné à assurer l'enregistrement d'images et ou de sons fournis par une ou des caméras embarquées et/ou déportées 2g dans un véhicule, avion et autres moyens de transports publics ou privés.

Dans une configuration, il peut être envisagé de réaliser ce boîtier1 en matériaux résistants et aux principes de structure et d'architecture externe et interne répondant aux paramètres les plus éprouvants et adapté aux milieux hostiles dans lequel il sera susceptible d'être confronté (explosion, accélération et décélérations violentes, surpressions, chocs, immersion, incendie...).

Ce type de configuration, dans la description qui suit, apparenterait alors le boîtier d'enregistrement 1, à une « boîte noire » vidéo.

Il convient de noter, que par sa particularité de capture de données numériques, ce boîtier d'enregistrement pourrait recueillir d'autres informations de type mesures diverses.

Sur cette figure 2g, le boîtier 1g supporte une caméra 2g qui transmet les images collectées vers le module 6g du circuit électronique 3g via un contacteur 4g.

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La description qui va suivre s'applique à la mémorisation d'images entrantes par le biais de cette caméra 2g, mais peut bien entendu s'appliquer également à la mémorisation de sons captés et de données diverses arrivant sur un connecteur adapté en amont du contacteur 4g, sous une forme et un format de données aptes à être traitées par le circuit 6g.

L'appareil d'enregistrement comporte un circuit électronique 3g intégrant les composants nécessaires au principe de capture précédemment rappelé.

Le système d'enregistrement étant alimenté en énergie suivant les moyens conventionnels (secteur, batterie...) via une prise repère 9g et bloc d'alimentation éventuellement intégré 10g, se trouve opérationnel, dès la connexion du contacteur 4g.

L'appareil se trouve donc, dès cet instant, dans une phase d'enregistrement en continu suivant le principe FIFO, et donc de mémorisation des séquences entrantes dans des premiers moyens de mémorisation 7g, après les fonctions de décodage/codage/compression éventuelle desdites données entrantes via le circuit 6g intégrant éventuellement un microprocesseur et autre circuit de gestion de données.

Ces premiers moyens de mémorisations 7g sont de type volatil, et assurent en continu un stockage temporaire des données entrantes émanant desdits appareils amont, et qui spécifiquement suivant la figure 2g, émanent de la caméra 2g.

De façon classique, la mémoire RAM FIFO 7g, est constituée par un ensemble de registres assurant en continu le stockage des données d'images selon un ordre « premier entré-premier sorti ».

Lorsque la mémoire RAM FIFO 7g est pleine, la mémorisation d'une nouvelle donnée d'images provoque le décalage du contenu des registres, de sorte que des données d'images enregistrées soient délivrées en sortie ou écrasées en cas de dépassement de la capacité de la mémoire.

En variante, ces premiers moyens de mémorisation 7g sont constitués par un disque de type « CD-ROM » réinscriptible,

ou une carte classique PCMCIA, voire autre mémoire flash, ou espace mémoire sur un disque dur interne ou périphérique.

L'extension de ces dits premiers moyens de mémorisation 7g, en terme de capacité et/ou pour d'autres raisons fonctionnelles, telle que par exemple la poursuite de capture durant une phase de lecture, peut conduire à adjoindre à ces premiers moyens de mémorisation 7g, des moyens du même type en cascade 7'a, 7'b, 7'c...

Les deuxièmes moyens de mémorisation 8 sont des moyens de mémorisation permanente. Ils sont constitués par un ensemble modulable de cartes à mémoires 8g de type RAM statique, venant se fixer sur le circuit 3g, et assurant un stockage permanent de données d'images sélectionnées automatiquement et/ou par un utilisateur et mémorisées dans les premiers moyens de mémorisation 7g.

Ces deuxièmes moyens de mémorisation permanente 8g ont une capacité de mémorisation supérieure à celle des premiers moyens de mémorisation 7g, peuvent être constitués par des moyens de mémorisation réinscriptibles.

En variante, ces deuxièmes moyens de mémorisation 8g sont constitués par un disque de type « CD-ROM » réinscriptible, ou une carte classique PCMCIA, mémoire flash, voire disque dur intégré ou périphérique.

L'extension de ces dits seconds moyens de mémorisation 8g, en terme de capacité, peut conduire à adjoindre à ces seconds moyens de mémorisation 8g, des moyens du même type en cascade 8'a, 8'b, 8'c...

Le boîtier repère 1g est connecté, extérieurement, à un détecteur ou des détecteurs 4g adaptés aux circonstances génératrices d'évènements envisageables.

Il en est ainsi pour des détecteurs de type surtension, ouverture, pression, température, présence, choc, et autres boutons poussoirs... dont les actions relayées par des équipements adaptés vers le contacteur 5g, provoqueront le transfert immédiat des séquences mémorisées dans les premiers

moyens de mémorisation temporaires 7g vers les seconds moyens de mémorisation permanente 8g, provoquant de ce fait la capture de séquences antérieures à la commande d'enregistrement, en vue de leur visionnage et/ou conservation ultérieurs sous formes de stockages diverses.

En variante, la commande de transfert de données à partir des mémoires 7g vers les moyens de mémorisation permanente 8g, peut s'effectuer manuellement à la convenance d'un opérateur averti, via un commutateur 12g.

En variante, et suivant la figure 3g, cette caméra 2g pourrait être déportée du boîtier 1g, afin de faciliter la saisie d'évènements en des endroits les plus inaccessibles et/ou avec un maximum de discrétion.

Il en serait ainsi, pour exemples, dans un avion, dans la soute à bagages, dans le compartiment train d'atterrissage, cabine passager... alors que, dans un véhicule terrestre, tout ou partie du boîtier serait intégrable dans un compartiment mécanique, habitacle, etc...

Dans ce cas de figure, et suivant la même figure 3g, le détecteur 4g pourra être relié au boîtier 1g en moyens filaires ou en systèmes de communication à distance tels que rayon infrarouge, radio, faisceau optique,...

A l'issue de cette capture de séquences mémorisées dans les moyens 8g, il sera possible :

- soit de récupérer cette boîte noire vidéo, en vue de la lecture et récupération des images et sons révélateurs des circonstances immédiatement antérieures à l'événement et/ou l'accident constaté, et mémorisés en 8g,
- soit extraire, s'ils sont extractibles et pour lecture et exploitation, les moyens de mémorisation permanents 8g.

Dans une variante de configuration, il est envisageable d'équiper le boîtier d'un commutateur 12g dont les positions permettront :

- en une première position du commutateur 12g, et c'est là la fonction de capture de base, le déclenchement du détecteur 4g provoquera, via un relayage adapté vers le contact 5g, le transfert immédiat des séquences mémorisées dans les premiers moyens de mémorisation temporaires 7g vers les seconds moyens de mémorisation permanente 8g, provoquant de ce fait la capture de séquences antérieures à la commande d'enregistrement, en vue de leur visionnage et/ou conservation ultérieurs sous formes de stockages diverses.

- en une seconde position du commutateur 12g, le déclenchement du détecteur 4g provoquera, via un relayage adapté vers le contact 5g, et via une gestion adaptée dans le circuit 6g, un bouclage immédiat des séquences mémorisées dans les premiers moyens de mémorisation temporaires 7g jusqu'à leur limite de capacité de stockage. Ceci permettra en outre, via la gestion adaptée dans le circuit 6g, de transférer ces informations mémorisées temporairement en 7g, vers le connecteur de sortie 11g en vue de leur visionnage vers le périphérique connecté.

En une troisième position du commutateur 12g assurée à la demande d'un opérateur averti, les séquences mémorisées dans les premiers moyens de mémorisation 7g seront automatiquement transférées vers les seconds moyens de mémorisation permanente 8g, provoquant de ce fait la capture durable de séquences antérieures à la commande d'enregistrement, en vue de leur visionnage et/ou conservation ultérieurs sous formes de stockages diverses.

Par sa compacité et intégration de fonctions, cet équipement s'avèrera particulièrement adapté aux cabines de pilotage, compartiments mécaniques et électroniques embarqués, cabine de passagers,.... aux fins particulièrement de visionnage des évènements antérieurs à un incident et/ou accident et/ou acte terroriste.

Description de la 7ième application de l'invention :

Sur la figure 1h on a représenté une vue de dessus d'un boîtier d'enregistrement selon l'invention, et désigné par le repère 1h. Il est destiné à assurer l'enregistrement d'images et ou de sons fournis par un téléviseur, magnétoscope, caméscope, lecteurs de DVD, téléphone mobile, ordinateur connecté à Internet, décodeur de programmes TV…..

Sur cette figure 1h, les informations entrantes dans le boîtier 1h et émanant des appareils cités, sont recueillies sur une prise d'entrée 2h adaptée au format de sortie de ces appareils de type connus et non représentés sur la dite figure.

La description qui va suivre s'applique à la mémorisation d'images entrantes par le bais de ce connecteur d'entrée 2, mais peut bien entendu s'appliquer également à la mémorisation de sons captés et de données diverses.

Le boîtier étant alimenté en énergie suivant les moyens conventionnels (secteur, batterie…) via une prise repère 4h et bloc d'alimentation intégré 5h, se trouve opérationnel, dès son raccordement via le connecteur 2h à / aux appareils amont (TV, magnétoscopes, et autres tels que déjà cités…), et dès la mise en fonction de ces appareils.

L'appareil se trouve donc, dès cet instant, dans une phase d'enregistrement en continu suivant le principe FIFO, et donc de mémorisation des séquences entrantes dans des premiers moyens de mémorisation 7h, après les fonctions de décodage/codage/compression éventuelle desdites données entrantes via le circuit 6h qui intègre par ailleurs un microprocesseur et autre circuit de gestion et répartition de données.

Ces premiers moyens de mémorisations 7h sont de type volatils, et assurent en continu un stockage temporaire des données entrantes émanant desdits appareils amont.

De façon classique, la mémoire RAM FIFO 7h, est constituée par un ensemble de registres assurant en continu le

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stockage des données d'images selon un ordre " premier entré-premier sorti ".

Lorsque la mémoire RAM FIFO 7h est pleine, la mémorisation d'une nouvelle donnée d'images provoque le décalage du contenu des registres, de sorte que des données d'images enregistrées soient délivrées en sortie ou écrasées en cas de dépassement de la capacité de la mémoire.

En variante, ces premiers moyens de mémorisation 7h sont constitués par un disque de type " CD-ROM " réinscriptible, ou une carte classique PCMCIA, voire autre mémoire flash, ou espace mémoire sur un disque dur interne ou périphérique.

L'extension de ces dits premiers moyens de mémorisation 7h, en terme de capacité et/ou pour d'autres raisons fonctionnelles, telle que par exemple la poursuite de capture durant une phase de lecture, peut conduire à adjoindre à ces premiers moyens de mémorisation 7h, des moyens du même type en cascade 7'a, 7'b, 7'c...

Les deuxièmes moyens de mémorisation 8h sont des moyens de mémorisation permanente. Ils sont constitués par un ensemble modulable de cartes à mémoires 8h de type RAM statique, venant se fixer sur le circuit 3h, et assurant un stockage permanent de données d'images sélectionnées par un utilisateur et mémorisées dans les premiers moyens de mémorisation 7h.

Ces deuxièmes moyens de mémorisation permanente 8h ont une capacité de mémorisation supérieure à celle des premiers moyens de mémorisation 7h, peuvent être constitués par des moyens de mémorisation réinscriptibles.

En variante, ces deuxièmes moyens de mémorisation 8h sont constitués par un disque de type " CD-ROM " réinscriptible, ou une carte classique PCMCIA, mémoire flash, voire disque dur intégré ou périphérique.

L'extension de ces dits premiers moyens de mémorisation 8h, en terme de capacité, peut conduire à adjoindre

à ces premiers moyens de mémorisation 8h, des moyens du même type en cascade 8'a, 8'b, 8'c...

Le boîtier repère 1h comporte, extérieurement, un bouton poussoir 9h aisément accessible par l'utilisateur.

Ce même boîtier peut être équipé d'un commutateur 10h dont les positions permettront :

A. En une première position du commutateur 10h, une action manuelle sur ce bouton poussoir 9h provoquera, via un relayage adapté, le transfert immédiat des séquences mémorisées dans les premiers moyens de mémorisation temporaires 7h vers les seconds moyens de mémorisation permanente 8h, provoquant de ce fait la capture de séquences antérieures à la commande d'enregistrement, en vue de leur visionnage et/ou conservation ultérieurs sous formes de stockages diverses.

B. En une seconde position du commutateur 10h, via une gestion des données dans le circuit électronique 6h, interdisant l'entrée de nouvelles données dans les premiers moyens de mémorisation temporaires 7h, les séquences mémorisées dans lesdits premiers moyens de mémorisation 7h, pourront être lues en boucle vers le périphérique connecté en 11h.

En variante, ce bouton poussoir 9h peut être remplacé, déporté à distance de façon filaire, et/ou doublé d'une télécommande à distance sans fil équipant le boîtier 1h. Une autre variante consisterait à équiper les télécommandes existantes de cette fonction de commande spécifique.

Ce cas de figure engendrerait l'intégration sur le boîtier 1h d'un récepteur 12h adapté à cette télécommande.

A l'issue de cette capture de séquences mémorisées dans les moyens 7h et 8h, il sera possible :

- soit de lire et de visionner les séquences mémorisées en 7h ou en 8h, en actionnant le bouton de commande adapté 13h, la lecture s'opérant alors par le transfert des données éventuellement décompactées et formatées dans un circuit adapté 6h, vers des connecteurs de sorties spécifiques 11h, eux-mêmes raccordés aux moyens de lecture existants tels que

téléviseur, magnétoscopes, caméscopes, et autres périphériques déjà énumérés.

- soit d'opérer les séquences communément assurées par ce type d'appareils telles que déroulement image par image, marche avant et retour arrière, pause, effacement,...

En complément et en façade de ce boîtier 1h, et tel que représenté en figure 2h, les accès aux fonctions suivantes seraient intégrées, à savoir :

- une cellule de réception 12h de la séquence de capture par télécommande
- un bouton de commande de lecture des séquences capturées 13h
- un bouton de commande de retour arrière des séquences capturées 14h
- une commande d'effacement 15h des séquences capturées sur la mémoire permanente 8h
- un bouton d'arrêt sur image 16h et/ou pause
- un/des slot(s) 17h de chargement de mémoires 8h éventuellement extractibles et interchangeables
- un/des connecteur(s) de sortie 11h au format adapté au périphérique concerné, pour la vision de ces séquences et/ou leur enregistrement.

Description de la 8ième application de l'invention :

Sur cette figure 3i, le boîtier 1i comporte un port d'entrée de données 14i émanant du dispositif de prises de vues via le connecteur 2i.

Ces données sont ensuite traitées dans un circuit électronique 15i qui comporte notamment et éventuellement :

• un module de conversion des données 16i en un format adapté à leur traitement ultérieur,

• un module de compression de données 17i,

• un gestionnaire du traitement des données 18i, de type microprocesseur par exemple,

• une première zone de stockage temporaire 19i,

• une commande 10i de transfert des données de ces premiers moyens de stockages temporaires 19i vers des moyens de stockage permanents 7i,

• un module 20i de décompression des données contenues dans les premiers moyens de stockage 19i et les seconds moyens de stockage 7i,

• un module de conversion 21i de ces données en vue d'une exploitation et/ou lecture ultérieure,

• un port de sortie 22i en vue d'une exploitation et/ou lecture ultérieure des données mémorisées dans les divers moyens de stockage 7i et/ou 19i.

La description qui va suivre s'applique à la mémorisation d'images entrantes par le biais d'un appareil de vision et, pour exemples, de type 3i présentés en figure 31-1i.

Le boîtier de capture étant alimenté en énergie suivant les moyens conventionnels (secteur, batterie...) via une prise repère 23i et bloc d'alimentation éventuellement intégré 24i, se trouve opérationnel, par exemple dès la connexion du connecteur 2i, mais peut l'être évidemment, suivant un commutateur équipant l'appareil.

En variante et/ou complément, le boîtier de capture peut être alimenté en énergie par des accumulateurs de type piles et/ou non rechargeables.

L'appareil se trouve donc, dès cet instant, dans une phase d'enregistrement en continu suivant le principe FIFO, et donc de mémorisation des séquences entrantes dans des premiers moyens de mémorisation 19i, après les fonctions de décodage/codage/compression éventuelles desdites données entrantes via le connecteur 14i dans le circuit électronique 15i.

Ces premiers moyens de mémorisations 19i sont de type volatils, et assurent en continu un stockage temporaire des données entrantes émanant desdits appareils amont.

De façon classique, la mémoire RAM FIFO 19i, est constituée par un ensemble de registres assurant en continu le

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stockage des données d'images selon un ordre « premier entré-premier sorti ».

Lorsque la mémoire RAM FIFO 19i est pleine, la mémorisation d'une nouvelle donnée d'images provoque le décalage du contenu des registres, de sorte que des données d'images enregistrées soient délivrées en sortie ou écrasées en cas de dépassement de la capacité de la mémoire.

En variante, ces premiers moyens de mémorisation 19i sont constitués par un disque de type « CD-ROM » réinscriptible, ou une carte classique PCMCIA, voire autre mémoire flash, ou espace mémoire sur un disque dur interne ou périphérique.

L'extension de ces dits premiers moyens de mémorisation 19i, en termes de capacité et/ou pour d'autres raisons fonctionnelles, telle que par exemple la poursuite de capture durant une phase de lecture, peut conduire à adjoindre à ces premiers moyens de mémorisation 19i, des moyens du même type en cascade 19'a, 19'b, 19'c...

Les deuxièmes moyens de mémorisation 7i sont des moyens de mémorisation permanente. Ils sont constitués par un ensemble modulable de cartes à mémoires 7i de type RAM statique, venant se connecter sur le circuit 15i, et assurant un stockage permanent de données d'images sélectionnées automatiquement et/ou par un utilisateur et mémorisées dans les premiers moyens de mémorisation 19i.

Ces deuxièmes moyens de mémorisation permanente 7i ont une capacité de mémorisation supérieure à celle des premiers moyens de mémorisation 19i, peuvent être constitués par des moyens de mémorisation réinscriptibles.

En variante, ces deuxièmes moyens de mémorisation 7i sont constitués par un disque de type « CD-ROM » réinscriptible, ou une carte classique PCMCIA, mémoire flash, voire disque dur intégré ou périphérique.

L'extension de ces dits premiers moyens de mémorisation 7i, en termes de capacité, peut conduire à

adjoindre à ces premiers moyens de mémorisation 7i, des moyens du même type en cascade 7'a, 7'b, 7'c...

Dès la survenance d'un évènement digne d'intérêt, la commande de transfert de données à partir des mémoires 19i vers les moyens de mémorisation permanente 7i, s'effectue manuellement à la convenance de l'utilisateur de l'équipement, via un commutateur 10i.

En variante, le boîtier repère 1i peut être connecté, extérieurement, à un détecteur ou des détecteurs adaptés aux circonstances génératrices d'évènements envisageables.

Il en est ainsi pour des détecteurs d'ouverture, de présence, et autres fonctionnalités particulières... dont les actions relayées par des équipements adaptés vers le contacteur 10i, provoqueront le transfert immédiat des séquences mémorisées dans les premiers moyens de mémorisation temporaires 19i vers les seconds moyens de mémorisation permanente 7i, provoquant de ce fait la capture de séquences antérieures à la commande d'enregistrement, en vue de leur visionnage et/ou conservation ultérieurs sous formes de stockages diverses.

Il en serait ainsi, pour exemples, lors d'observations diverses, des cas de présence d'un animal dans son repaire, de passages furtifs d'étoiles filantes, de génération d'infrarouge inopportun.

A l'issue de cette capture de séquences mémorisées dans les moyens 7i, il sera possible :

- soit de visionner immédiatement, les faits et circonstances immédiatement antérieurs à la séquence vécue et/ou inaperçue en tout ou partie,
- soit extraire, s'ils sont extractibles et pour lecture et exploitation, les moyens de mémorisation permanents 7i.

Dans une variante de configuration, il est envisageable d'équiper le boîtier de capture 1i d'une commande spécifique dont la position permettra, et sans mémorisation permanente en 7i, et après traitement dans les mêmes circuits

implantés dans la carte électronique 15i, le visionnage des séquences mémorisées en 19i, en vue d'apprécier, s'il était besoin, la pertinence de leur stockage dans les moyens adaptés en 7i.

Dans une autre variante de construction, les équipements électroniques dont il est fait état dans le boîtier de capture 1i, peuvent être intégrés dans les moyens de vision tels que cités, en vue de reproduire les fonctionnalités décrites.

Par sa compacité et intégration de fonctions, cet équipement s'avèrera particulièrement adapté aux passionnés de l'observation et autres professionnels à des fins de recherche et autres enquêtes, soucieux de saisir l'instant furtif susceptible de leur échapper.

Il convient de noter que, dans le cadre de la description de l'invention ou de ses applications, le terme « dispositif » doit être compris comme équivalent au terme « système ».

Notamment, il n'est pas nécessaire que les différents éléments d'un dispositif défini par l'invention soient compris dans un même boîtier ou une même enceinte physique.

En d'autres termes, ces différents éléments peuvent être déportés, c'est-à-dire à distance, tout en coopérant conformément à l'invention directement ou indirectement via des moyens de transmissions tels que des ondes radio, des câbles, etc.

Par ailleurs, il convient également de noter que les descriptions effectuées ci-dessus sont relatives à des images et/ou des sons. Cependant, il est clair que l'invention peut être mise en œuvre avec tout type de données multimédia telle qu'une vidéo.

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REVENDICATIONS

1. Appareil d'enregistrement de données multimédia associé à un dispositif de prise de données multimédia, cet appareil comprenant des moyens de mémorisation de données délivrées par le dispositif de prise de données multimédia et une unité de traitement desdites données en vue de leur conversion dans un format adapté pour leur stockage dans les moyens de mémorisation, caractérisé en ce que les moyens de mémorisation comportent des premiers moyens de mémorisation temporaire et en continu des données délivrées par le dispositif de prise de données multimédia et des deuxièmes moyens de mémorisation permanente de données stockées temporairement dans lesdits premiers moyens de mémorisation, et en ce qu'il comporte des moyens de transfert sélectif de données desdits premiers moyens de mémorisation vers lesdits deuxièmes moyens de mémorisation, en vue de l'enregistrement permanent d'au moins une scène captée par le dispositif de prise de données multimédia et mémorisées temporairement dans les premiers moyens de mémorisation.

2. Dispositif comprenant un appareil d'enregistrement de données multimédia selon la revendication 1 permettant à un opérateur de déclencher une capture d'une séquence vidéo en tout ou partie antérieure audit déclenchement de ladite capture, notamment une séquence vidéo représentant les instants ayant précédé et suivi la chute d'un randonneur en montagne ou l'agression d'une personne dans un train ;

ledit dispositif d'enregistrement comprenant :

- un premier terminal (1b) équipé de moyens de capture vidéo (2b), notamment un téléphone mobile intégrant une caméra vidéo ; lesdits moyens de capture vidéo (2b) étant destinés à capter des séquences vidéo, notamment des séquences relatives à un objet de surveillance tel qu'une personne ou un lieu déterminés ;

ledit premier terminal (1b) comprenant :

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- des premiers moyens de mémorisation (7b), destinés à mémoriser de manière continue et temporaire lesdites séquences vidéo ainsi captées ; lesdits premiers moyens de mémorisation (7b) comportant une zone mémoire volatile d'une capacité appropriée à la mémorisation de fractions glissantes et de durée déterminée desdites séquences vidéo ainsi captées ; ladite mémorisation étant notamment effectuée selon une procédure FIFO (première entrée première sortie) ;

ledit premier terminal (1b) comprenant en outre :

- un organe de commande (12b) permettant de :

• sélectionner une séquence vidéo particulière parmi lesdites séquences vidéo ainsi mémorisées par lesdits premiers moyens de mémorisation (7b), notamment les images des instants ayant précédé et suivi la chute d'un randonneur en montagne ou l'agression d'une personne dans un train,

• transférer ladite séquence vidéo particulière vers des seconds moyens de mémorisation (8b) dudit premier terminal (1b), destinés à mémoriser de manière permanente, en tout ou partie, ladite séquence vidéo particulière ainsi sélectionnée ;

ledit premier terminal (1b) comprenant en outre :

- un premier module d'émission et de réception, notamment de type téléphonique, pour connecter ledit premier terminal (1b) à un réseau de communication, notamment à un réseau de téléphonie mobile ;

ledit dispositif d'enregistrement comprenant en outre un second terminal, notamment un téléphone mobile, distant dudit premier terminal (1b) ; ledit second terminal comportant :

- un second module d'émission et de réception, notamment de type téléphonique, pour connecter ledit second terminal audit premier terminal (1b), notamment via le réseau de téléphonie mobile ;

ledit premier module d'émission et de réception émettant vers ledit second module d'émission et de réception dudit second terminal, via ledit réseau de communication, ladite séquence vidéo particulière ainsi mémorisée ;

ledit dispositif d'enregistrement comprenant en outre des moyens de lecture, notamment situés dans ledit second terminal, permettant de visionner ladite séquence vidéo particulière ainsi mémorisée par lesdits seconds moyens de mémorisation (8b) ;

(de sorte que la capture de la séquence vidéo particulièrement intéressante est commandée à distance, mémorisée puis transférée via le réseau de communication dans la perspective d'être visionnée et analysée à distance).

3. Dispositif selon la revendication 2 ; ledit dispositif d'enregistrement comprenant en outre :

- des moyens de connexion pour connecter ledit premier terminal (1b) à un capteur, notamment un capteur de température, un capteur de pression, une alarme de bâtiment,

- des moyens de réception, associés auxdits moyens de connexion, destinés à recevoir dudit capteur une information d'alerte, notamment le déclenchement d'une alarme de bâtiment, une alerte liée à une température ou à une pression anormale,

- des moyens de commande, activés de manière automatique par lesdits moyens de réception, en fonction de ladite information d'alerte ; lesdits moyens de commande permettant de :

• sélectionner automatiquement une seconde séquence vidéo particulière parmi lesdites séquences vidéo ainsi mémorisées par lesdits premiers moyens de mémorisation (7b), notamment une séquence vidéo débutant une minute avant et se terminant une minute après la réception de ladite information d'alerte,

• commander un transfert de ladite seconde séquence vidéo particulière vers lesdits seconds moyens de mémorisation (8b) ;

(de sorte que la mémorisation de la seconde séquence vidéo particulière est effectuée de manière automatique, en liaison avec la survenance d'un événement particulier).

4. Dispositif comprenant un appareil d'enregistrement de données multimédia selon la revendication 1 destiné à permettre de capturer et de restituer une séquence vidéo pour retracer les circonstances du déclenchement d'un dispositif d'alerte (10c), notamment le déclenchement d'une commande d'arrêt d'urgence d'un train;

ledit dispositif d'enregistrement comprenant :

- des moyens de capture vidéo (2c), notamment une caméra vidéo, destinés à capter des séquences vidéo représentant ledit dispositif d'alerte (10c) et/ou son environnement immédiat,

- des premiers moyens de mémorisation (7c), destinés à mémoriser de manière continue et temporaire lesdites séquences vidéo ainsi captées ; lesdits premiers moyens de mémorisation (7c) comportant une zone mémoire volatile d'une capacité appropriée à la mémorisation de fractions glissantes et de durée déterminée desdites séquences vidéo ainsi captées ; ladite mémorisation étant notamment effectuée selon une procédure FIFO (première entrée première sortie) ;

ledit dispositif d'enregistrement comprenant en outre :

- des moyens de connexion pour connecter ledit dispositif d'enregistrement (1c) audit dispositif d'alerte (10c), notamment à une commande d'arrêt d'urgence d'un train,

- des moyens de détection, associés auxdits moyens de connexion, pour détecter un actionnement dudit dispositif d'alerte (10c), notamment l'actionnement par un voyageur de la commande d'arrêt d'urgence d'un train,

- des moyens de commande, activés de manière automatique par lesdits moyens de détection, en fonction dudit actionnement dudit dispositif d'alerte (10c) ; lesdits moyens de commande permettant de :

• sélectionner une séquence vidéo particulière parmi lesdites séquences vidéo ainsi mémorisées par lesdits premiers moyens de mémorisation (7c), notamment une séquence vidéo

débutant une minute avant et se terminant une minute après ledit actionnement dudit dispositif d'alerte (10c),

• commander un transfert de ladite séquence vidéo particulière vers des seconds moyens de mémorisation (8c), destinés à mémoriser de manière permanente, en tout ou partie, ladite séquence vidéo particulière ainsi sélectionnée ;

ledit dispositif d'enregistrement (1c) étant associé à des moyens de lecture permettant à un opérateur de visionner ladite séquence vidéo particulière ainsi mémorisée par lesdits seconds moyens de mémorisation (8c) ;

de sorte que le seul déclenchement du dispositif d'alerte provoque la mémorisation automatique d'une séquence vidéo, retraçant les circonstances du déclenchement du dispositif d'alerte, la séquence vidéo pouvant être visionnée et analysée, notamment dans le cadre d'une enquête.

5. Dispositif comprenant un appareil d'enregistrement de données multimédia selon la revendication 1 afin de permettre à un opérateur de capturer et de restituer une séquence vidéo retraçant les circonstances d'un événement survenu sur un lieu de travail, notamment un accident ou une explosion survenus sur un lieu de travail, une intrusion malveillante dans une usine ou dans un entrepôt ;

ledit dispositif d'enregistrement (1d) comprenant :

- des moyens de capture vidéo (2d), notamment des caméras vidéo, destinés à capter des séquences vidéo relatives audit lieu de travail, notamment les images d'un poste de travail d'un salarié,

- des premiers moyens de mémorisation (7d), destinés à mémoriser de manière continue et temporaire lesdites séquences vidéo ainsi captées ; lesdits premiers moyens de mémorisation (7d) comportant une zone mémoire volatile d'une capacité appropriée à la mémorisation de fractions glissantes et de durée déterminée desdites séquences vidéo ainsi captées ; ladite mémorisation étant notamment effectuée selon une procédure FIFO (première entrée première sortie) ;

ledit dispositif d'enregistrement (1d) comprenant en outre :

- un organe de commande, actionné par ledit opérateur, permettant de :

• sélectionner une séquence vidéo particulière parmi lesdites séquences vidéo ainsi mémorisées par lesdits premiers moyens de mémorisation (7d), notamment les images d'un accident ou d'une explosion survenus sur ledit lieu de travail,

• commander un transfert de ladite séquence vidéo particulière vers des seconds moyens de mémorisation (8d), destinés à mémoriser de manière permanente, en tout ou partie, ladite séquence vidéo particulière ainsi sélectionnée ;

ledit dispositif d'enregistrement (1d) étant associé à des moyens de lecture permettant audit opérateur de visionner ladite séquence vidéo particulière ainsi mémorisée par lesdits seconds moyens de mémorisation (8d) ;

(de sorte que la séquence vidéo particulièrement intéressante, retraçant les circonstances d'un événement survenu sur un lieu de travail, notamment un accident survenu sur un lieu de travail, une intrusion malveillante dans une usine ou dans un entrepôt, est mémorisée dans la perspective d'être visionnée et analysée a posteriori).

6. Dispositif selon la revendication 5 ; ledit dispositif d'enregistrement (1d) comprenant en outre :

- des moyens de connexion pour connecter ledit dispositif d'enregistrement à un capteur, notamment un capteur de température, un capteur de pression, une alarme de bâtiment,

- des moyens de réception, associés auxdits moyens de connexion, destinés à recevoir dudit capteur une information d'alerte, notamment le déclenchement d'une alarme de bâtiment, une alerte liée à une température ou à une pression anormale,

- des moyens de commande, activés de manière automatique par lesdits moyens de réception, en fonction de ladite information d'alerte ; lesdits moyens de commande permettant de :

• sélectionner automatiquement une seconde séquence vidéo particulière parmi lesdites séquences vidéo ainsi mémorisées par lesdits premiers moyens de mémorisation (7d), notamment une séquence vidéo débutant une minute avant et se terminant une minute après la réception de ladite information d'alerte,

• commander un transfert de ladite seconde séquence vidéo particulière vers lesdits seconds moyens de mémorisation (8d) ;

de sorte que la mémorisation ladite seconde séquence vidéo particulière est effectuée de manière automatique, en liaison avec la survenance d'un événement particulier.

7. Dispositif comprenant un appareil selon la revendication 1 pour permettre le partage de manière conviviale et d'archiver des données multimédia ; lesdites données multimédia provenant d'une pluralité de supports d'enregistrements, notamment de type mémoires flash extractibles ;

ledit dispositif mobile de lecture (1e) et d'enregistrement comprenant :

- des moyens de lecture desdites données multimédia provenant de ladite pluralité de supports d'enregistrements,

- des moyens de visualisation (2e) desdites données multimédia, associés auxdits moyens de lecture, notamment un écran de visualisation (2e) et des haut-parleurs,

- des moyens d'enregistrement desdites données multimédia, notamment sur des supports de type mémoires flash extractibles ;

lesdits moyens d'enregistrement comportant :

- des moyens de duplication permettant de dupliquer tout ou partie desdites données multimédia, et/ou

- des moyens de duplication sélective permettant de mémoriser a posteriori et de manière sélective lesdites données multimédia ;

ledit dispositif mobile de lecture (1e) et d'enregistrement comprenant en outre :

- des interfaces d'entrée (11e) et/ou des interfaces de sorties (12e), destinées à connecter ledit dispositif mobile de lecture (1e) et d'enregistrement à des appareils périphériques, notamment à des équipements informatiques, à des magnétoscopes, à des appareils photo numériques ;

ledit dispositif mobile de lecture (1e) et d'enregistrement comprenant en outre :

- des moyens d'archivage (8e), notamment extractibles, desdites données multimédia ; lesdits moyens d'archivage se présentant sous la forme d'emplacements intégrés audit dispositif mobile de lecture (1e) et d'enregistrement, notamment sous la forme d'emplacements de rangement destinés à recevoir des supports d'enregistrement, notamment des mémoires flash extractibles ;

ledit dispositif mobile de lecture (1e) et d'enregistrement comprenant en outre :

- des moyens de transport (19e), notamment une poignée de transport, destinés à permettre une mobilité aisée dudit dispositif mobile de lecture (1e) et d'enregistrement,

de sorte que le dispositif mobile de lecture (1e) et d'enregistrement peut être utilisé comme un boîtier mobile universel de lecture et de stockage de vidéos, de photos, de musique.

8. Dispositif comprenant un appareil selon la revendication 1 afin de permettre à un opérateur de capturer et de restituer une séquence vidéo retraçant les circonstances d'un événement survenu dans un environnement déterminé, notamment un accident entre deux véhicules à un carrefour routier, un panneau "stop" non-respecté par un automobiliste ;

ledit dispositif d'enregistrement (1f) comprenant :

- des moyens de capture vidéo (2f), notamment des caméras vidéo, destinés à capter des séquences vidéo relatives

audit environnement déterminé, notamment les images d'un carrefour dangereux,

- des premiers moyens de mémorisation (7f), destinés à mémoriser de manière continue et temporaire lesdites séquences vidéo ainsi captées ; lesdits premiers moyens de mémorisation (7f) comportant une zone mémoire volatile d'une capacité appropriée à la mémorisation de fractions glissantes et de durée déterminée desdites séquences vidéo ainsi captées ; ladite mémorisation étant notamment effectuée selon une procédure FIFO (première entrée première sortie) ;

ledit dispositif d'enregistrement (1f) comprenant en outre :

- un organe de commande permettant de :

• sélectionner une séquence vidéo particulière parmi lesdites séquences vidéo ainsi mémorisées par lesdits premiers moyens de mémorisation (7f), notamment les images d'un accident entre deux véhicules à un carrefour routier, le franchissement d'un panneau "stop" non-respecté par un automobiliste,

• commander un transfert de ladite séquence vidéo particulière vers des seconds moyens de mémorisation (8f), destinés à mémoriser de manière permanente, en tout ou partie, ladite séquence vidéo particulière ainsi sélectionnée ; ledit organe de commande pouvant être actionné de manière manuelle par ledit opérateur et/ou de manière programmée en cas de réalisation d'une condition prédéterminée, notamment en cas de présence prolongée d'un véhicule dans le champ des moyens de capture vidéo ;

ledit dispositif d'enregistrement (1f) étant associé à des moyens de lecture permettant audit opérateur de visionner ladite séquence vidéo particulière ainsi mémorisée par lesdits seconds moyens de mémorisation (8f) ;

de sorte que la séquence vidéo particulièrement intéressante retraçant les circonstances d'un accident ou d'une infraction au code de la route est mémorisée dans la perspective d'être visionnée et analysée a posteriori.

9. Dispositif comprenant un appareil d'enregistrement de données multimédia selon la revendication 1 destiné à une surveillance (1g) dans un véhicule permettant à un opérateur de capturer et de restituer une séquence vidéo particulière relative à un incident survenu dans ledit véhicule, notamment un accident d'autocar ou un détournement d'avion ;

ledit dispositif de surveillance (1g) comprenant :

- des moyens de capture vidéo (2g), notamment des caméras vidéo, destinés à capter des séquences vidéo se déroulant à l'intérieur dudit véhicule,

- des premiers moyens de mémorisation (7g), destinés à mémoriser de manière continue et temporaire lesdites séquences vidéo ainsi captées ; lesdits premiers moyens de mémorisation (7g) comportant une zone mémoire volatile d'une capacité appropriée à la mémorisation de fractions glissantes et de durée déterminée desdites séquences vidéo ainsi captées ; ladite mémorisation étant notamment effectuée selon une procédure FIFO (première entrée première sortie) ;

ledit dispositif de surveillance (1g) comprenant en outre :

- un organe de commande (12g) permettant de :

• sélectionner une séquence vidéo particulière parmi lesdites séquences vidéo ainsi mémorisées par lesdits premiers moyens de mémorisation (7g), notamment l'instant d'un accident d'autocar ou l'entrée en scène de pirates de l'air,

• commander un transfert de ladite séquence vidéo particulière vers des seconds moyens de mémorisation (8g), destinés à mémoriser de manière permanente, en tout ou partie, ladite séquence vidéo particulière ainsi sélectionnée ; ledit organe de commande (12g) pouvant être actionné de manière manuelle par ledit opérateur et/ou de manière programmée en cas de réalisation d'une condition prédéterminée, notamment en cas de dépressurisation de la cabine d'un avion ou en cas de dépassement d'un seuil de température dans le véhicule ;

ledit dispositif de surveillance (1g) étant associé à

des moyens de lecture permettant audit opérateur de visionner ladite séquence vidéo particulière ainsi mémorisée par lesdits seconds moyens de mémorisation ;

de sorte que la séquence vidéo particulièrement intéressante contenant la scène d'un incident survenu dans le véhicule est mémorisée dans la perspective d'être visionnée et analysée a posteriori.

10. Procédé d'enregistrement de données multimédia au moyen d'un appareil selon la revendication 1, notamment de séquences télévisées émises par un émetteur distant, en vue d'une rediffusion de séquences antérieures à la décision d'enregistrement ; ledit procédé comprenant les étapes suivantes : d'enregistrement de données multimédia, notamment de séquences télévisées émises par un émetteur distant, en vue d'une rediffusion de séquences antérieures à la décision d'enregistrement ; ledit procédé comprenant les étapes suivantes :

- l'étape, pour un téléspectateur, de visualiser lesdites séquences télévisées sur un écran d'un équipement de télévision les recevant en temps réel,

- l'étape d'enregistrer, en continu, dans une zone mémoire volatile de capacité appropriée, des tranches glissantes de durée déterminée desdites séquences télévisées ainsi visualisées, selon une procédure FIFO (première entrée, première sortie),

- l'étape, pour ledit téléspectateur, de sélectionner une séquence déterminée venant d'être diffusée et qu'il souhaite revoir ; ladite séquence déterminée ayant été préalablement enregistrée selon ladite procédure FIFO ;

ledit procédé comprenant en outre l'étape, pour ledit téléspectateur, d'actionner au moyen d'un organe de commande (9h, 10h) le transfert de ladite séquence déterminée de ladite zone mémoire (7h) vers un équipement de traitement d'image (1h) :

- soit pour rediffuser ladite séquence déterminée,

- soit pour enregistrer ladite séquence déterminée sur un support (8h) durable et/ou amovible ;

de sorte que le téléspectateur a ainsi la possibilité de revivre des instants furtifs ayant capté son attention au cours de l'émission télévisée.

11. Procédé selon la revendication 10 ; ladite zone mémoire volatile ayant une capacité appropriée pour pouvoir retrouver quasi instantanément la séquence passée ayant capté l'attention du téléspectateur.

12. Procédé selon l'une quelconque des revendications 10 ou 11 ; ladite zone mémoire volatile ayant une capacité appropriée pour que le téléspectateur puisse actionner en toute quiétude par une action manuelle réflexe ledit organe de commande, en disposant d'un temps suffisant.

13. Procédé selon l'une quelconque des revendications 10 à 12 ; ledit procédé étant tel que ladite zone mémoire volatile a une capacité comprise entre 10s et 30s.

14. Dispositif comprenant un appareil pour enregistrer des données multimédia selon la revendication 1, notamment des séquences télévisées émises par un émetteur distant, en vue d'une rediffusion de séquences antérieures à la décision d'enregistrement ; ledit dispositif comprenant :

- un équipement de télévision recevant lesdites séquences télévisées, en temps réel, et les diffusant sur un écran à l'usage d'un téléspectateur

- des premiers moyens de mémorisation (7h), en continu, temporaires comportant une zone mémoire volatile de capacité appropriée, de tranches glissantes de durée déterminée desdites séquences télévisées ainsi visualisées, selon une procédure FIFO (première entrée, première sortie),

- un organe de commande (9h, 10h), actionnable par ledit téléspectateur, pour transférer vers un équipement de traitement d'image une séquence déterminée sélectionnée par ledit téléspectateur, parmi les séquences venant d'être diffusée

et ayant été préalablement enregistrée selon ladite procédure FIFO dans lesdits premiers moyens de mémorisation (7h) ;

- ledit équipement de traitement d'image (1h) comportant :

* des deuxièmes moyens de mémorisation (8h) destinés à mémoriser de manière permanente, en totalité ou en partie, ladite séquence déterminée ainsi transférée, et/ou

* des moyens pour rediffuser ladite séquence déterminée ;

de sorte que le téléspectateur a ainsi la possibilité de revivre des instants furtifs ayant capté son attention au cours de l'émission télévisée.

15. Dispositif selon la revendication 14 ; ledit dispositif étant tel que lesdits premiers moyens de mémorisation (7h) et/ou lesdits deuxièmes moyens de mémorisation (8h) sont amovibles.

16. Dispositif selon l'une quelconque des revendications 14 ou 15 ; ladite zone mémoire volatile ayant une capacité appropriée pour pouvoir retrouver quasi instantanément la séquence passée ayant capté l'attention du téléspectateur.

17. Dispositif selon l'une quelconque des revendications 14 à 16 ; ladite zone mémoire volatile ayant une capacité appropriée pour que le téléspectateur puisse actionner en toute quiétude par une action manuelle réflexe ledit organe de commande, en disposant d'un temps suffisant.

18. Dispositif selon l'une quelconque des revendications 14 à 17 ; ladite zone mémoire volatile a une capacité comprise entre 10s et 30s.

- l'étape, pour un téléspectateur, de visualiser lesdites séquences télévisées sur un écran d'un équipement de télévision les recevant en temps réel,

- l'étape d'enregistrer, en continu, dans une zone mémoire volatile de capacité appropriée, des tranches glissantes de durée déterminée desdites séquences télévisées ainsi

visualisées, selon une procédure FIFO (première entrée, première sortie),

- l'étape, pour ledit téléspectateur, de sélectionner une séquence déterminée venant d'être diffusée et qu'il souhaite revoir ; ladite séquence déterminée ayant été préalablement enregistrée selon ladite procédure FIFO ;

ledit procédé comprenant en outre l'étape, pour ledit téléspectateur, d'actionner au moyen d'un organe de commande (9h, 10h) le transfert de ladite séquence déterminée de ladite zone mémoire (7h) vers un équipement de traitement d'image (1h) :

- soit pour rediffuser ladite séquence déterminée,

- soit pour enregistrer ladite séquence déterminée sur un support (8h) durable et/ou amovible ;

de sorte que le téléspectateur a ainsi la possibilité de revivre des instants furtifs ayant capté son attention au cours de l'émission télévisée.

19. Dispositif comprenant un appareil d'enregistrement de données multimédia selon la revendication 1 destiné à traiter des données multimédia captées au moyen d'un instrument de vision, notamment de type jumelles ; ledit dispositif d'enregistrement étant destiné à permettre à un opérateur d'enregistrer des événements et des séquences relatifs à des faits antérieurs à une décision d'enregistrement dudit opérateur ; ledit dispositif comprenant :

- un instrument de vision, notamment de type jumelles, permettant de capter des séquences de données multimédia,

- un équipement électronique, recevant lesdites séquences de données multimédia dudit instrument de vision, via des connecteurs ;

ledit équipement électronique comprenant :

- des premiers moyens de mémorisation, destinés à mémoriser de manière continue lesdites séquences d'images et/ou de sons en provenance dudit instrument de vision ; lesdits premiers moyens de mémorisation comportant une zone mémoire

volatile d'une capacité appropriée à la mémorisation de fractions glissantes et de durée déterminée desdites séquences de données multimédia ainsi reçues ; ladite mémorisation étant notamment effectuée selon la procédure FIFO (première entrée-première sortie) ;

ledit équipement électronique comprenant en outre:

- un organe de commande permettant de :

• sélectionner une séquence particulière parmi les séquences de données multimédia ainsi mémorisées par lesdits premiers moyens de mémorisation, notamment un instant furtif, parfois inattendu et soudain vu au travers dudit instrument de vision,

• commander un transfert de ladite séquence particulière vers des seconds moyens de mémorisation, destinés à mémoriser de manière permanente, en tout ou partie, ladite séquence particulière ainsi sélectionnée. ; ledit organe de commande étant actionné manuellement par ledit opérateur et/ou de manière préprogrammée en cas de réalisation d'une condition déterminée, notamment en cas de présence devant un capteur dudit instrument de vision et/ou en fonction d'un paramètre déclenchant, adapté à une condition d'observation déterminée.

20. Dispositif d'enregistrement de séquences de données multimédia selon la revendication 19 ; ledit dispositif d'enregistrement de séquences de données multimédia étant tel que ledit équipement électronique est connecté à des moyens de lecture externes et/ou à des moyens de lecture intégrés audit instrument de vision ; lesdits moyens de lecture permettant audit opérateur de visionner ladite séquence particulière ainsi mémorisée par les seconds moyens de mémorisation ;

de sorte que la séquence, appréciée après-coup comme étant digne d'intérêt et contenant l'instant furtif attendu durant l'observation, est mémorisée afin d'être visionnée, analysée et reproduite à des fins spécifiques aux objectifs de l'observation effectuée au moyen de l'instrument de vision.

FIG . 1a

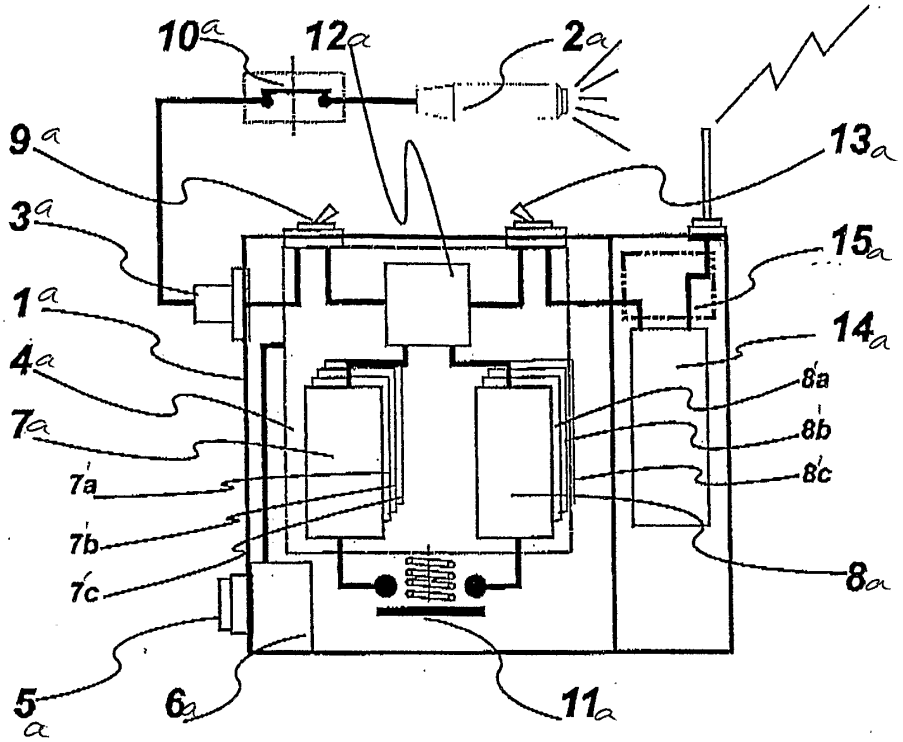
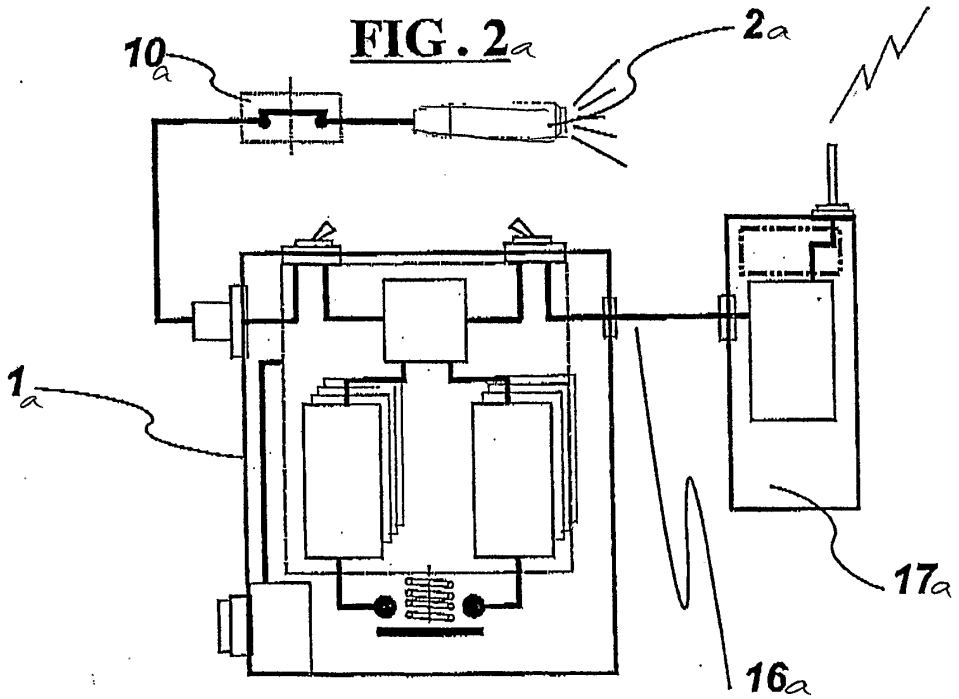


FIG . 2a



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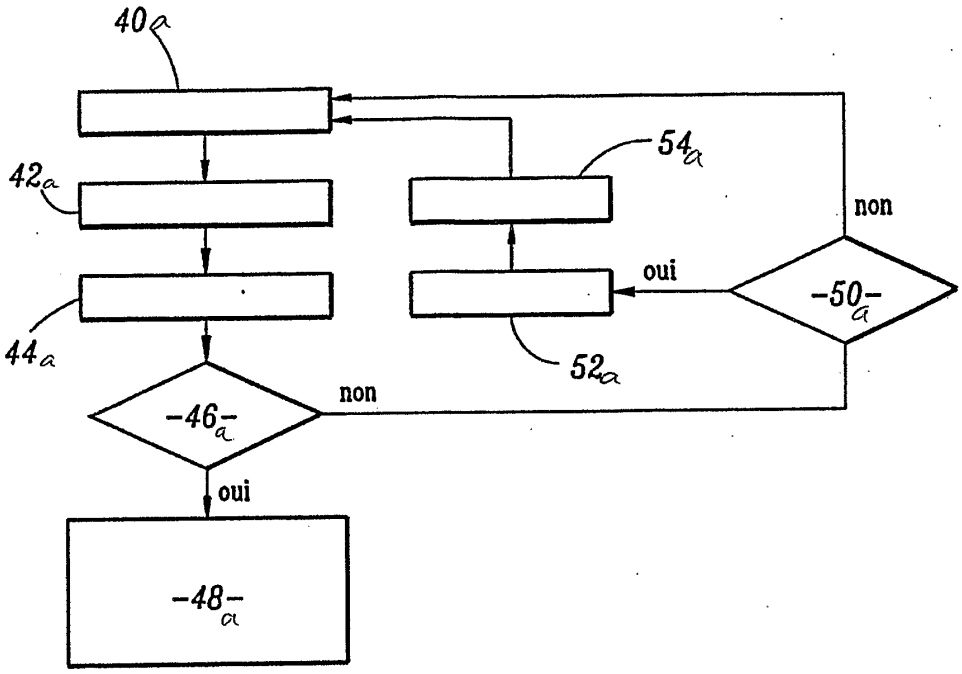


FIG.3a

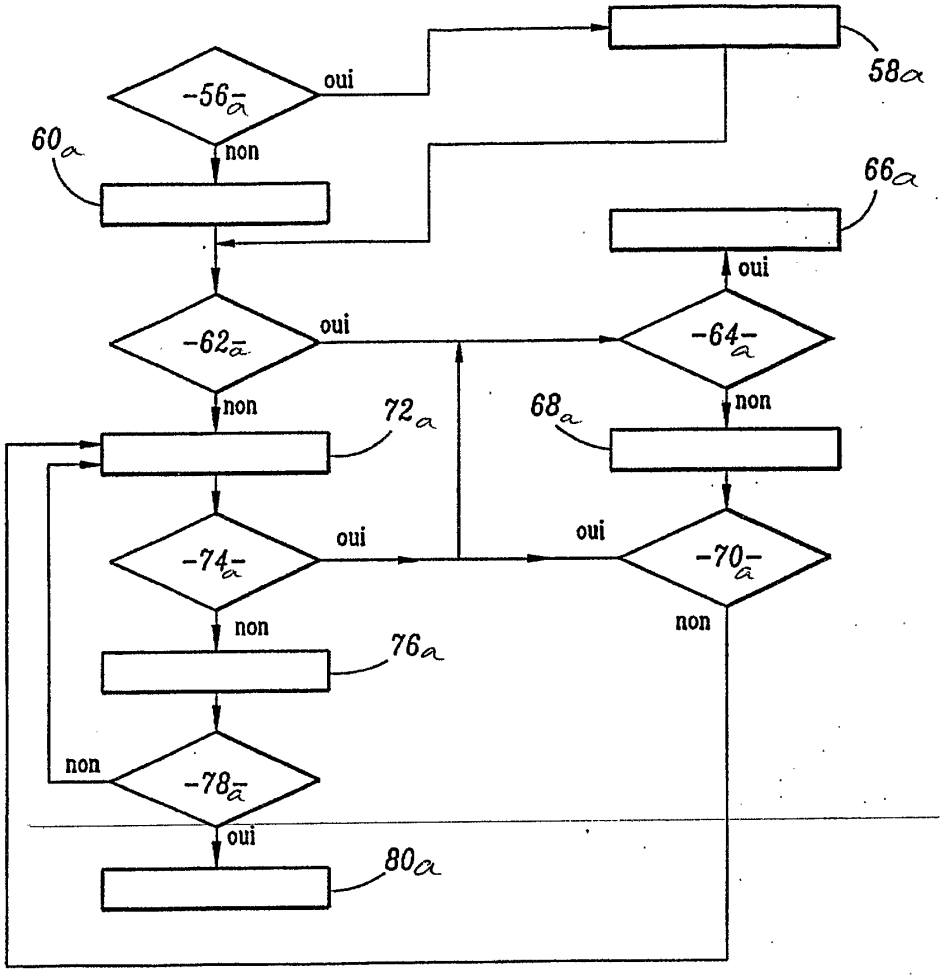

58a
-56a
oui
non
60a
66a
oui
-62a
oui
-64a
non
non
72a
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oui
oui
-70a
non
non
76a
non
-78a
oui
80a

FIG. 4a

FIG . 1b

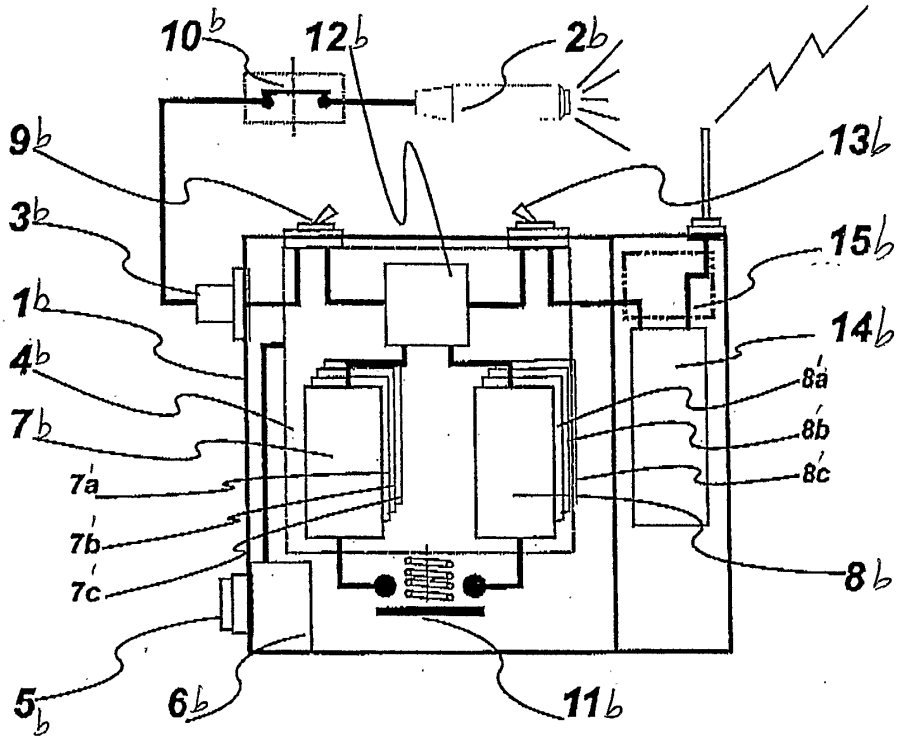

10b
12b
2b
9b
13b
3b
15b
1b
14b
4b
8'a
7b
8'b
7'a
8'c
7'b
8b
7'c
5b
6b
11b

FIG . 2b

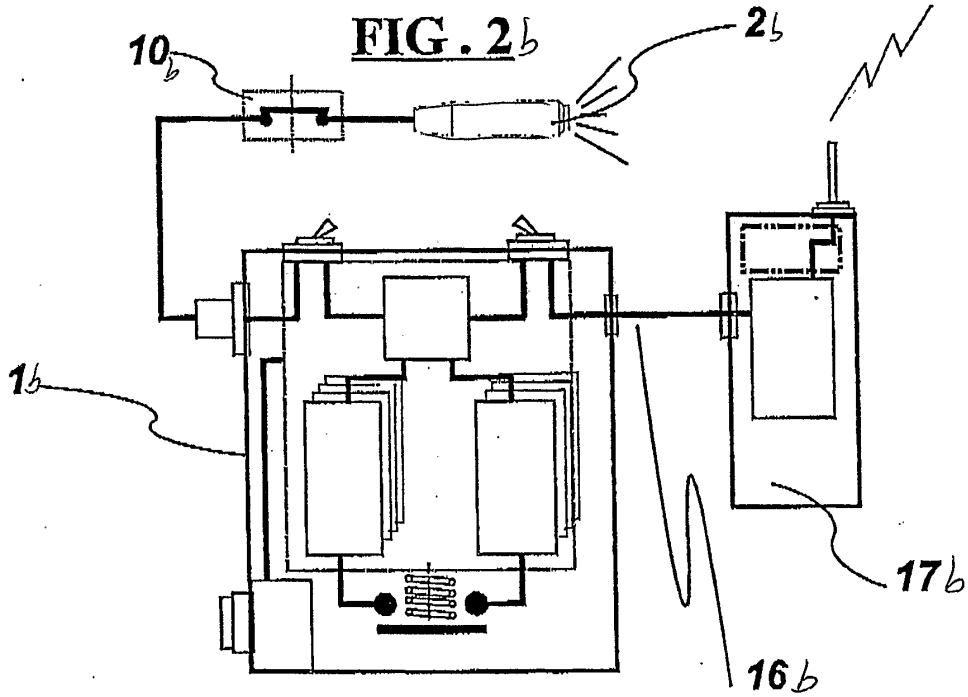

10b
2b
1b
17b
16b

FIG . 3b

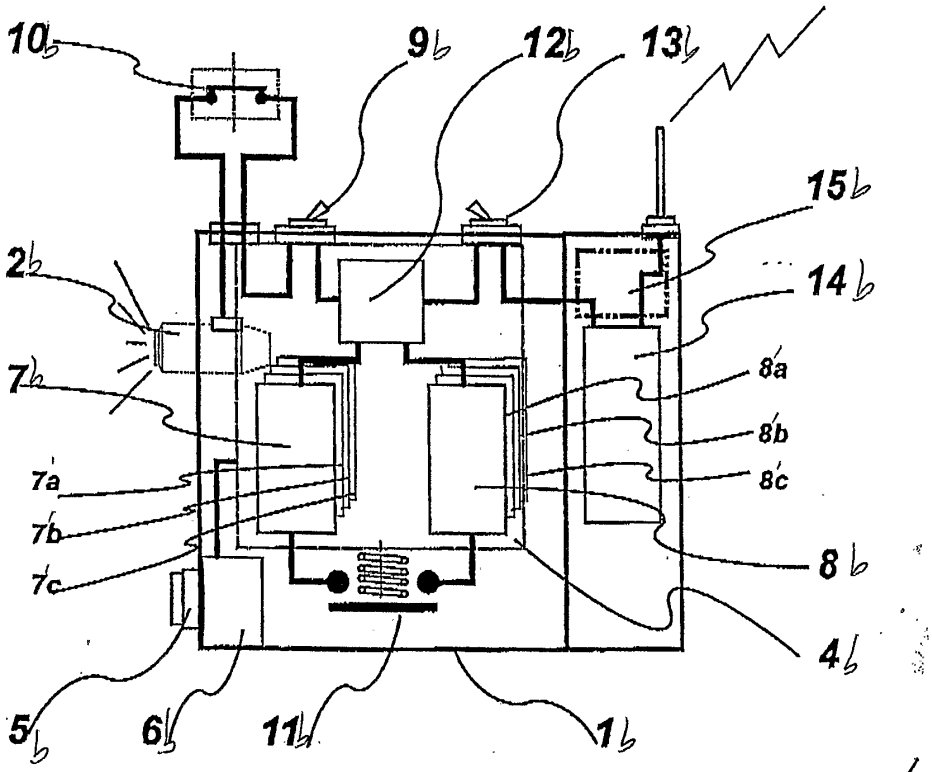

10b
9b
12b
13b
15b
14b
2b
7b
8'a
8'b
8'c
7a
7b
7c
8b
4b
5b
6b
11b
1b

FIG . 4b

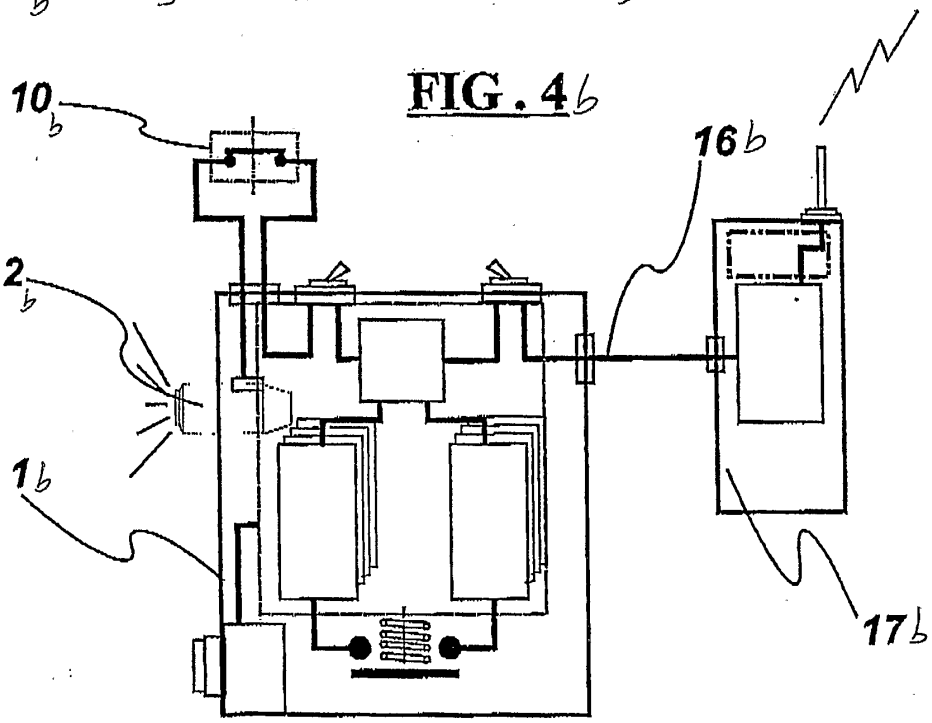

10b
16b
2b
1b
17b

FIG . 1c

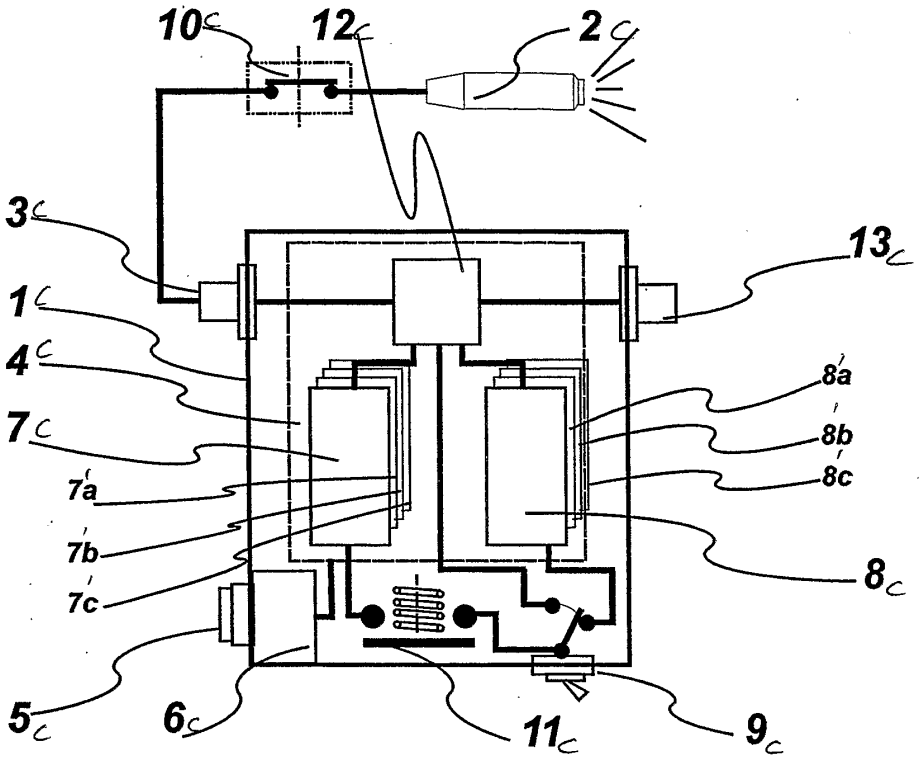

10c
12c
2c
3c
13c
1c
4c
8'a
7c
8'b
7'a
8'c
7'b
8c
7'c
5c
6c
11c
9c

FIG . 2c

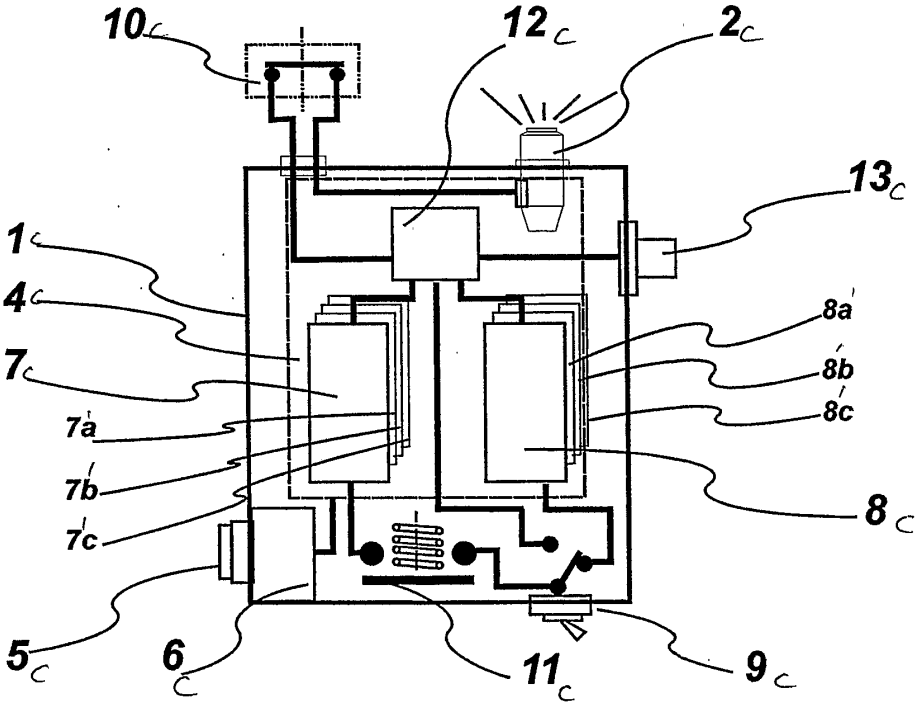

10c
12c
2c
13c
1c
4c
8'a
7c
8'b
7'a
8'c
7'b
8c
7'c
5c
6c
11c
9c

FIG . 1d

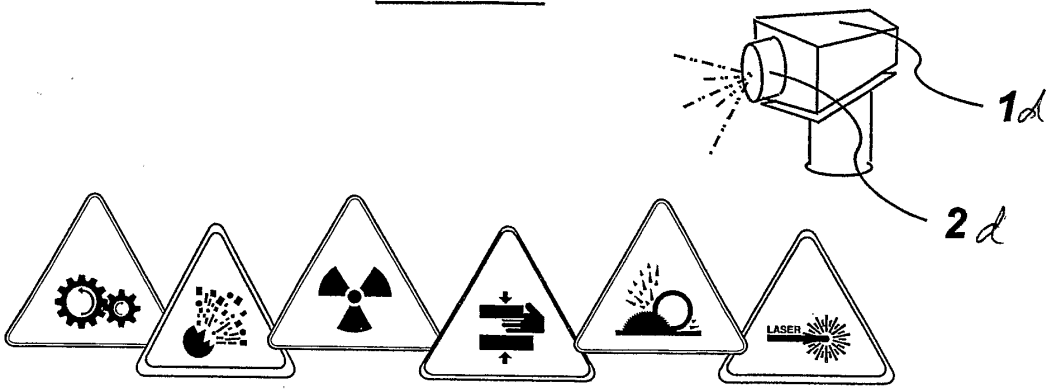


FIG . 2d

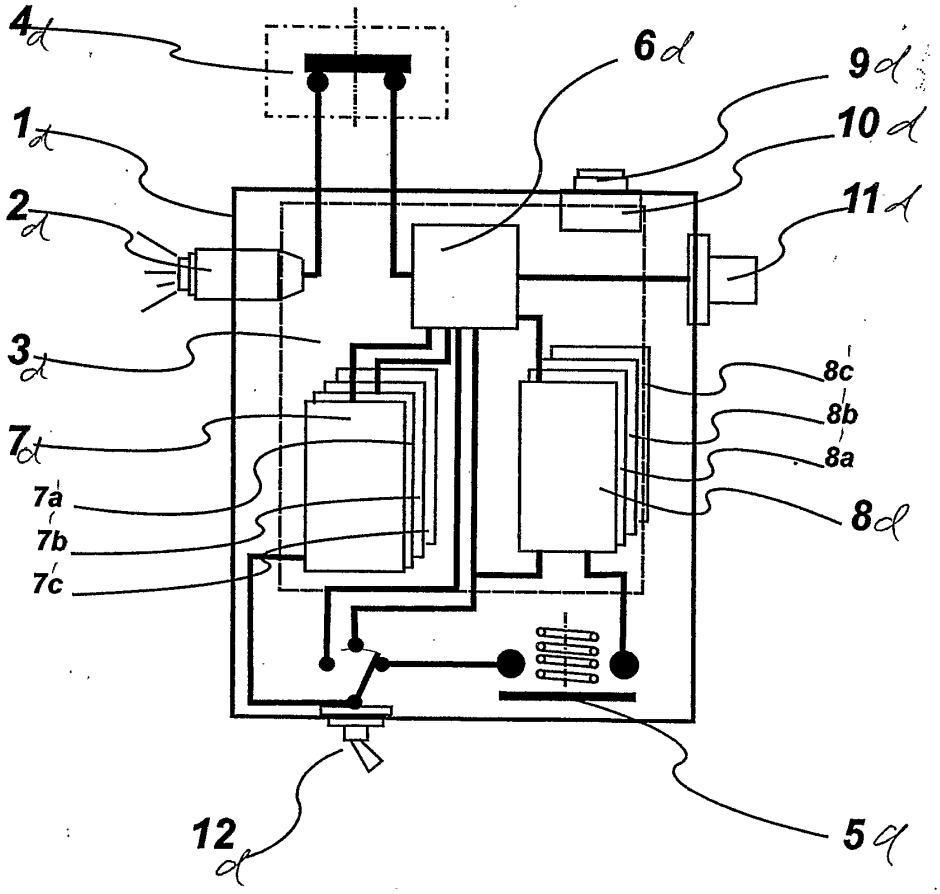


FIG . 1

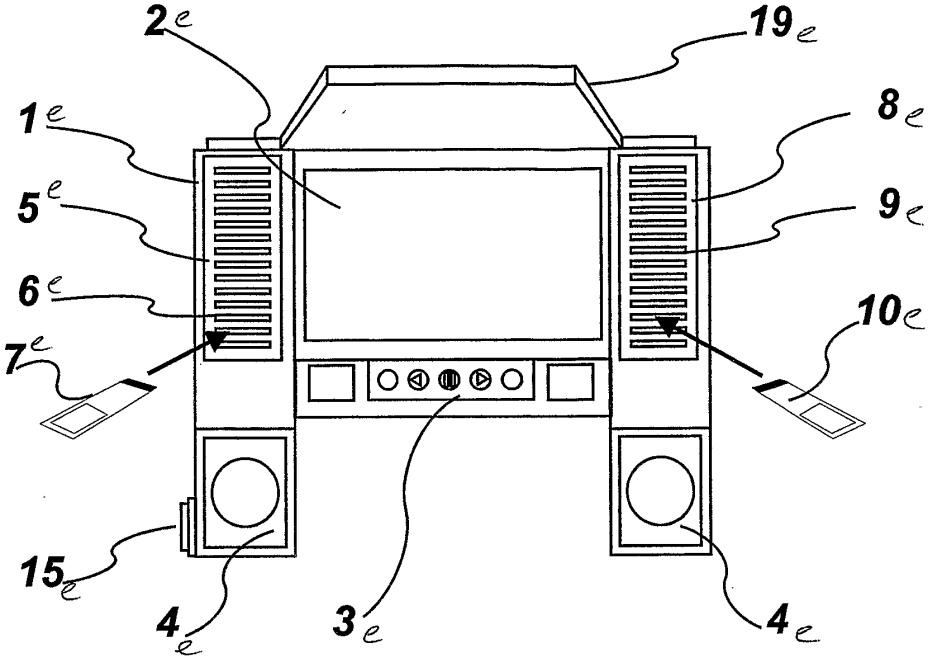
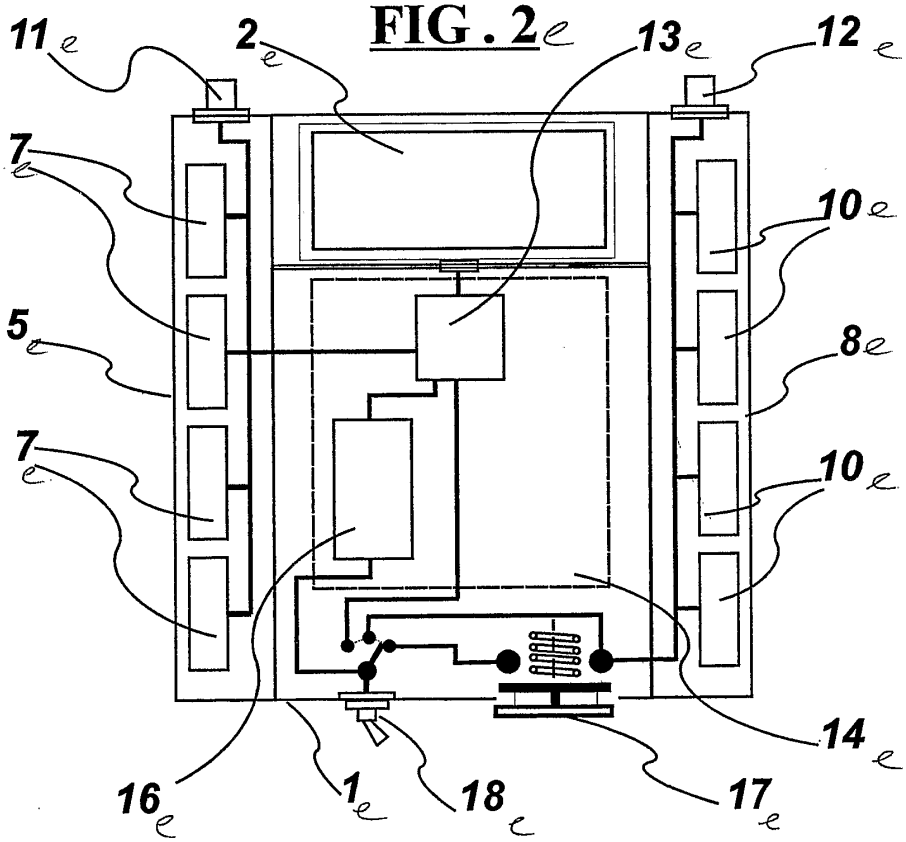


FIG . 2



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FIG. 1

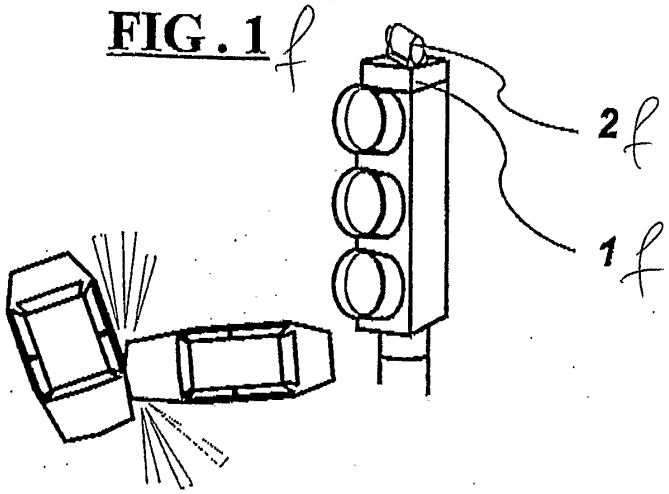
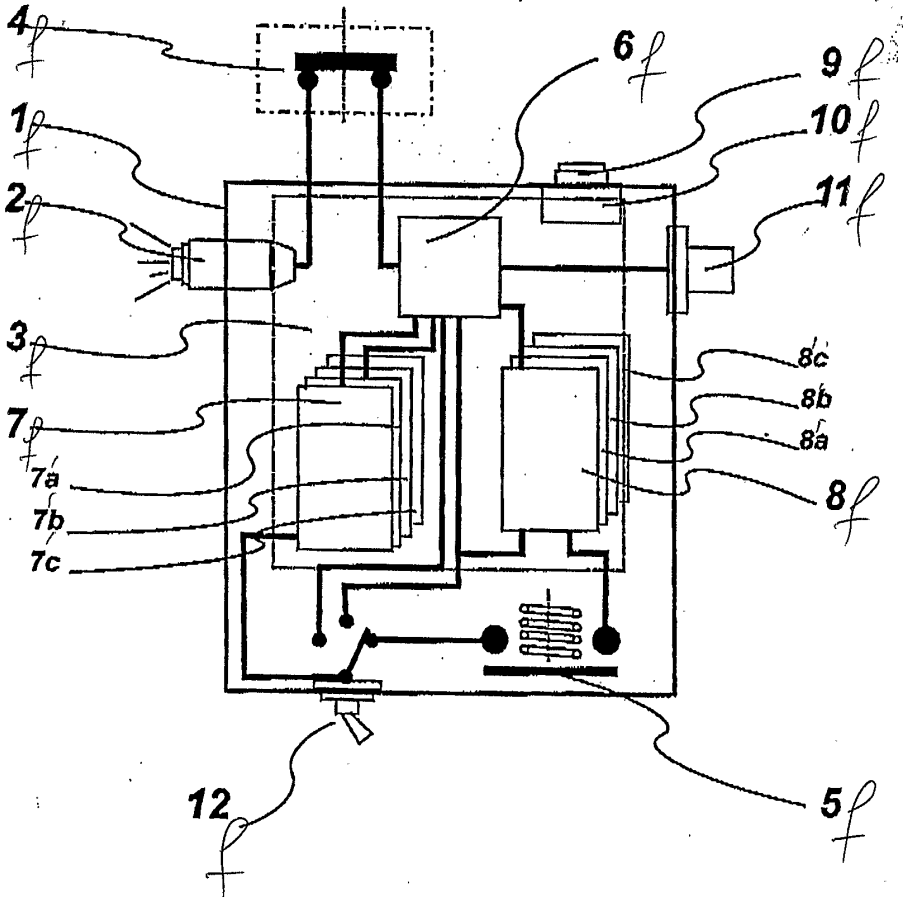


FIG. 2



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FIG . 1

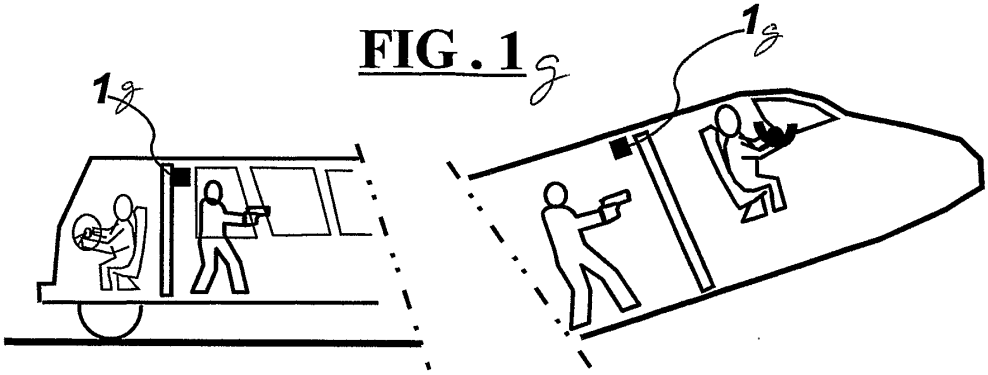


FIG . 2

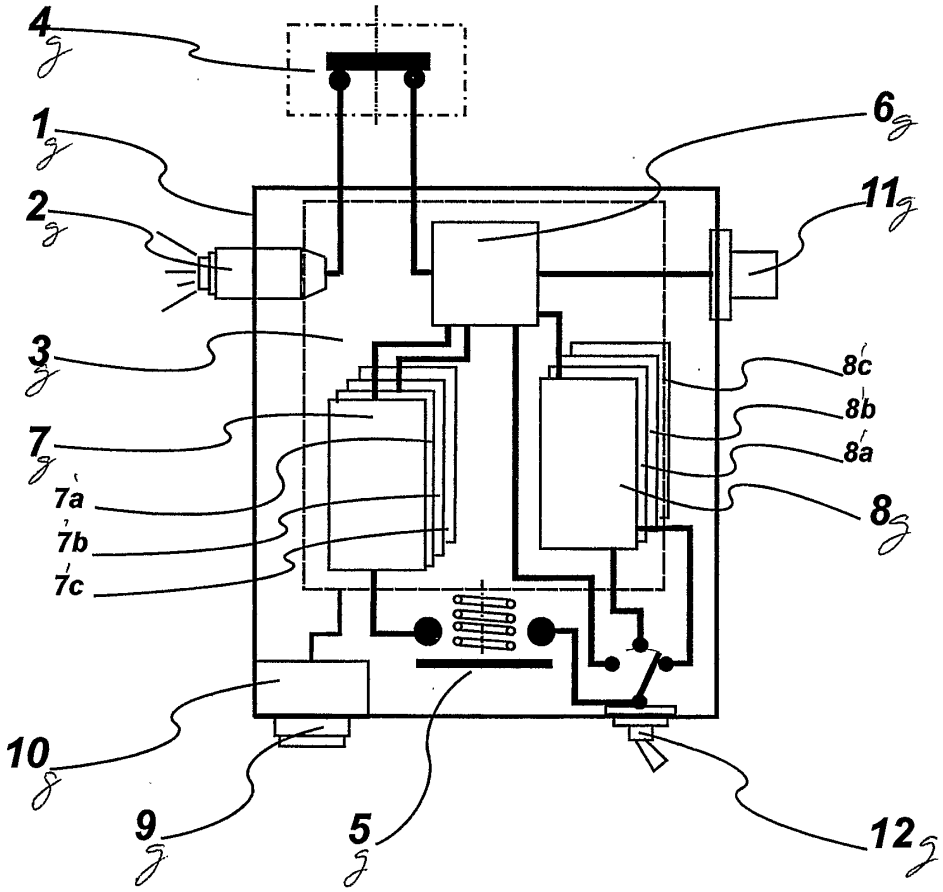


FIG . 3

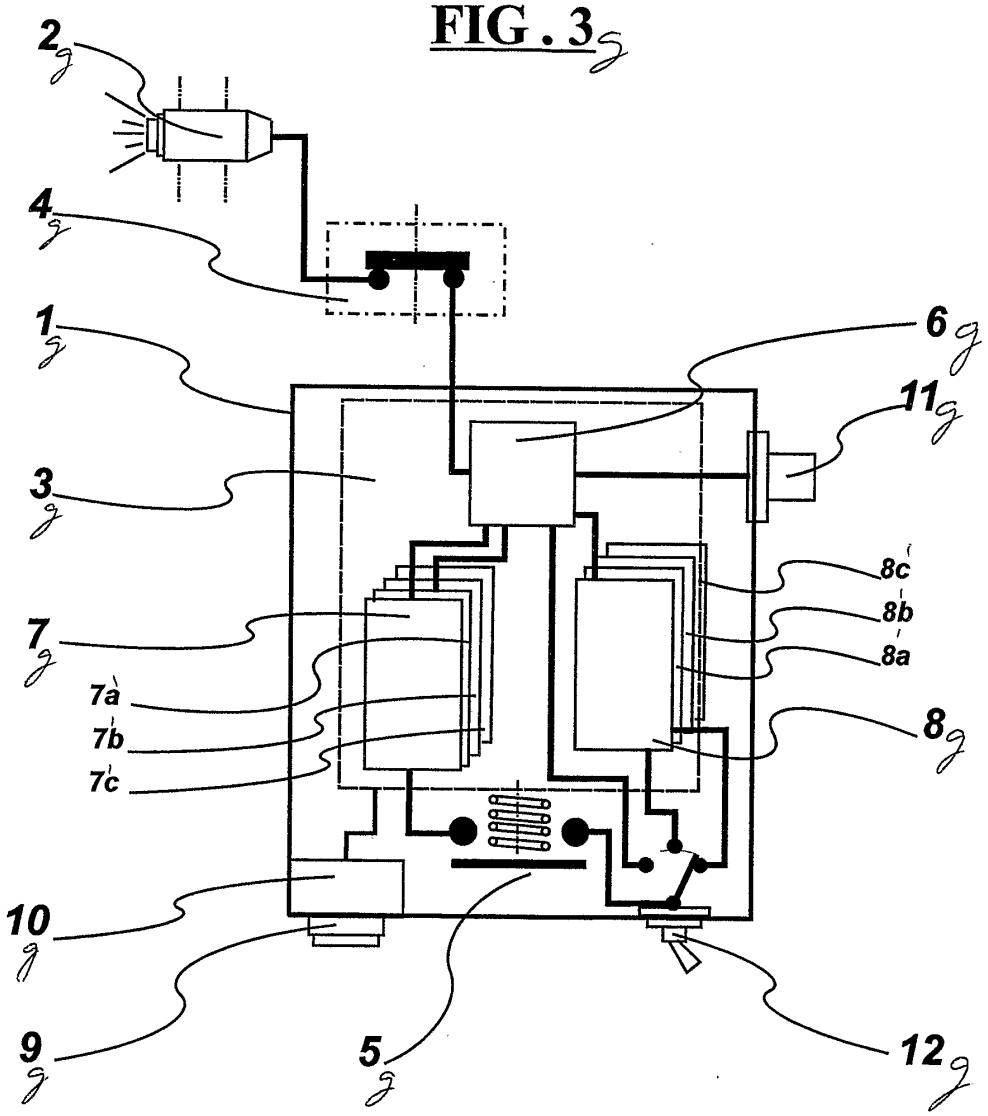


FIG . 1h

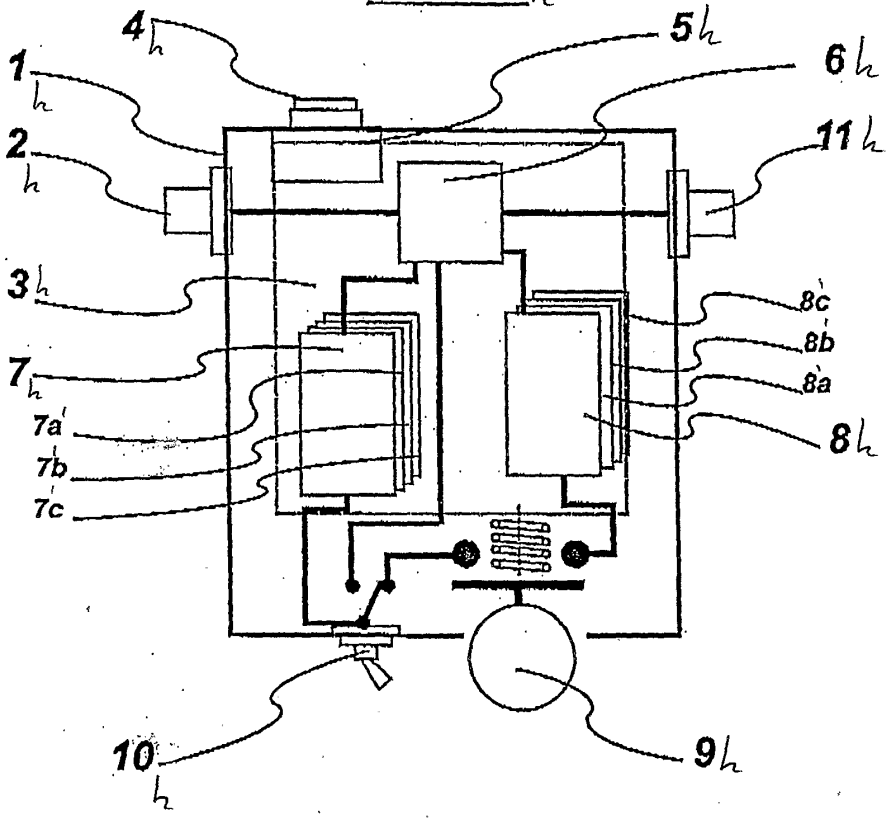

4h
5h
6h
1h
2h
11h
3h
8c
8b
8a
7h
7a
7b
7c
8h
10h
9h

FIG . 2h

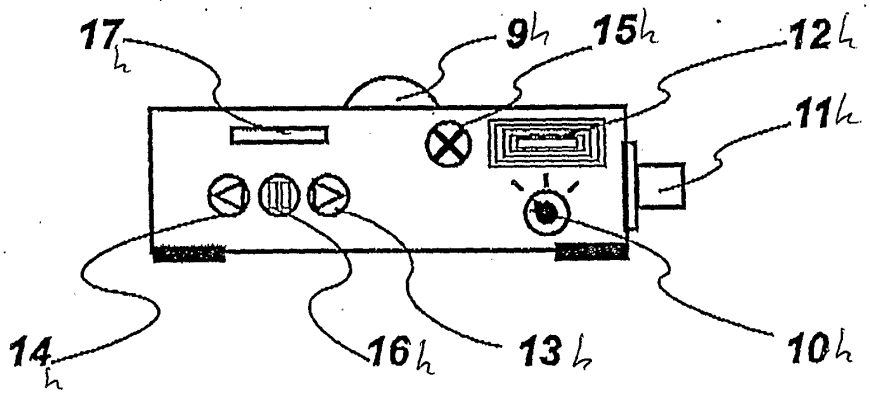

17h
9h
15h
12h
11h
14h
16h
13h
10h

FIG . 1

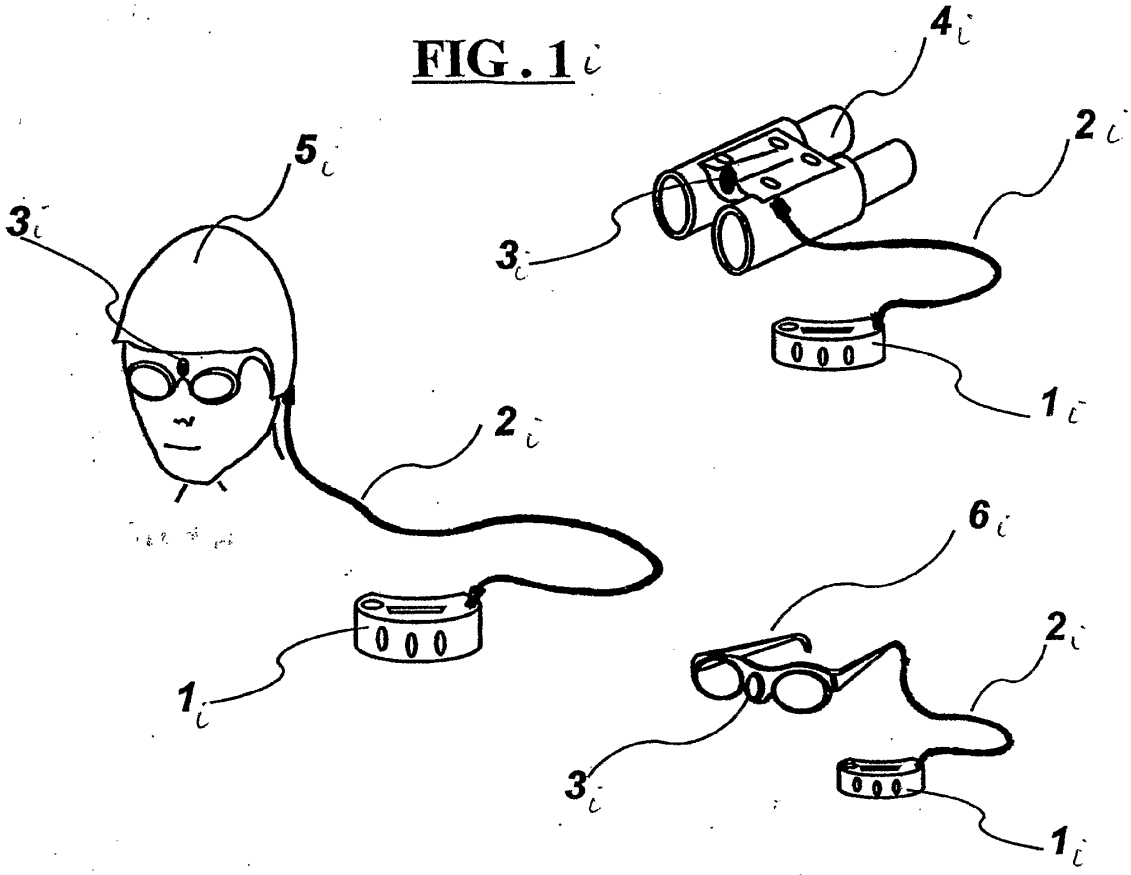


FIG . 2

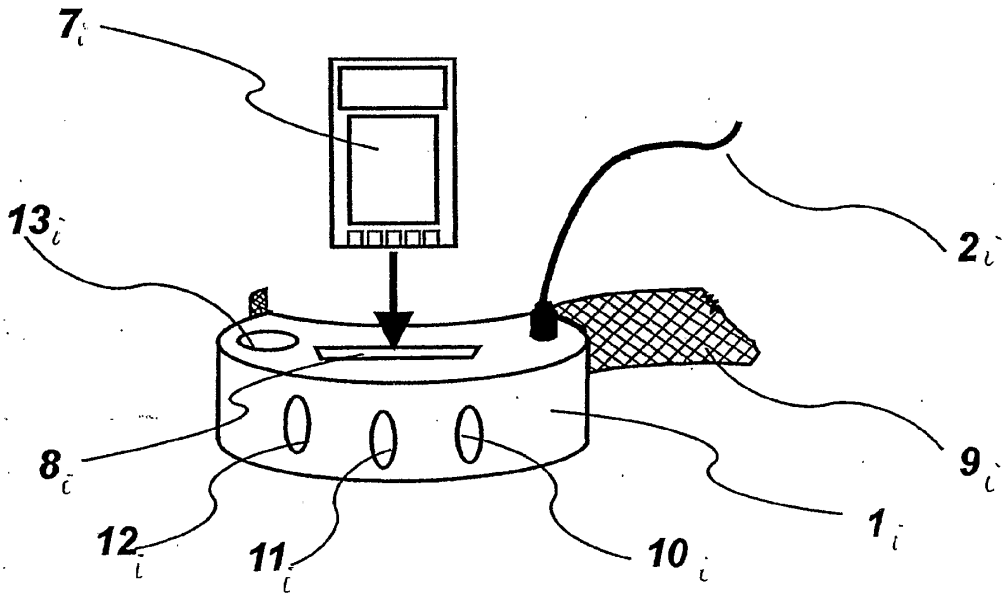
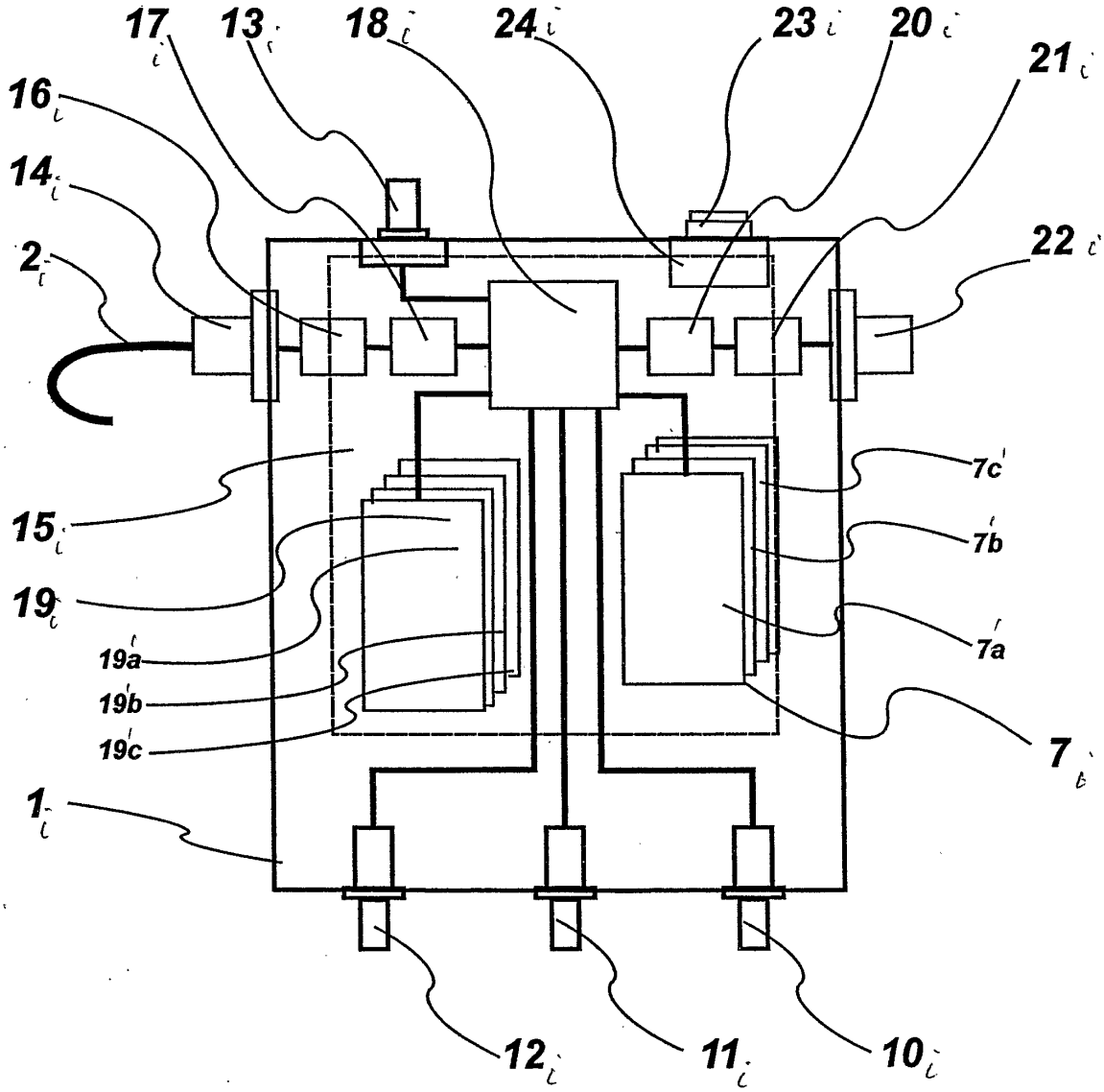


FIG . 3



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Appendix GGG

US 20050036103A1

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(12) **Patent Application Publication** (10) **Pub. No.: US 2005/0036103 A1**

Bloch (43) **Pub. Date: Feb. 17, 2005**

(54) **EYEGLASSES WITH INTERCHANGABLE TEMPLE-MEMBERS**

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SOLANA BEACH, CA 92075 (US)

(21) Appl. No.: **10/916,180**

(22) Filed: **Aug. 10, 2004**

Related U.S. Application Data

(60) Provisional application No. 60/493,728, filed on Aug. 11, 2003.

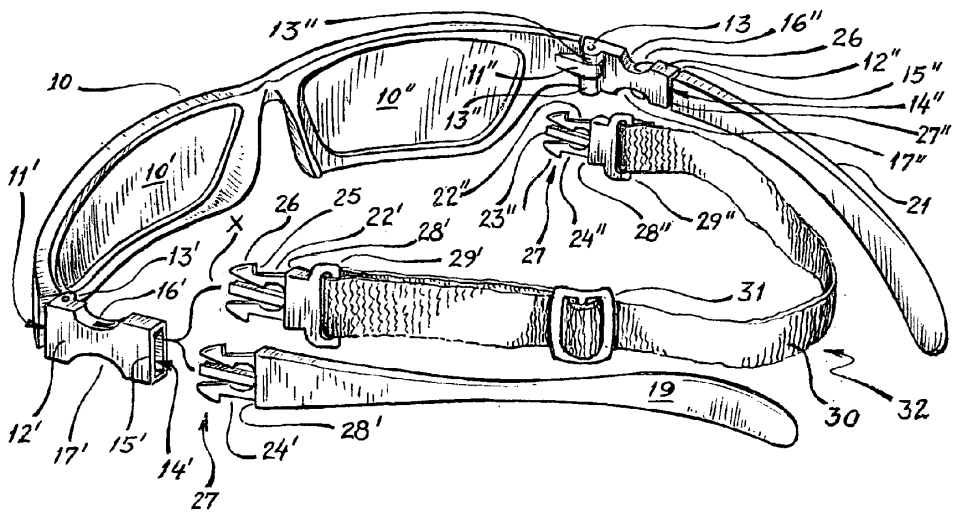
Publication Classification

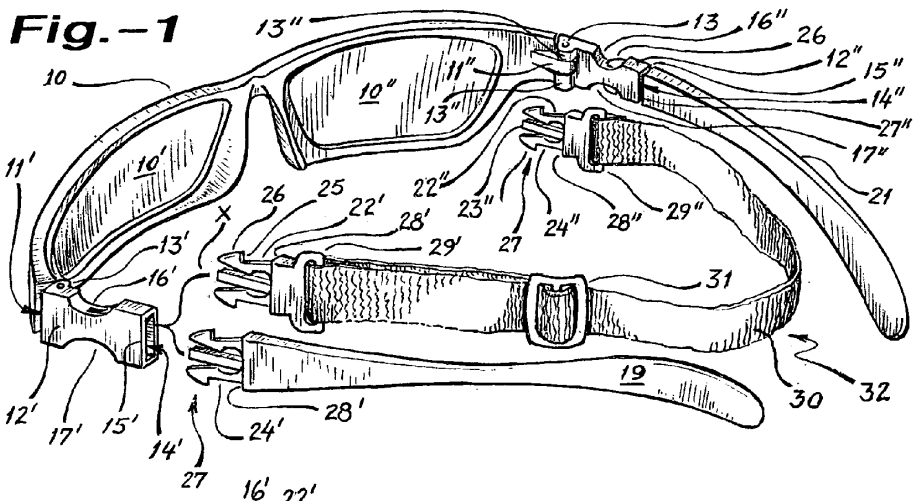
(51) **Int. Cl.**[7] **G02C 5/14**; G02C 5/02

(52) **U.S. Cl.** **351/116**

(57) **ABSTRACT**

An eyeglasses apparatus and transformation system thereof, facilitating quick and easy convertibility of the left and right traditionally folding temples into an adjustable headband; thereby making the light-weight eyeglasses much more suited to dynamic activities such as jogging, skiing, and cycling for example. The user of this novel eyeware can advantageously move between more sedentary situations, where the extreme appearance of eye-goggles would appear very out of place;—yet by manually releasing an inconspicuously integrated pair of bifurcated retention-latches located immediately aftward of both temple-hinges, the temples can be instantly detatched and readily interchanged with a headband employing similar slide-in bayonet-type retention-latches. The disclosure identifies a particularly critical human-factors problem addressed by the uniquely configured finger operated opposed latches; plus, the notion of my slim-lined detatchable-temples, enables a host of optional companion accessory temple embodiments, facilitating a miniature radio, cell-phone, or digital-camera;—conveniences for the person on the go!





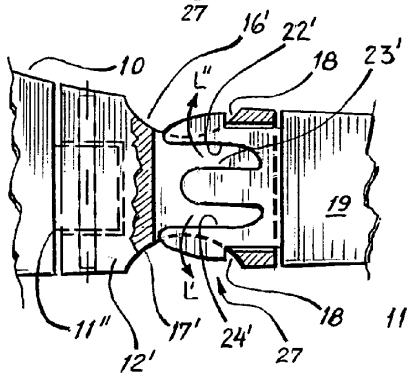


Fig.—2A

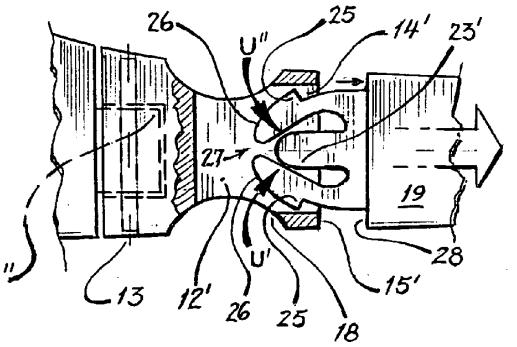


Fig.—2B

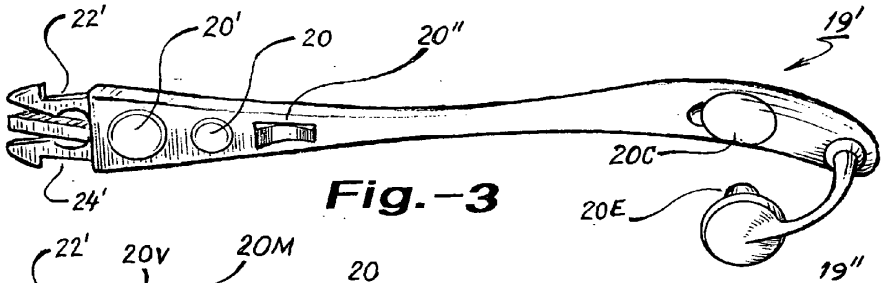


Fig.—3

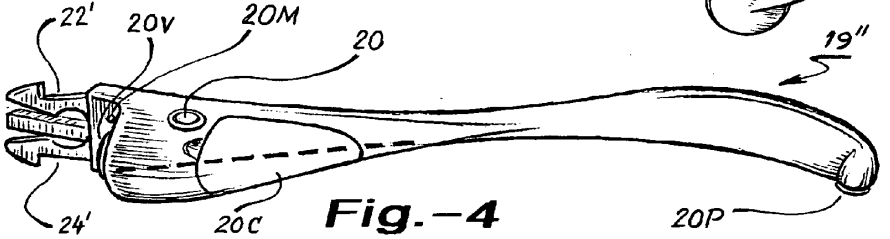


Fig.—4

EYEGLASSES WITH INTERCHANGABLE TEMPLE-MEMBERS

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This disclosure relates to paired-eyeglasses or spectacles of the type having folding right and left temples supported upon users ears; and more specifically it relates to eyeware having some manner of conveniently detatchable and possibly interchangeable temple supporting members.

[0003] 2. Relevant Prior-Art

[0004] Background research discovery provides some prior patent-art regarded as germane to this disclosure, chronologically for example, U.S. Pat. No. 766,413 (filed: August 1903) contemplates the notion of spectacles(pair of eyeglasses) having detachable left and right contemplates the notion of spectacles(pair of eyeglasses) having detachable left and right side temple support-arms by means of a fixed C-shaped receiver-mount which opposed C-lugs portions are employed to receive a the springy Y-shaped forward-tips at both the left and right temple/support-arms;—which afford a folding-hinge and appear to be readily detachable from the C-lugs when desired.

[0005] In U.S. Pat. No. 3,118,962 (filed: February 1961) is shown a pair of eyeglasses having abbreviated left and right conventionally hinging (for folding purposes) male/receiver-mounts, each having a plural-detented trailing-rod member which fits into a hole provided in the forward-end of both left and right temple/support-arms which male-ends thus insert into a medial/support-sleeve permanently attached over their respective male/receiver-mounts;—whereby a spring-loaded detenting-ball facilitates a convenient selective manual fore/aft-adjustment of their respective temple/support-arms (not intended to be completely detachable).

[0006] In U.S. Pat. No. 3,133,141 (filed: January 1962) is shown a pair of eyeglasses having slidingly adjustable aftward temple/support-arm members, which however are not actually intended to provide a detachable function.

[0007] In U.S. Pat. No. 3,394,980 (filed: June 1964) is shown a pair of eyeglasses having folding left and right temple/support-arms, and including plural trunion hinging points arranged along the temple/support-arms at spaced apart intervals; which however are not actually intended to provide a detachable function.

[0008] In U.S. Pat. No. 3,416,858) filed: March 1965) is shown a pair of eyeglasses having left and right temple/support-arms made in two optional generic variants, the first version showing the temple/support-arms being of a male-body configuration slidibly fitting into the trailing-end of a hinging female/receiver-mount, the second version showing the temple/support-arms being of a female-body configuration slidibly fitting around the hinging male/receiver-mount;—both iterations relying solely upon the friction-fit of the internally sliding portion as to achieve a variable adjustable length. Additionally, an optional hearing-aid fitted temple/support-arm is also set forth.

[0009] In U.S. Pat. No. 3,667,834 (filed: March 1971) is shown a pair of eyeglasses having left and right extended-trailing female/temple-supports, both sides including a forward support-swivel portion hingingly adapted to their respective conventional temple-support members; and in combination with left and right male male/support-arm members which thus slide within their respective female/temple-support portions. The aftward male/support-arm members each include a bifurcated-prong having laterally disposed accurately formed index-tip, which detents into one of plural indexing-detents provided in the sidewall of the female/temple-supports;—thereby enabling user to manually slideably adjust the aft male/support-arms to a suitable length relative to their ears, however the male/support-arm members are not intended to be detachable.

[0010] In U.S. Pat. No. 4,488,792 (filed: December 1984) is shown a pair of eyeglasses having detachable left and right temple/support-arms, wherein generic-variant removable wire-clip equipped hinge-pins are disclosed, which are said to enable the left and right temple/support-arms to be readily detached for the reason of obtaining a more intimate fitting and sealing when donning a military/gas-mask.

[0011] In U.S. Pat. No. 5,007,728 (filed: December 1989) is shown a pair of eyeglasses with conventional left and right temple-supports, to which hinges are adapted special left and right male/receiver-mounts having bifurcated-prongs, both upper prongs being a latching-prong having a positive-catch **(24)** formed thereto;—while both detachable temple/support-arms include a non-adjustable forward female/prong-receptacle having an internal cavity-separator partition **(48/52)** which cooperates with the lower/slider-prong **(30)**, plus an engagement-relief **(54)** having a notch-catch **(56)**,—whereby manual finger-tip depressing of the upper/latching-prongs obtains detachment so as to thereby change to differently styled temple/support-arms. These hollow-cavity temple/support-arms are necessarily rather costly to produce via two relatively complex three-piece injection-molding dies.

[0012] In U.S. Pat. No. 5,594,511 (filed: November 1995) is shown a pair of eyeglasses having left and right extended-trailing female/temple-supports, both sides including a forward support-swivel portion hingingly adapted to their respective conventional temple-mounting members; and in combination with left and right detachable male male/support-arm members which thus slidably engage into their respective female/temple-support portions. The male-prong of the aftward support-arm members each include a laterally disposed latch **(503)** which positively detents into a catch **(400)** formed integrally within the sidewall of the female/temple-supports;—thereby enabling user to manually remove the aft male/support-arms and substitute alternate male/head-strap members.

[0013] In U.S. Pat. No. 6,582,075 (filed: October 2001) is shown a pair of eyeglasses having left and temple/support-arms, which can be readily detached by removal of a special retention-pin at both left and right sides which features an annular-detent for engagement by a detent-spring at the temple/supports. The retention-pins also include discrete plural annular electrical-conductors, said useful in communicating of electrical-circuits between the left and right temple/support-arms. However, in actual practice it has been found that handling of such small retention-pins is not practical, as they are easily dropped and lost by the average user.

[0014] Therefore, in full consideration of the preceding patent review, there is determined a need for an improved

form of device to which these patents have been largely addressed. The instant inventor hereof believes their newly improved eyeglasses invention, commercially referred to as the EQS™ (Eyeglasses Quick-release System), currently being developed for production under auspices of the Products-Mfg./Mkt.Co., exhibits certain advantages as shall be revealed in the subsequent portion of this instant disclosure.

SUMMARY OF THE INVENTION

[0015] A.) In view of the foregoing discussion about the earlier invention art, it is therefore important to make it pellucid to others interested in the art that the object of this invention is to provide a pair of convertible eyeglasses, or spectacles as they are also called, having substantially conventional left and right hinging portions to which are adapted special aftwardly extending left and right female/receiver-mounts, thereby accommodating readily detachable left and right temple/support-arm members. Note that to best facilitate this "convertibility"-objective, it was found advantageously practical to not employ the usual mirror-image left and right female/receiver-mount members. Instead, it was found that these two permanent non-detaching female/receiver-mounts could be molded from a common injection-molding die, and the same part is merely flipped-over 180-degreed left-to-right,—thereby enabling substantial cost-saving by sharing a common molding-die cavity. They employ a hollow tunnel-like female "support-cavity" portion which is relatively costly to injection-mold, owing that they involve a more complex three-piece molding-die (not shown in this disclosure because it is a conventional molding procedure). Additionally, the cooperatively detachable left and right extending mirror-image shaped male temple/support-arm members, can also be more economically produced from a less costly conventional longitudinally-split two-piece opposed-cavity injection-molding die. Hence, the point being made here is that the more costly components preferably remain a permanent part of my eyeglasses, while the detachable portions are less-costly, thereby enabling users of these eyeglasses to at any time enjoy purchasing variously styled modularly interchangable temple-supports (as to shape/size/color/trimmings, as well as my differently functioning temple/support-arms options),—on a very cost-effective basis.

[0016] B.) Another object of this invention disclosure is to set forth a pair of convertible eyeglasses having left and right female/receiver-mounts hingingly adapted to conventional fixed left and right temple-supports according to item-A, wherein the cooperative left and right male temple/support-arms are discretely detachable, both of the temple/support-arms having an upper and lower forward male latching-prong with outwardly-opposed catches upon their forwardmost terminuses. These trailing temple/support-arms are manually inserted forward into into their respective left or right trailing female/receiver-mount support-cavities, whereby the temple/support-arm latching-prong catches preferably being of a resilient-plastic thus upon moderate manual urging, snap into positive engagement with mating upper and lower engangement-reliefs formed integrally within both female/receiver-mount support-cavities. The discrete left and right temple/support-arms are therefore held fast into their respective left and right female/receiver-mount support-cavities, yet are readily detachable by a simple secondary detaching procedure, whereby the user need merely squeeze their thumb and opposing forefinger together at the opposite upper and lower engangement-reliefs formed into both of the female/receiver-mounts;—whereby of a critical improvement nature, the upper and lower latching-prongs yield and deflect against a preferred third or medial-prong of the male/pronged-assembly acts as a centering abutment deflection-limit member, assuring simultaneous disengagement of the opposed catches, whereupon the temple/support-arms are simply manually withdrawn.

[0017] In any case, even if the preferred medial-prong is not included as a part of the male/pronged-assembly, an upper/finger-relief and an opposed lower/finger-relief are nevertheless provided upon the discrete left and right said female/receiver-mounts proximal the upper and lower latching-catches, whereby simultaneous manual squeezing of one's thumb and an opposing finger at the upper/finger-relief and the lower/finger-relief (ie: finger above and thumb-below, or, thumb above and finger below), thus biases the latching-prongs toward one another as to thereby disengage the latching-catches from impingement upon said latching-notches, thus releasing the temple/support-arms free from retention by the female/receiver-mount.

[0018] C.) Another object of this invention disclosure is to set forth a pair of convertible eyeglasses having left and right female/receiver-mounts hingingly adapted to conventional fixed left and right temple-supports according to items-A&B, whereby in one regard the left and right detachable temple/support-arms can be fashioned into various aesthetic colorations and reconfigurations as design-trends may warrant. Additionally, although this disclosure essentially only sets forth information deemed pertinent to the specific utility function of detaching/attaching of either left or right temple/support-arms in a modular manner, it is to be understood that as such, the disclosed temple/support-arm apparatus may include optionally integrated accessory pomponents according to engineering design choice to provide an additional convenience-feature option,—such as an Am/Fm-radio, video-camera, cell-phone, and the like (all of which necessarily relying upon conventional state-of-art micro/integrated-circuiting);—hence, the novel detachable means being set forth herein thus serves to conveniently facilitate optional interchangability of temple/support-arms having substantially self-contained electronic operatives as well.

DESCRIPTION OF THE PREFERRED EMBODIMENT DRAWINGS

[0019] The foregoing and still other objects of this invention will become fully apparent, along with various advantages and features of novelty residing in the present embodiments, from study of the following description of the variant generic species embodiments and study of the ensuing description of these embodiments. Wherein indicia of reference are shown to match related matter stated in the text, as well as the Claims section annexed hereto; and accordingly, a better understanding of the invention and the variant uses is intended, by reference to the drawings, which are considered as primarily exemplary and not to be therefore construed as restrictive in nature; wherein:

[0020] **FIG. 1**, is a pictorial perspective-view, favoring the upper-left aftward portion of an exemplified pair of eyeglasses, wherein the trailing left temple/support-arm member is shown immediately detached from the forward left

female/receiver-mount member,—and also shown thereto is an optionally interchangable temple/headband member;

[0021] **FIG. 2A**, is the first of two companion sequences showing an exemplified partial cross-sectional cut-away detail of the temple/support-arm, here revealing relationship of the latching-prongs during their normal positive full-engagement during use of the eyeglasses;

[0022] **FIG. 2B**, is the second of two sequences corresponding to **FIG. 2A**, here show only initially inserted as to reveal the vital relationship of the latching-prongs to the medial-prong during their normal detaching/attaching procedure;

[0023] **FIG. 3**, is a pictorial view showing an exemplified optional radio integrated within the left temple/support-arm;

[0024] **FIG. 4**, is a pictorial view showing an exemplified optional video-camera integrated within the left temple/support-arm.

ITEMIZED NOMENCLATURE REFERENCES

[0025] **10,10'/10"**—conventional binocular-frame, conventional Lenses: left/right

[0026] **11',11"**—conventional left/temple-support, conventional right/temple-support

[0027] **12'/12"**—female/receiver-mount: left/right

[0028] **13,13'/13"**—support-swivel pin, support-swivel: left/right

[0029] **14'/14"**—support-cavity: left/right

[0030] **15'/15"**—cavity-abutment: left/right

[0031] **16'/16"**—upper/finger-relief: left/right

[0032] **17'/17"**—lower/finger-relief: left/right

[0033] **18**—latching-notch (all four places)

[0034] **19,19',19"**—left temple/support-arm options: standard, radio-arm, videocam-arm

[0035] **20,20',20"**—component options: off/on-button, tuning-button, audio-volume rocker-switch

[0036] **20C,20E,20M,20P,20V**—bat.-cover, earphone, microphone, download-port, videocam

[0037] **21**—right temple/support-arm: standard

[0038] **22'/22"**—upper male/latching-prong: left/right

[0039] **23'/23"**—male medial-prong: left/right

[0040] **24'/24"**—lower male/latching-prong: left/right

[0041] **25**—latching-catch (all four places)

[0042] **26**—entry-ramp (all four places)

[0043] **27**—male/pronged-assembly

[0044] **28'/28"**—latching-abutment: left/right

[0045] **29'/29"**—male-extension/support-loop: left/right

[0046] **30**—headstrap

[0047] **31**—strap/adjustment-buckle

[0048] **32**—temple/strap-assembly

[0049] L'/L"—resiiient-bias to expanded "Latched" condition

[0050] U'/U"—resilient-bias to convenged "Unlatched" condition

[0051] X—{—indicator representing interchangability

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0052] Initial reference is given by way of **FIG. 1**, wherein is exhibited a pictorial view of my eyeglasses looking toward their backside so as to clearly reveal the novel construction of my detachable left temple/support-arm **19** and detachable right temple/support-arm **21**, here the right temple/support-arm **21** being shown fully attached, as also would actually be the left,—during normal wear by the user. However, here the left standard temple/support-arm **19** is shown fully detached, as to thereby clearly reveal how detaching the standard left **19** and right **21** temple/support-arms, enables quick and easy insertion of attendantly shown alternate temple/strap-assembly **32**. The abbreviated male-extension/support-loop portions **29'**(left) and **29"**(right) are supporting the oppositely affixed preferably elastic flexible head-band strap **30** member, preferably including a conventional adjustable strap/adjustment-buckle **31**. This easily interchanged temple/strap-assembly **32** thus makes the otherwise rather traditional appearing eyeglasses readily convertible into a sport goggle; whereby the light-traveler can thus transform their eyeglasses into an embodiment much more suitable for activities such as skiing, skydiving, or swimming for example,—simply stowing the alternate components (ie: temple/strap-assembly **32** or temple/support-arms **19/21**) conveniently in ones shirt-pocket if desired, whereby one is ready for any eventuality.

[0053] Therefore, regardless as to their configuration aftward of the left **28'** and right **28"** latching-abutments, the forwardly extending left and right male/pronged-assemblies **27** employ the same preferably tri-pronged configuration dependent from said left **28'** and right **28"** latching-abutment portions;—therefore characterizing a modular construction facilitating instant inter-changability of my different aftwardly extending temple-support options. Moreover, it is preferred that the male/pronged-assemblies **27** dependent from the left latching-abutment **28'** and the right latching-abutment **28"**, are also capable of being conveniently interchangeable left to right (and hence right to left);—thereby in particular enabling the rigid left and right temple/support-arm assemblies **19** and **21** respectively to be optionally symmetrically configured for convenient support upon users either ear (a flip-over feature which is only really relevant in the case of the electronically adapted embodiments **19'** and **19"** to be discussed later herein).

[0054] There remain subtle, however vital other differences which are to become herein more evident and understood as important improvements. For example, FIGS. **2A/2B** reveal vital details as to how the uniquely configured elements of the male/pronged-assembly **27** necessarily interact so as to engage with either supporting cavity-abutments **15'** and **15"** in a simultaneously biasing albeit oppositely latching manner. In **FIG. 2B** is shown how, as the male/pronged-assembly is manually urged into the support-cavity **14'**, the two opposed entry-ramps **26** of the upper **22'** and lower **24'** resilient-fingers have yielded in toward male/

medial-prong member **23'**, and as the upper **22'** and lower **24'** resilient-fingers proceeded into the support-cavity **14'** the centered male/medial-prong member **23'** serves to limit the yielding convergence of the upper **22'** and lower **24'** resilient-fingers. Whilst in companion **FIG. 2A** is shown how the upper **22'** and lower **24'** resilient-fingers have sprung back out to their natural substantially relaxed condition once slidingly leaving the confines of support-cavity **14'**, whereby their upper and lower latching-catchs **25** positively engage against respective upper and lower latching-notchs **18**,—thereby preventing withdrawal of the temple/support-arm **19**. Conversely, to detach the temple/support-arm **19**, the user simply squeezes their thumb and fore-finger together at both the upper/finger-relief **16'** and lower/finger-relief **17'**, whereby the simultaneous convergence of both the upper male/latching-prong **22'** and lower male/latching-prong **24'** is caused to critically abut the male medial-prong **23'**;—thereby assuring a critical "balanced" simultaneous disengagement of both latching-catches **25**, resulting in a non-snagging free-withdrawal of the male/pronged-assembly from support-cavity **14'**. Therefore, it is critical to understand that without presence of the novel male medial-prong **23'** member, it was found that a user could quickly became confounded when either the upper or lower latching-catch **25** would usually remain engaged;—at which point the frustrated user would commense to very forcibly yank at the temple/support-arm, ultimately leading to breakage of the temple-support structure **11'** for example. Accordingly, it has been found that employment of the exemplified three-element male/pronged-assembly **27** on all of the exemplified interchangeable accouterments **19**, **19'**, **19"**, **32**,—assures a consistently smooth detachment procedure.

[**0055**] Reference to **FIGS. 3 & 4** shows how my conveniently detachable temple/support-arms **19**, can be readily interchanged with still other uniquely configured temple/support-arms **19'** or **19"** for example. The embodiment of **FIG. 3** featuring an integral AM/FM-radio, having a conventional On/Off-button **20**, a conventional sequentially operating PPL-type station-selecting tuning-button **20'** coupled internally to a conventional integrated-circuit amplifier (unshown), a conventional audio-volume rocker-switch **20"**, a substantially conventional audio-transducer earphone **20**E, and a system activating conventional button-battery (not shown) beneath battery-cover **20**C. This aggregation defines a self-contained radio apparatus, not requiring external power-supply. The embodiment of **FIG. 4** features an integral conventional videocam(ie: digital-camera) **20**V with conventional On/Off-button **20**, a conventional mini-microphone **20**M, and optional conventional button-battery (unshown) power-supply **20**C in the form of a female-receptacle **20**P which function is akin to that of a conventional computer USB-port for subsequent downloading of pictures from a conventional internal microprocessor (unshown) to a conventional computer. This aggregation thus defining a digital-camera which can compile a series of individual snap-shot pictures, or process rapid-frame sequences tantamount to a video. Although the objective-lens is exemplified as situated at **20**V, it can be arranged further forward if wide-angle images are desired. Therefore, while the basic objective is to provide the user of my EQS™-eyeglasses (ref. **FIG. 1**) with the convenience of readily interchanging between traditional appearing temple/support-arms **19** and **21**, to a more sport-activity type of eyeglasses by readily substituting the temple/strap-assembly **32**;—a further object of my versatile eyeglasses is to explore the full potential of interchangability as is set forth in the interchangeable electronics-equipped temple/support-arms of **FIGS. 3 and 4**.

[**0056**] Thus, it is readily understood how the preferred and generic-variant embodiments of this invention contemplate performing functions in a novel way not heretofore available nor realized. It is implicit that the utility of the foregoing adaptations of this invention are not necessarily dependent upon any prevailing invention patent; and, while the present invention has been well described hereinbefore by way of certain illustrated embodiments, it is to be expected that various changes, alterations, rearrangements, and obvious modifications may be resorted to by those skilled in the art to which it relates, without substantially departing from the implied spirit and scope of the instant invention. Therefore, the invention has been disclosed herein by way of example, and not as imposed limitation, while the appended Claims set out the scope of the invention sought, and are to be construed as broadly as the terminology therein employed permits, reckoning that the invention verily comprehends every use of which it is susceptible. Accordingly, the embodiments of the invention in which an exclusive property or proprietary privilege is claimed, are defined as follows.

What is claimed of proprietary inventive origin is:

1.) A pair of convertible eyeglasses; said apparatus comprising:

a left-side female/receiver-mount means with forward support-swivel portion hingingly adapted to the conventional left/temple-support, said left female/receiver-mount portion serving to intimately receive both upper and lower cooperative male latching-prongs of a trailing left temple/support-arm means, whereby outwardly opposed latching-catches on terminuses of resilient said latching-prongs make positive engagement with upper and lower latching-notches formed in said left female/receiver-mount;

a right-side female/receiver-mount means with forward support-swivel portion hingingly adapted to the conventional right/temple-support, said right female/receiver-mount portion serving to intimately receive both upper and lower cooperative male latching-prongs of a trailing right temple/support-arm means, whereby outwardly opposed latching-catches on terminuses of resilient said latching-prongs make positive engagement with upper and lower latching-notches formed in said right female/receiver-mount;

an upper/finger-relief and an opposed lower/finger-relief included upon discrete left and right said female/receiver-mounts proximal upper and lower said latching-catches, whereby simultaneous manual squeezing of one's thumb and opposing finger at said upper/finger-relief and said lower/finger-relief, biases said latching-prongs toward one another as to thereby disengage said latching-catches from impingement upon said latching-notches, thereby releasing said temple/support-arms free from retention by said female/receiver-mounts:

2.) The convertible eyeglasses according to claim 1, wherein said left and right temple/support-arms include a medial-prong member acting as a centering abutment

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against which said upper and lower latching-prongs become ultimately biased during the manual release procedure; said medial-prong member thereby eliminating any tendency of one or the other male latching-prongs to otherwise snag upon said latching-notches.

3.) The convertible eyeglasses according to claim 1, wherein thumb and finger squeezing action upon upper and lower said male latching-prongs is ultimately balanced by provision of a medial-prong disposed equidistant there between, whereby said latching-catches are thus biased evenly away from fixed said latching-catches; thereby obviating otherwise tendancy of one said latching-catch to snag upon its said fixed latching-notch.

4.) The convertible eyeglasses according to claim 1, wherein standard said left and right temple/support-arms are injection-molded in one-piece from a simple longitudinally-split two-piece opposed-cavity die; thereby making them economical to produce, whereby a user may more affordably enjoy the purchase of various styles.

5.) The invention apparatus according to claim 1, wherein standard said left and right temple/support-arms are readily interchangeable in a modular manner with a temple/strap-assembly having an abbreviated body terminating with a male-extension/support-loop portion to which is affixed a headstrap portion; thereby making the eyeglasses more suitable for use as goggles while skiing or sky-diving for example.

6.) The invention apparatus according to claim 5, wherein said male-extension/support-loop bodies can be installed interchangably left or right, thereby obviating possibility of improper installation.

7.) The invention apparatus according to claim 1, wherein independent said left and right female/receiver-mounts both include a discrete support-cavity, which serve to receive respective said left and right male/pronged-assembly members; wherein the aftward terminus of said support-cavities impinges against the latching-abutment portion when said left and right temple/support-arm members are slidingly installed.

8.) The invention apparatus according to claim 1, wherein both left and right said female/receiver-mounts are a permanent part of said eyeglasses and comprise a common injection-molded component which is simply flipped-over left-to-right so as to thereby oppose each of the other as installed; thus substantially reducing the considerable expenditure for otherwise complex seperate mirror-image three-piece molding-dies.

9.) The invention apparatus according to claim 1, wherein one said standard said temple/support-arm is modularly interchangable with a special radio-arm iteration providing the eyeglasses wearer with selective radio-station listening.

10.) The invention apparatus according to claim 1, wherein one standard said temple/support-arm is modularly interchangable with a special videocam-arm iteration providing the eyeglasses wearer with ability to selectively photograph their surroundings.

11.) A pair of convertible eyeglasses; said apparatus comprising:

a left-side female/receiver-mount means with forward support-swivel portion hingingly adapted to the conventional left/temple-support, said left female/receiver-mount portion serving to intimately receive both upper and lower cooperative male latching-prongs and medial-prong of a trailing left temple/support-arm means, whereby outwardly opposed latching-catches on terminuses of resilient said latching-prongs make positive engagement with upper and lower latching-notches formed in said left female/receiver-mount;

a right-side female/receiver-mount means with forward support-swivel portion hingingly adapted to the conventional right/temple-support, said right female/receiver-mount portion serving to intimately receive both upper and lower cooperative male latching-prongs and medial-prong of a trailing right temple/support-arm means, whereby outwardly opposed latching-catches on terminuses of resilient said latching-prongs make positive engagement with upper and lower latching-notches formed in said right female/receiver-mount;

an upper/finger-relief and an opposed lower/finger-relief included upon discrete left and right said female/receiver-mounts proximal upper and lower said latching-catches, whereby simultaneous manual squeezing of one's thumb and opposing finger at said upper/finger-relief and said lower/finger-relief, biases said latching-prongs toward one another and ultimately against said male medial-prong as to thereby disengage said latching-catches from impingement upon said latching-notches, thereby releasing said temple/support-arms free from retention by said female/receiver-mounts.

12.) The convertible eyeglasses according to claim 11, wherein standard said left and right temple/support-arms are injection-molded in one-piece from a simple longitudinally-split two-piece opposed-cavity die; thereby making them economical to produce, whereby a user may more affordably enjoy the purchase of various styles.

13.) The invention apparatus according to claim 11, wherein standard said left and right temple/support-arms are readily interchangeable in a modular manner with a temple/strap-assembly having an abbreviated body terminating with a male-extension/support-loop portion to which is affixed a headstrap portion; thereby making the eyeglasses more suitable for use as goggles while skiing or sky-diving for example.

14.) The invention apparatus according to claim 13, wherein said male-extension/support-loop bodies can be installed interchangably left or right, thereby obviating possibility of improper installation.

15.) The invention apparatus according to claim 13, wherein either said temple/strap-assembly or said right and said left standard temple/support-arms may be conveniently carried in one's pocket; thereby enabling user to readily interchange between either traditional appearing eyeglasses or goggles according to the necessity at hand.

16.) The invention apparatus according to claim 11, wherein independent said left and right female/receiver-mounts both include a discrete support-cavity, which serve to receive respective said left and right male/pronged-assembly members; wherein the aftward terminus of said support-cavities impinges against the latching-abutment portion when said left and right temple/support-arm members are slidingly installed.

17.) The invention apparatus according to claim 11, wherein both left and right said female/receiver-mounts are a permanent part of said eyeglasses and comprise a common injection-molded component which is simply flipped-over left-to-right so as to thereby oppose each of the other as

installed; thus substantially reducing the considerable expenditure for otherwise complex seperate mirror-image three-piece molding-dies.

18.) The invention apparatus according to claim 11, wherein one said standard said temple/support-arm is modularly interchangable with a special radio-arm iteration providing the eyeglasses wearer with selective radio-station listening.

19.) The invention apparatus according to claim 11, wherein one standard said temple/support-arm is modularly interchangable with a special videocam-arm iteration providing the eyeglasses wearer with ability to selectively photograph their surroundings.

20.) In a pair of convertible eyeglasses; a method of interchanging temple-supports comprising:

Providing a left-side female/receiver-mount means with forward support-swivel portion hingingly adapted to the conventional left/temple-support, said left female/receiver-mount portion serving to intimately receive both upper and lower cooperative male latching-prongs and medial-prong of a trailing left temple/support-arm means, whereby outwardly opposed latching-catches on terminuses of resilient said latching-prongs make positive engagement with upper and lower latching-notches formed in said left female/receiver-mount;

providing a right-side female/receiver-mount means with forward support-swivel portion hingingly adapted to the conventional right/temple-support, said right female/receiver-mount portion serving to intimately receive both upper and lower cooperative male latching-prongs and medial-prong of a trailing right temple/support-arm means, whereby outwardly opposed latching-catches on terminuses of resilient said latching-prongs make positive engagement with upper and lower latching-notches formed in said right female/receiver-mount;

Providing an upper/finger-relief and an opposed lower/finger-relief included upon discrete left and right said female/receiver-mounts proximal upper and lower said latching-catches, whereby simultaneous manual squeezing of one's thumb and opposing finger at said upper/finger-relief and said lower/finger-relief, biases said latching-prongs toward one another and ultimately against said male medial-prong as to thereby disengage said latching-catches from impingement upon said latching-notches, thereby releasing said temple/support-arms free from retention by said female/receiver-mounts.

providing a secondary attaching procedure whereby user merely slides a different left and/or different right said temple/support-arm into support-cavity until said latching-catches positively engage with said latching-notches, whereupon said temple/support-arms are held fast with said eyeglasses.

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