US 20050078211A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2005/0078211 A1**

Whitehorn et al. (43) **Pub. Date: Apr. 14, 2005**

(54) **HANDHELD DEVICE WITH INTEGRAL AXIAL CAMERA**

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(21) Appl. No.: **10/632,616**

(22) Filed: **Jul. 31, 2003**

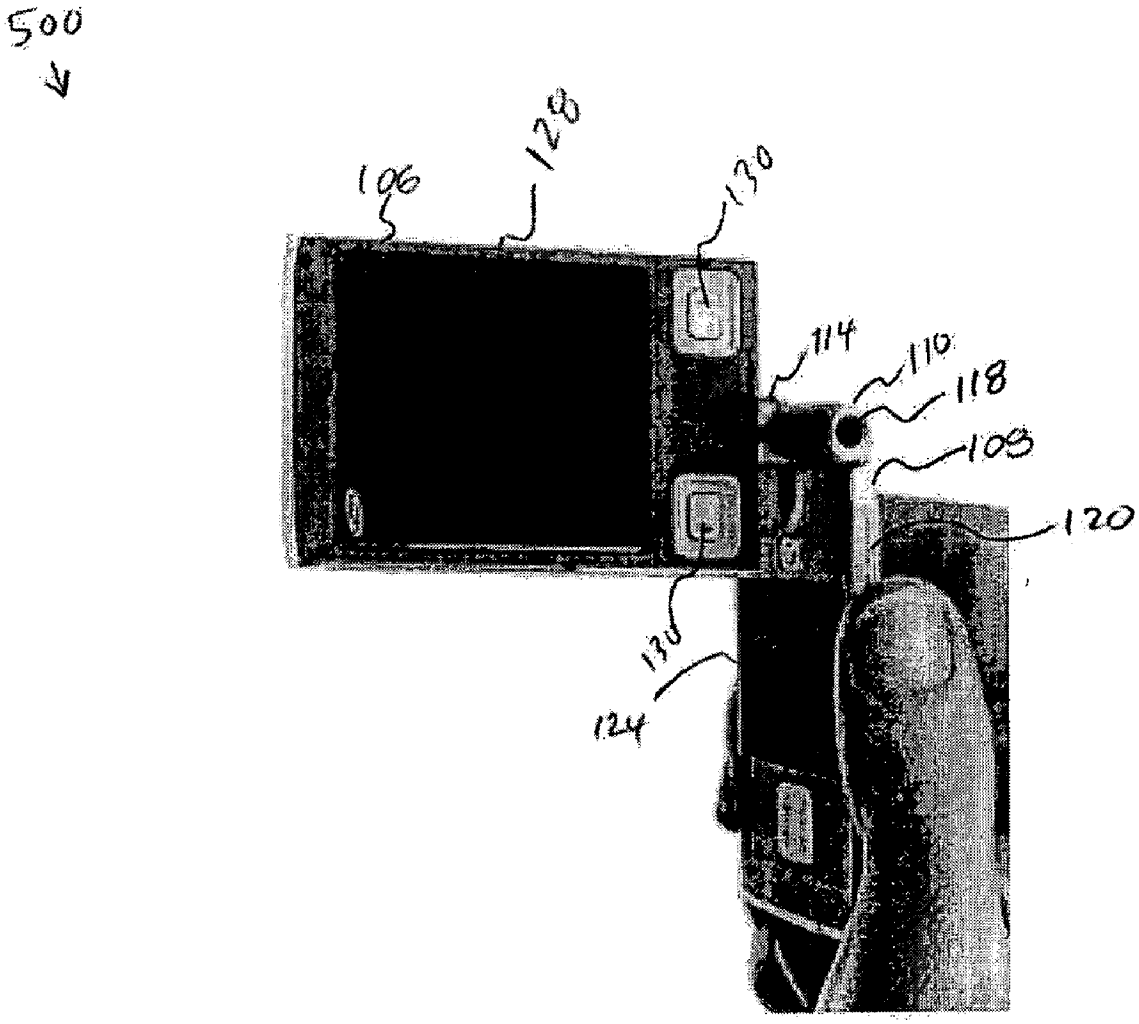
Publication Classification

(51) **Int. Cl.**[7] **H04N 5/225**; H04N 5/222; H04N 9/04

(52) **U.S. Cl.** **348/376**; 348/373; 348/333.06; 348/333.01; 348/207.99

(57) **ABSTRACT**

A handheld device with integral axial camera is disclosed. The apparatus discloses: a top portion; a bottom portion; a hinge, rotational about a first axis and having a first end and a second end, coupling the top portion to the bottom portion; and an image capture device, coupled to the first end of the hinge and oriented to capture images aligned along the first axis of the hinge. The method discloses: permitting a first large screen interface to rotate about a first hinge axis with respect to a second large screen interface; capturing images aligned along the first hinge axis; and setting a mode in which the device operates in response to an orientation of the first large screen interface to a second large screen interface.



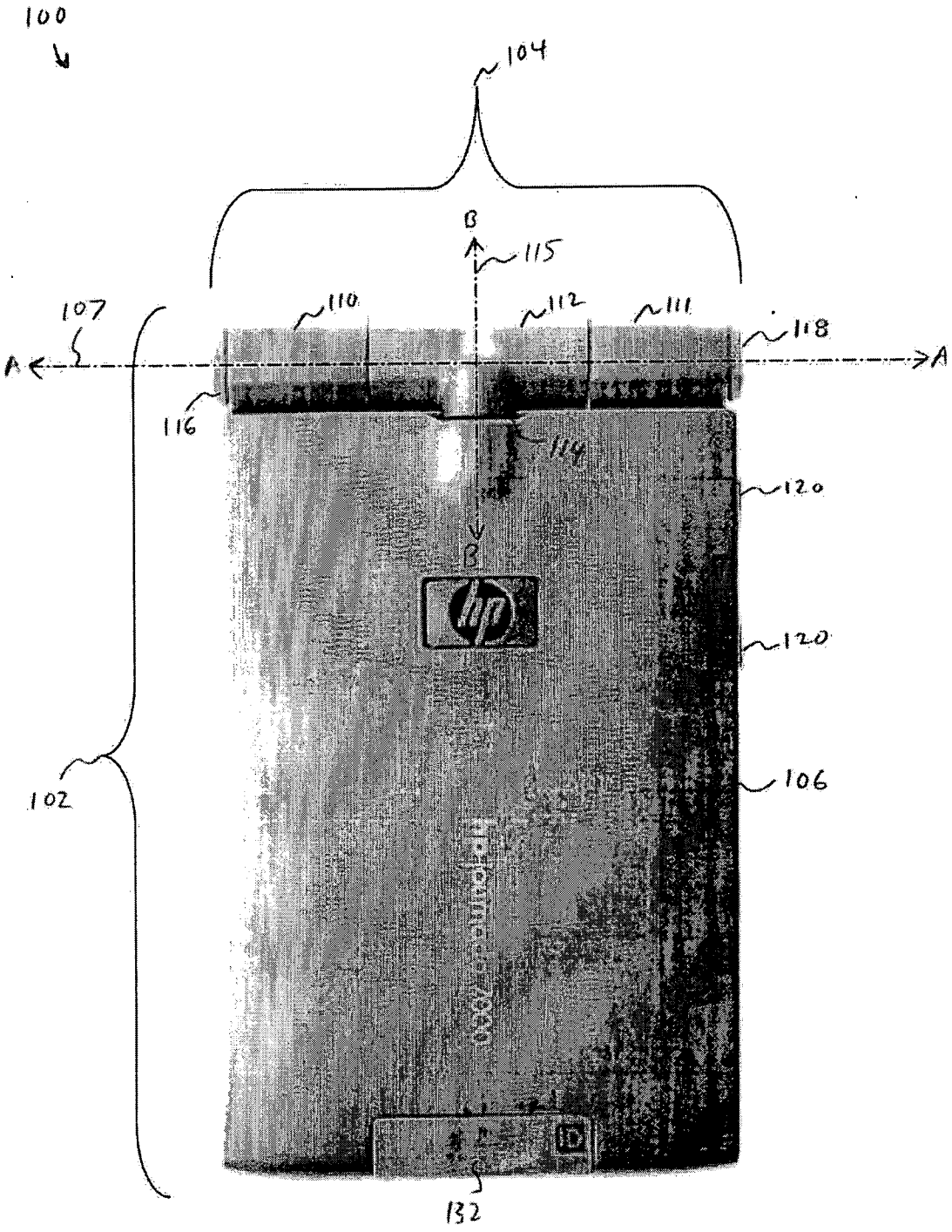


Fig. 1

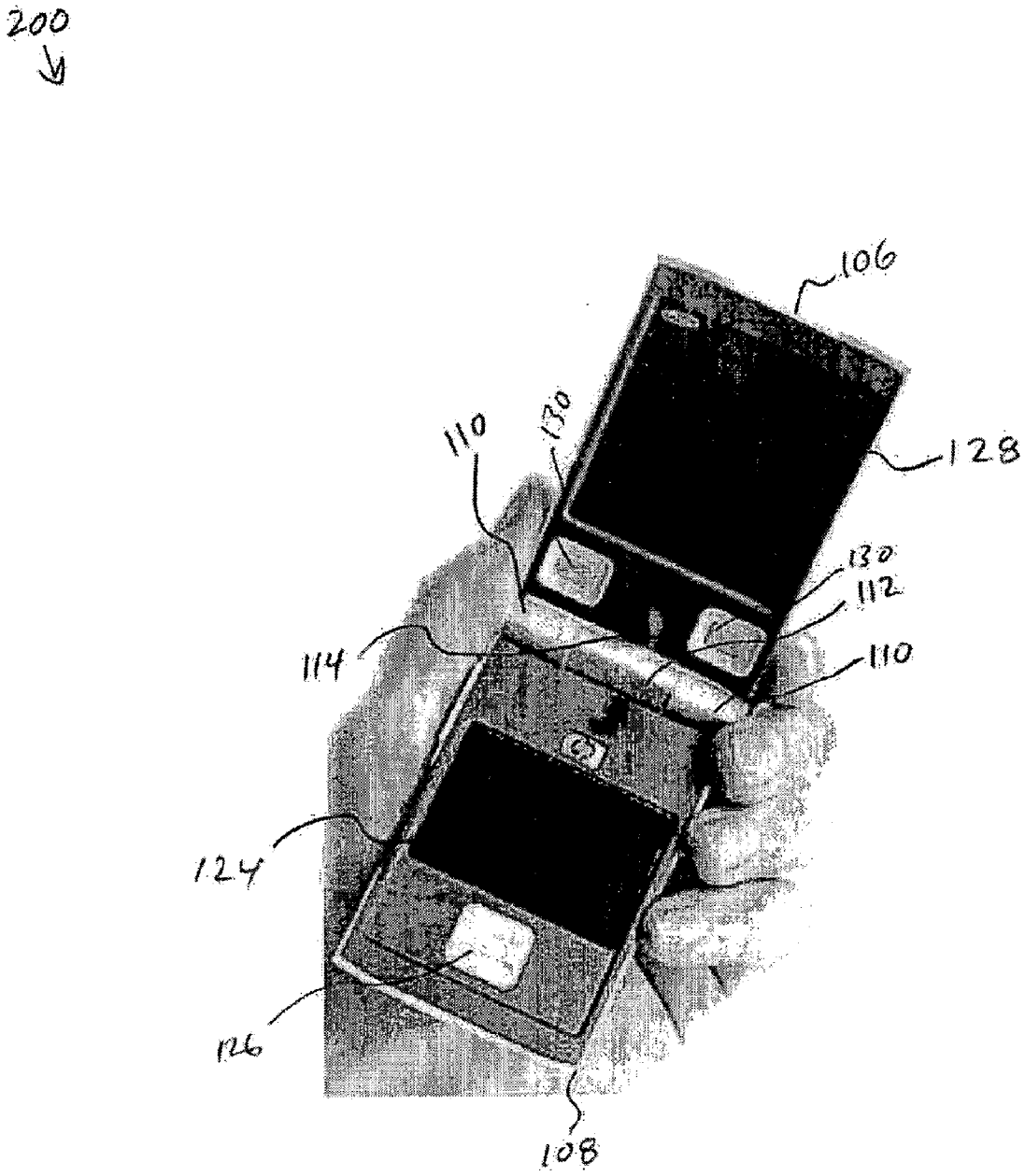


Fig. 2

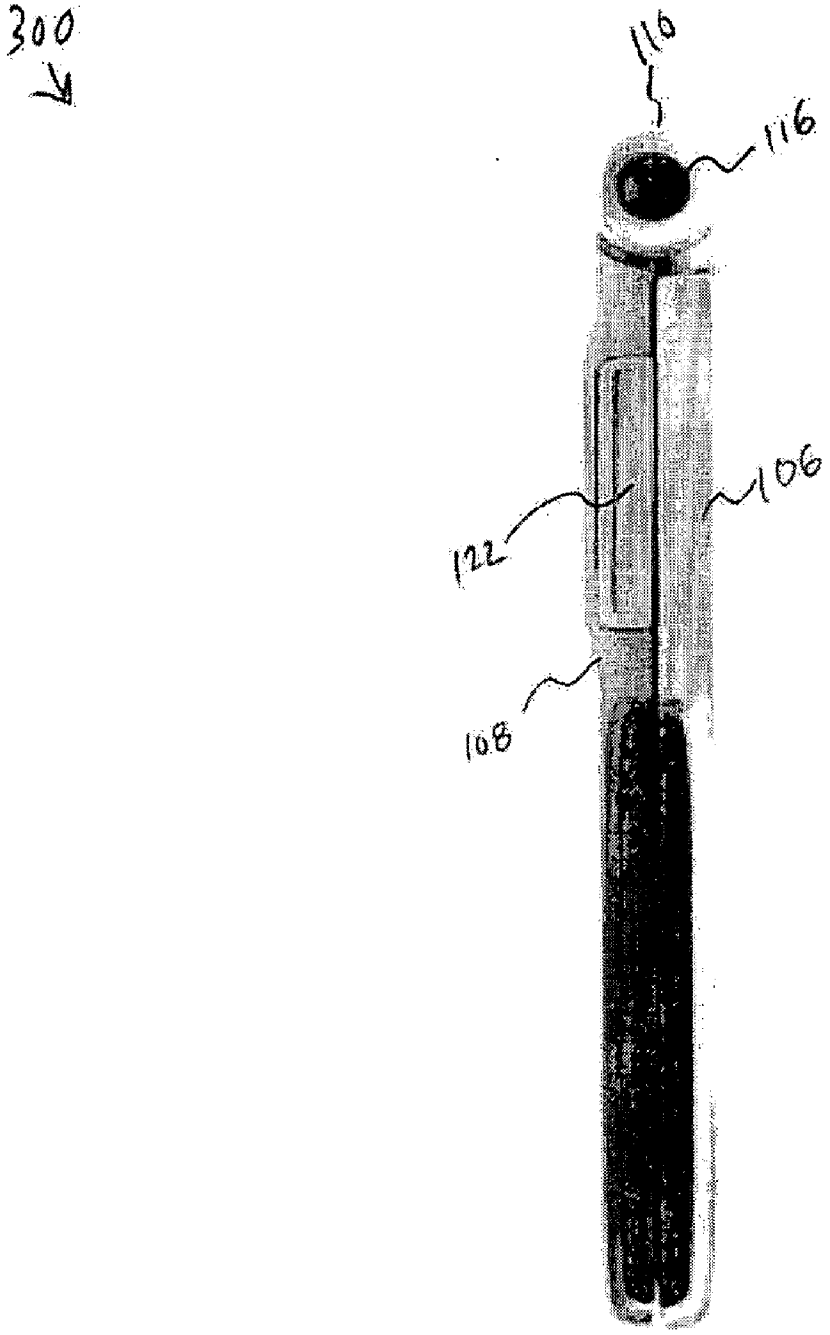


Fig. 3

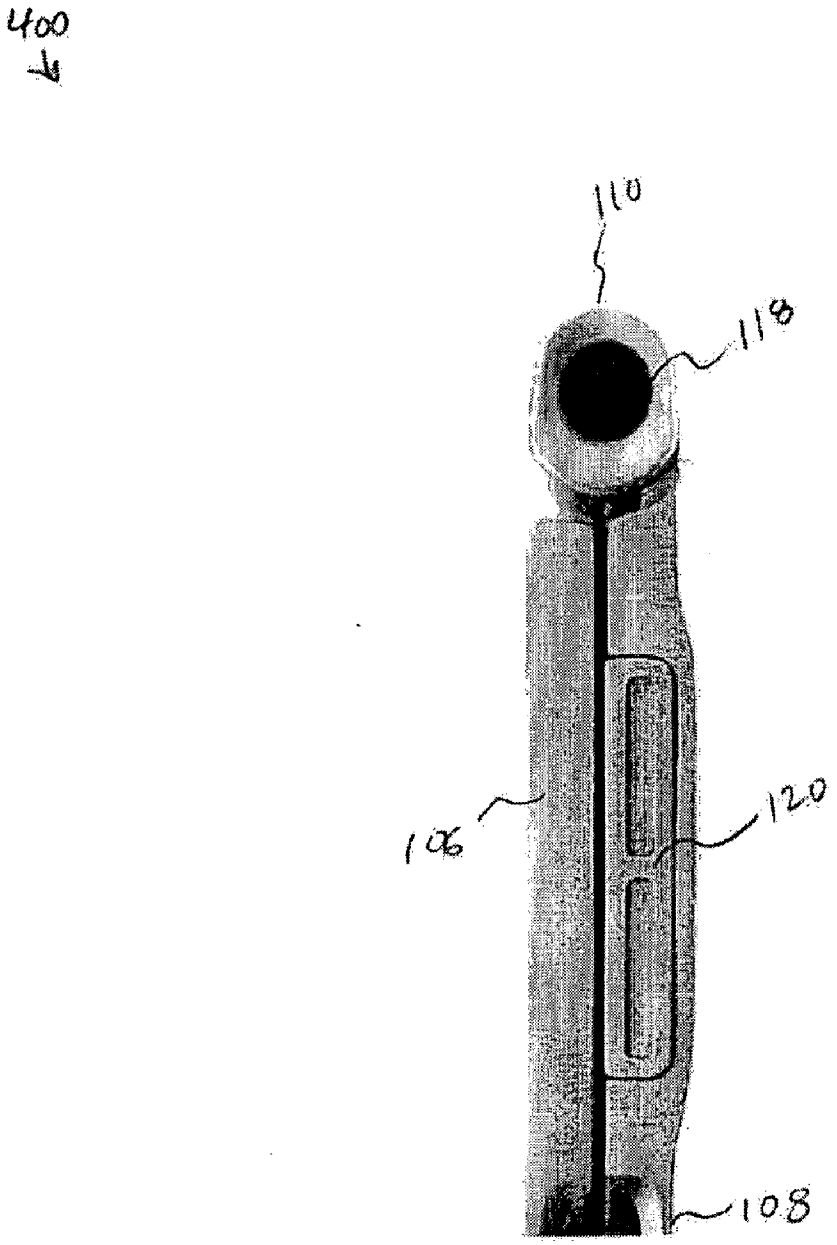


Fig. 4

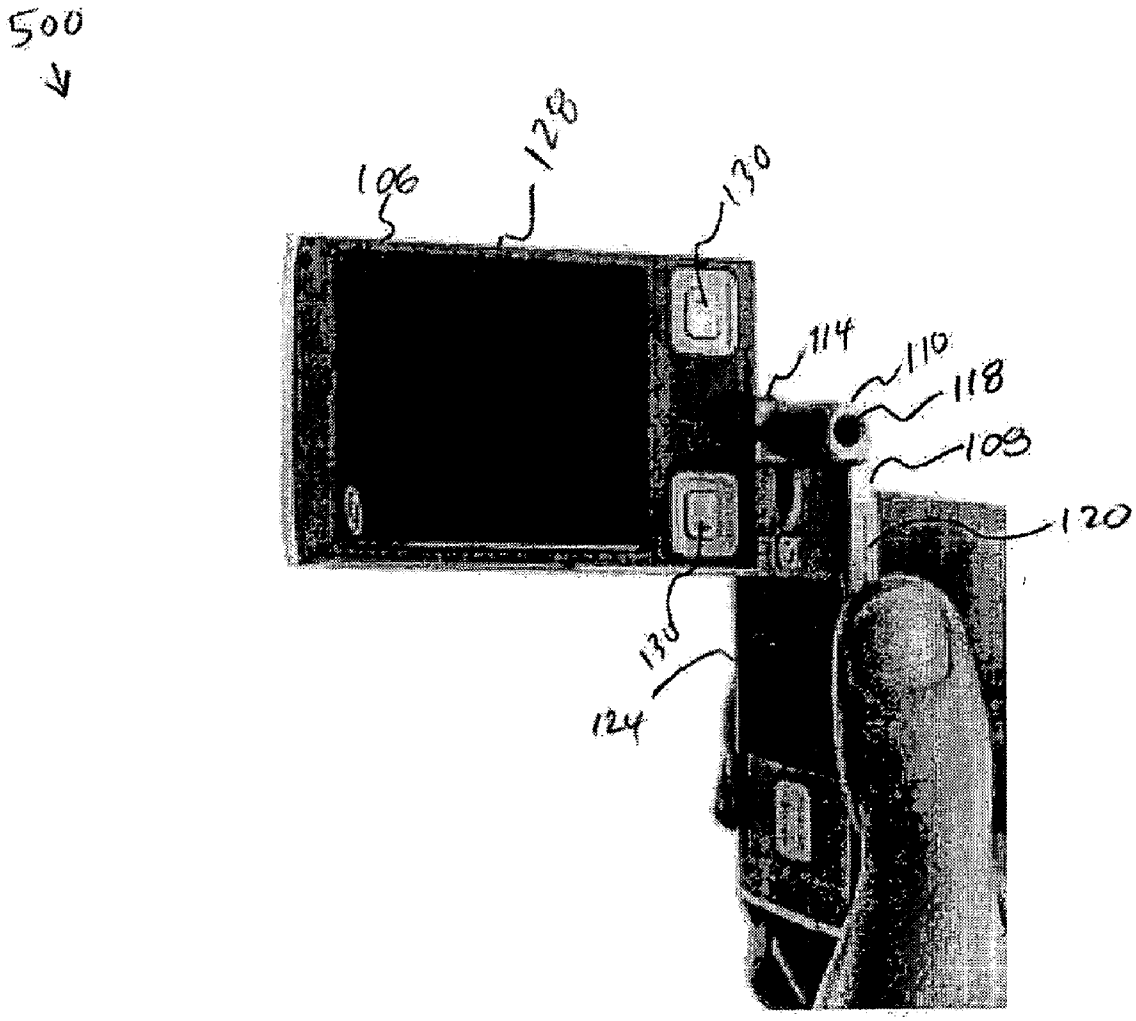


Fig. 5

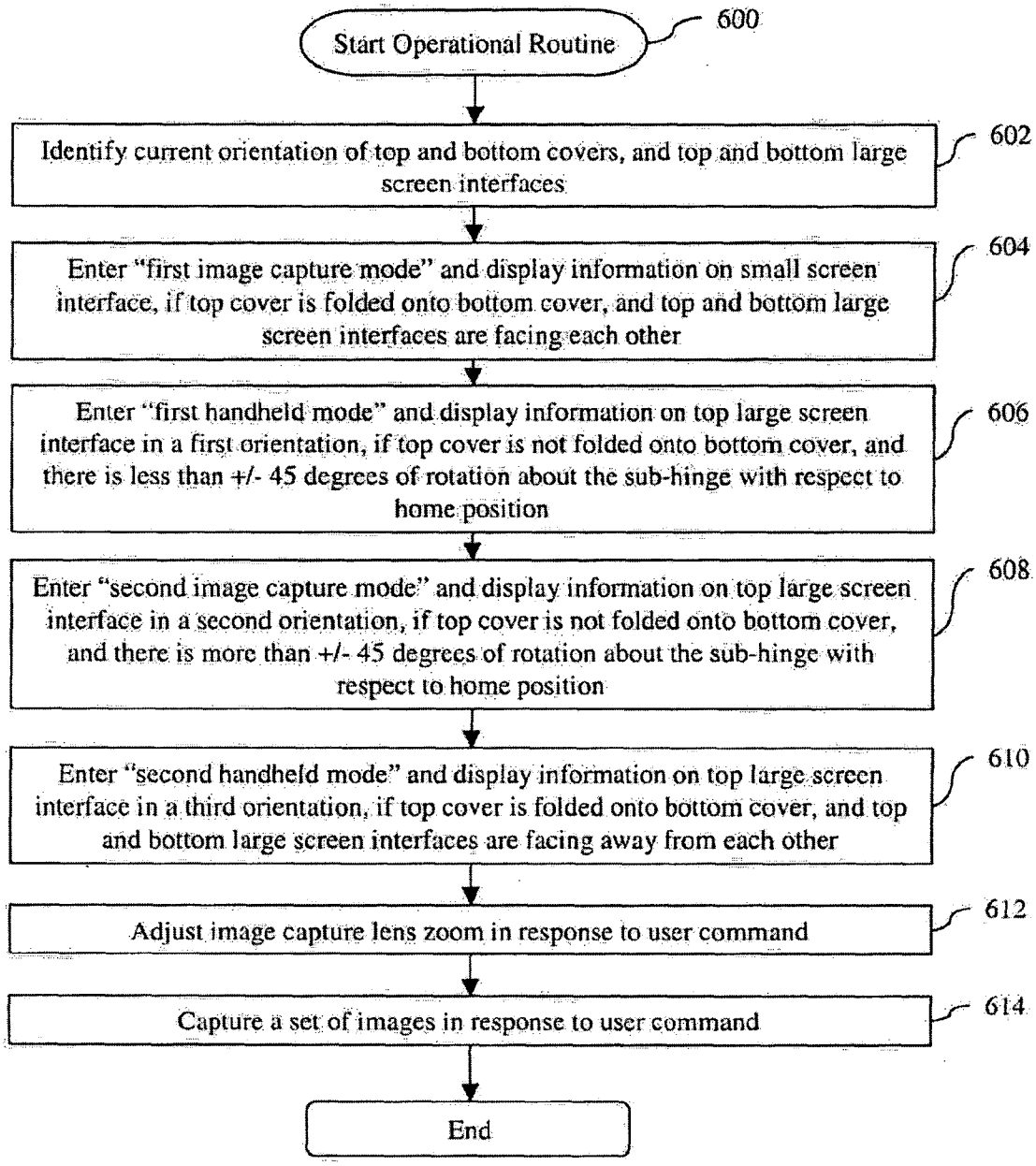

Start Operational Routine
600
Identify current orientation of top and bottom covers, and top and bottom large screen interfaces
602
Enter "first image capture mode" and display information on small screen interface, if top cover is folded onto bottom cover, and top and bottom large screen interfaces are facing each other
604
Enter "first handheld mode" and display information on top large screen interface in a first orientation, if top cover is not folded onto bottom cover, and there is less than +/- 45 degrees of rotation about the sub-hinge with respect to home position
606
Enter "second image capture mode" and display information on top large screen interface in a second orientation, if top cover is not folded onto bottom cover, and there is more than +/- 45 degrees of rotation about the sub-hinge with respect to home position
608
Enter "second handheld mode" and display information on top large screen interface in a third orientation, if top cover is folded onto bottom cover, and top and bottom large screen interfaces are facing away from each other
610
Adjust image capture lens zoom in response to user command
612
Capture a set of images in response to user command
614
End

Fig. 6

HANDHELD DEVICE WITH INTEGRAL AXIAL CAMERA

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates generally to handheld devices, and more particularly toward incorporating a camera into a handheld device.

[0003] 2. Discussion of Background Art

[0004] Handheld devices, such as Personal Digital Assistants (PDAs), are information appliances geared toward mobile users. They have been evolving very quickly as users are demanding, and manufacturers are adding, new features and functionalities at an increasing pace.

[0005] Basic handheld devices are commonly used for maintaining personal information, such as schedules, lists of names and phone numbers, performing basic calculations, and note taking. However some enhanced handheld devices may further include: a cell phone, modem, a wireless connection, e-mail, and Web browsing capabilities. Most have tiny keyboards, while others include touch pads.

[0006] Many of the enhanced handheld features, however, have been hastily added, and thus tend to be unrefined, bulky, and difficult to use. For example, recent handhelds have included a still camera as a next "must have" feature. These cameras tend to be tacked wherever there is space left, but often are very awkward to use and/or have limited capabilities.

[0007] In response to the concerns discussed above, what is needed is handheld computer that overcomes the problems of the prior art.

SUMMARY OF THE INVENTION

[0008] The present invention is a handheld device with integral axial camera. The apparatus of the present invention includes: a top portion; a bottom portion; a hinge, rotational about a first axis and having a first end and a second end, coupling the top portion to the bottom portion; and an image capture device, coupled to the first end of the hinge and oriented to capture images aligned along the first axis of the hinge.

[0009] The method of the present invention includes: permitting a first large screen interface to rotate about a first hinge axis with respect to a second large screen interface; capturing images aligned along the first hinge axis; and setting a mode in which the device operates in response to an orientation of the first large screen interface to a second large screen interface.

[0010] These and other aspects of the invention will be recognized by those skilled in the art upon review of the detailed description, drawings, and claims set forth below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] **FIG. 1** is a first pictorial diagram of one embodiment of a handheld device;

[0012] **FIG. 2** is a second pictorial diagram of the one embodiment;

[0013] **FIG. 3** is a third pictorial diagram of the one embodiment;

[0014] **FIG. 4** is a fourth pictorial diagram the one embodiment;

[0015] **FIG. 5** is a fifth pictorial diagram the one embodiment; and

[0016] **FIG. 6** is a flowchart of one embodiment of a method of operation for the device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0017] The present invention ergonomically incorporates an image capture device into a hand held device. By placing image capture and display devices axially within the handheld device's hinge, the present invention permits users to capture and view images under any lighting condition, while holding the device in a natural and ergonomically friendly manner, and even when the device is in a folded orientation. Such an axial location also permits a variety of aftermarket lenses and filters to be attached to the image capture device for better viewing. Also the relatively long length of the hinge permits optical lenses to translate along the axis for telephoto or wide angle image captures.

[0018] **FIG. 1** is a first pictorial diagram **100** of one embodiment of a handheld device **102**. **FIG. 2** is a second pictorial diagram **200** of the one embodiment. **FIG. 3** is a third pictorial diagram **300** of the one embodiment. **FIG. 4** is a fourth pictorial diagram **400** the one embodiment. And, **FIG. 5** is a fifth pictorial diagram **500** the one embodiment. **FIGS. 1 through 5** are discussed together.

[0019] The handheld device **102** preferably falls into a class of devices known as Personal Digital Assistants (PDAs), and thus preferably provides certain computing and information storage and retrieval functionalities common to the class. Alternative embodiments of the present invention, however, could be embodied within other types of hinged apparatus, such as cell phones, a laptop computers, notepads, or even items of luggage.

[0020] The device **102** includes a hinge **104** which permits a top cover **106** to rotate about a first axis (A) **107** with respect to a bottom cover **108**. The hinge **104** includes a first end **110**, and a second end **111** both affixed to the bottom cover **108**, and a middle portion **112** affixed to the top cover **106**. The middle portion **112** includes a sub-hinge **114**, which permits the top cover **106** to rotate about a second axis (B) **115** with respect to the bottom cover **108**. Those skilled in the art recognize that there are an unlimited number of orientations of the top cover **106** with respect to the bottom cover **108** about the hinge **104** and sub-hinge **114**.

[0021] Rotation of the top and bottom covers **106** and **108** with respect to each other automatically determines a mode in which the device **102** operates. These modes include: a "first image capture mode," a "first handheld mode," a "second image capture mode," and a "second handheld mode." A preferred method for determining when each mode is entered and what effect each mode has on the device **102**, is described below with respect to **FIG. 6**. Those skilled in the art however recognize that while the modes describe are preferred, they can be varied for different implementations of the present invention.

Ex. 1005, p. 8
MOTOROLA et al. v. MULTIFOLD
IPR2025-00038

[0022] The hinge **104** also includes an image capture device **116** located within the first end **110** and a small screen interface **118** located within the second end **111** of the hinge **104**. The image capture device **116** includes a light sensitive sensor for acquiring optical information, and one or more lenses for focusing optical light on the light sensitive device. Some embodiments of the image capture device **116** include multiple lens which can translate with respect to each other, so as to provide an optical zoom capability. Additional lenses and/or filters (not shown) may also be attached to the image capture device **116** to provide for enhanced image capture capabilities. The small screen interface **118** is preferably capable of displaying both captured images (either in real-time like a viewfinder or which have been previously recorded) and any other information generated by the device **102**. Both the image capture device **116** and the small screen interface **118** are preferably aligned along the hinge's axis of rotation so that users may simultaneously capture and view images when the top and bottom covers **106** and **108** of the device **102** are closed.

[0023] The bottom cover **108** includes a telephoto (T) and wide-angle (W) zoom control **120** beneath the small screen interface **118** and a shutter control **122** beneath the image capture device **116**. The zoom control **120** provides for an optical and/or digital zoom feature, and the shutter control **122** instructs the device **102** to capture one or more images (i.e. a still picture or a video clip) using the image capture device **116**. The bottom cover **108** also includes a bottom large screen interface **124** and a touch sensitive pad **126**. The bottom large screen interface **124** is at a minimum preferably capable of receiving input commands from users of the device **102**, but may also display any information generated by the device **102**, including captured images. The bottom large screen interface **124** preferably accepts a pen inputs, while user selections are made with the touch sensitive pad **126**. In alternate embodiments, the bottom large screen interface **124** may be wholly replaced with another input device, such as a keyboard or touch sensitive pad.

[0024] The top cover **106** includes a top large screen interface **128** and a set of selection buttons **130**. The top large screen interface **128** preferably functions as an image display for either captured images or other information generated by the device **102**. However, since the top cover **106** can be rotated and flipped back onto the bottom cover **108** such that the top large screen interface **128** faces away from the bottom large screen interface **124**, the top large screen interface **128** preferably can also accept user inputs so that the device functions as a tablet computer.

[0025] Other features of the device **102** include: a sound capturing device, so that sounds may be recorded by the device **102** along with images; a biometric fingerprint recognition pad **132** for unlocking the device **102**; wireless phone and networking capabilities; and spatial locational device.

[0026] **FIG. 6** is a flowchart **600** of one embodiment of a method of operation for the device. The method begins in step **602** where the device **102** identifies a current orientation of top and bottom covers **106** and **108**, and top and bottom large screen interfaces **128** and **124**.

[0027] Next in step **604**, the device **102** enters a "first image capture mode" and displays information on the small screen interface **118**, if the top cover **106** is folded onto bottom cover **108**, and top and bottom large screen interfaces **128** and **124** are facing each other. **FIGS. 1, 3** and **4** show the device in the "first image capture mode." In this mode, users are capturing images with the image capture device **116** while looking through the small screen interface **118** at what is being captured. Users may prefer this mode out of convenience or due to bright lighting conditions which would otherwise obscure images displayed on one of the large screen interfaces **124** and **128**.

[0028] In step **606**, the device **102** enters a "first handheld mode" and displays information on the top large screen interface **128** in a first (preferably portrait) orientation, if the top cover **106** is not folded onto the bottom cover **108**, and there is less than +/−45 degrees of rotation about the sub-hinge **114** with respect to home position. The home position is herein preferably defined as the orientation of the top and bottom covers **106** and **108** about the sub-hinge **114** as shown in **FIG. 2**. **FIG. 2** shows the device in the "first handheld mode." In this mode, users are primarily using the device **102** as a handheld PDA, whereby commands and inputs are received on the bottom large screen interface **124** and information is displayed on the top large screen interface **128**.

[0029] In step **608**, the device **102** enters a "second image capture mode" and displays information on the top large screen interface **128** in a second (preferably landscape) orientation, if top cover **106** is not folded onto bottom cover **108**, and there is more than +/−45 degrees of rotation about the sub-hinge **114** with respect to the home position. **FIG. 5** shows the device in the "second image capture mode" after the top cover **106** as been rotated approximately 90 degrees about the sub-hinge **114**. In this mode, users are capturing images with the image capture device **116** while looking through the top large screen interface **128** at what is being captured. Users may prefer this mode when viewing images on the top large screen interface **128** would be more convenient than viewing them on the small screen interface **118**.

[0030] Then in step **610**, the device **102** enters a "second handheld mode" and displays information on the top large screen interface **128** in a third (preferably portrait) orientation, if top cover **106** is folded onto the bottom cover **108**, and the top and bottom large screen interfaces **128** and **124** are facing away from each other. The third orientation is upside-down with respect to the first orientation. This mode is not shown in the Figures, however, in this mode, users are primarily using the device **102** as a handheld tablet computer, whereby commands and inputs are received and information is displayed on the top large screen interface **128**.

[0031] Those skilled in the art will know that the values given for degrees of rotation, home position, image orientation, and information displayed and/or received on the screen interfaces, as discussed herein are preferred but not required. Other embodiments of the present invention may vary these elements to fit any particular design. Such other embodiments can perhaps include replacing the "second handheld mode" in step **610** with a "simultaneous handheld and image capture mode" which displays information on both the top large screen interface **128** and the small screen interface **118**, when the top cover **106** is folded onto the bottom cover **108**, and the top and bottom large screen interfaces **128** and **124** are facing away from each other.

[0032] Next in step **612**, the device **102** adjusts zoom of the image capture lens **116** in response to user command (e.g. rocking the zoom control **120**). And in step **614**, the device **102** captures a set of image in response to user command (e.g. pressing the shutter button **122**).

[0033] While one or more embodiments of the present invention have been described, those skilled in the art will recognize that various modifications may be made. Variations upon and modifications to these embodiments are provided by the present invention, which is limited only by the following claims.

What is claimed is:

1. A handheld device, comprising:

a top portion;

a bottom portion;

a hinge, rotational about a first axis and having a first end and a second end, coupling the top portion to the bottom portion; and

an image capture device, coupled to the first end of the hinge and oriented to capture images aligned along the first axis of the hinge.

2. The device of claim 1, wherein:

wherein the handheld device is a personal digital assistant.

3. The device of claim 1, wherein:

wherein the handheld device is a cell phone.

4. The device of claim 1, wherein:

wherein the handheld device is a laptop computer.

5. The device of claim 1, wherein the image capture device includes:

an optically adjustable lens.

6. The device of claim 1, further comprising:

a lens filter coupled to the image capture device along the first axis.

7. The device of claim 1, further comprising:

a detachable lens coupled to the image capture device along the first axis.

8. The device of claim 1, further comprising:

a shutter control coupled to the image capture device.

9. The device of claim 1, further comprising:

a sub-hinge coupling the top portion to the bottom portion, and rotational about a second axis which is perpendicular to the first axis.

10. The device of claim 1, further comprising:

a small screen interface, coupled to the second end and aligned along the first axis of the hinge, for displaying images captured by the image capture device.

11. The device of claim 1, wherein the top portion includes:

a large screen interface for displaying images captured by the image capture device and other handheld device information.

12. The device of claim 11, wherein the bottom portion includes:

a second large screen interface for accepting input for controlling the handheld device.

13. A personal digital assistant, comprising:

a top portion;

a bottom portion;

a hinge, rotational about a first axis and having a first end and a second end, coupling the top portion to the bottom portion;

an image capture device, coupled to the first end of the hinge and oriented to capture images aligned along the first axis of the hinge;

a sub-hinge coupling the top portion to the bottom portion, and rotational about a second axis which is perpendicular to the first axis;

a small screen interface, coupled to the second end and aligned along the first axis of the hinge, for displaying images captured by the image capture device;

a first large screen interface for displaying images captured by the image capture device and other digital assistant information; and

a second large screen interface for accepting input for controlling the digital assistant.

14. A method for operating a handheld device, comprising:

permitting a first large screen interface to rotate about a first hinge axis with respect to a second large screen interface;

capturing images aligned along the first hinge axis; and

setting a mode in which the device operates in response to an orientation of the first large screen interface to a second large screen interface.

15. The method of claim 14 wherein the setting element includes:

displaying information on a small screen interface aligned along the first hinge axis, if the first large screen interface is folded onto the second large screen interface, and the top and bottom large screen interfaces are facing each other.

16. The method of claim 14 wherein the setting element includes:

displaying information on the first large screen interface in a first portrait orientation, if the first large screen interface is not folded onto the second large screen interface, and there is less than +/−45 degrees of rotation about a second hinge axis, which is perpendicular to the first hinge axis.

17. The method of claim 14 wherein the setting element includes:

displaying information on the first large screen interface in a landscape orientation, if the first large screen interface is not folded onto the second large screen interface, and there is more than +/−45 degrees of rotation about a second hinge axis, which is perpendicular to the first hinge axis.

18. The method of claim 16 wherein the setting element includes:

displaying information on the first large screen interface in a second portrait orientation, if the first large screen interface is folded onto the second large screen inter-

face, and the first and second large screen interfaces are facing away from each other, wherein the second portrait orientation is upside-down with respect to the first portrait orientation.

19. The method of claim 14 wherein the setting element includes:

displaying information on both a small screen interface and a large screen interface, if the first large screen interface is folded onto the second large screen interface and the first and second large screen interfaces are facing away from each other.

20. A handheld device, comprising a:

means for permitting a first large screen interface to rotate about a first hinge axis with respect to a second large screen interface;

means for capturing images aligned along the first hinge axis; and

means for setting a mode in which the device operates in response to an orientation of the first large screen interface to a second large screen interface.

* * * * *