PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1
Stylesheet Version v1.2

Assignment ID: PATI342200

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	ASSIGNMENT

CONVEYING PARTY DATA

Name	Execution Date
KONINKLIJKE PHILIPS N.V.	04/01/2024

RECEIVING PARTY DATA

Company Name:	GENERAL VIDEO, LLC
Street Address:	7209 LANCASTER PIKE
Internal Address:	SUITE 4
City:	HOCKESSIN
State/Country:	DELAWARE
Postal Code:	19707

PROPERTY NUMBERS Total: 8

Property Type	Number
Patent Number:	7088398
Patent Number:	6914637
Patent Number:	7257163
Patent Number:	7359437
Patent Number:	7225282
Patent Number:	9036010
Patent Number:	9462258
Patent Number:	9843786

CORRESPONDENCE DATA

Fax Number:

Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.

Phone: +82(109)2809544
Email: dylan@generalvideo.com
Correspondent Name: MINSANG CHO
Address Line 1: 333, Godeok-ro, Gangdong-gu
Address Line 2: 115-604
Address Line 4: Seoul, KOREA, REPUBLIC OF 05224

NAME OF SUBMITTER:	Minsang Cho
SIGNATURE:	Minsang Cho

DATE SIGNED:	07/04/2024
	This document serves as an Oath/Declaration (37 CFR 1.63).
Total Attachments: 2 source=US DoA#page1.tiff source=US DoA#page2.tiff	

US

UNITED STATES OF AMERICA

ASSIGNMENT

WHEREAS, **KONINKLIJKE PHILIPS N.V.** ("ASSIGNOR"), a corporation organized under the laws of **The Netherlands** , with a place of business at **HIGH TECH CAMPUS 5 EINDHOVEN 5656 AE NETHERLANDS**, owns the United States Patent(s) (the "Patent(s)") listed on the attached Schedule A; and

WHEREAS, **General Video, LLC** ("ASSIGNEE") , a corporation organized under the laws of **U.S.A.**, with a place of business at **7209 Lancaster Pike, Suite, Hockessin, DE, 19707, U.S.A.**, desires to acquire all rights to the Patent(s);

NOW, THEREFORE, in consideration of One Dollar ($1.00) and other valuable consideration, the receipt of which ASSIGNOR acknowledges, ASSIGNOR has sold, assigned, transferred, and set over, and does, by this Assignment, sell, assign, transfer, and set over unto ASSIGNEE, all rights to the Patent(s), including reissues and extensions, to be held and enjoyed by ASSIGNEE, its successors, assigns, and legal representatives, for ASSIGNEE's own use and benefit and for the use and benefit of its successors, assigns, and legal representatives, to the end of the term(s) for which the Patent(s) has/have been granted or may be reissued or extended, as fully and entirely as the Patent(s) would have been held and enjoyed by ASSIGNOR had this assignment and sale not been made; together with all claims for profits and damages by reason of past infringement, with the right to sue for and collect the same for the use and benefit of ASSIGNEE, its successors, assigns, and legal representatives.

This Assignment is deemed to have become effective as from: April 01, 2024

IN WITNESS WHEREOF, ASSIGNOR and ASSIGNEE have caused this Assignment to be executed by its duly authorized officer or representative on the date(s) indicated below.

KONINKLIJKE PHILIPS N.V.

By: _____

Name: Paul Emile de Haan
Title: Head of IP Supplies
Date: June 26, 2024

General Video, LLC

By: _____

Name: ROBERT COLAO
Title: PRESIDENT
Date: JUNE 18, 2024

Schedule

Country	Application Number	IP Grant Number
U.S.A.	10171860	7088398
U.S.A.	10192296	6914637
U.S.A.	10095422	7257163
U.S.A.	10036234	7359437
U.S.A.	10171820	7225282
U.S.A.	12808685	9036010
U.S.A.	14629642	9462258
U.S.A.	15256839	9843786

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/808,685	05/19/2015	9036010	2007P01979WOUS	5071

24737 7590 04/29/2015

PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 425 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Nicoll Burleigh Shepherd, Coulsdon, UNITED KINGDOM;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

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United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/808,685	06/17/2010	Nicoll Burleigh Shepherd	2007P01979WOUS	5071

24737 7590 04/23/2015

PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

EXAMINER	
PHAM, NAM D	

ART UNIT	PAPER NUMBER
2487	

NOTIFICATION DATE	DELIVERY MODE
04/23/2015	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

debbie.henn@philips.com
marianne.fox@philips.com

Response to Rule 312 Communication	Application No. 12/808,685	Applicant(s)
	Examiner	Art Unit

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address –

1. ☒ The amendment filed on *26 January 2015* under 37 CFR 1.312 has been considered, and has been:

a) ☒ entered.

b) ☐ entered as directed to matters of form not affecting the scope of the invention.

c) ☐ disapproved because the amendment was filed after the payment of the issue fee.
Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.

d) ☐ disapproved. See explanation below.

e) ☐ entered in part. See explanation below.

/ A. Marty Willis /

A. Marty Willis

Publishing Division

Office of Data Management

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	Shepherd, N. B.	Attn. No.: 2007P01979WOUS	
SERIAL NO.:	12/808,685	EXAMINER:	Pham, N.D.
FILED:	June 17, 2010	ART UNIT:	2487
		CONFIRMATION No.: 5071	

FOR: ***TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE***

Mail Stop: Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT PURSUANT TO 37 CFR 1.312

Dear Sir:

Prior to the issuance of a patent after timely payment of the issue fee as indicated in the Notice of Allowance, dated October 29, 2014, in the above matter, the Applicant hereby submits this paper, and requests amendment of the above-identified application as follows wherein:

Amendments made to the Claims begin on page 2,

Remarks begin on page 9.

/N.P./ 04/02/2015

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

24737 7590 10/29/2014
PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/808,685	06/17/2010	Nicoll Burleigh Shepherd	2007P01979WOUS	5071

TITLE OF INVENTION: TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	01/29/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
PHAM, NAM D	2487	348-046000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Koninklijke Philips N.V.
(B) RESIDENCE: (CITY and STATE OR COUNTRY): Eindhoven, NL

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
- ☒ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number 14-1270 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ☐ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ☐ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ☐ Applicant changing to regular undiscounted fee status. — NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Michael E. Belk/ Date January 26, 2015
Typed or printed name Michael E. Belk Registration No. 33,357

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	Shepherd, N. B.	Attn. No.:	2007P01979WOUS
SERIAL NO.:	12/808,685	EXAMINER:	Pham, N.D.
FILED:	June 17, 2010	ART UNIT:	2487
		CONFIRMATION No.:	5071

FOR: ***TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE***

Mail Stop: Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT PURSUANT TO 37 CFR 1.312

Dear Sir:

Prior to the issuance of a patent after timely payment of the issue fee as indicated in the Notice of Allowance, dated October 29, 2014, in the above matter, the Applicant hereby submits this paper, and requests amendment of the above-identified application as follows wherein:

Amendments made to the Claims begin on page 2,

Remarks begin on page 9.

IN THE CLAIMS:
Kindly replace the claims of record with the following full set of claims:

1-49. (Canceled)

50. (Previously presented) A digital display interface part, for use in a first audio-visual device, for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface having a known data carrying capacity for transmitting uncompressed pixel information, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter, in accordance with signal information received from the second audio-device, is operable in:

a first mode to generate a stream of first data elements, said first data element comprising pixel data of a 2D image, at a data carrying capacity no greater than said known data carrying capacity; and,

a second mode to generate a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, wherein said components of said stereoscopic image elements being transmitted in a first portion of said interface and in a second portion of said interface, each of said first portion and said second portion having a lesser data carrying capacity than said known data carrying capacity and a combined data carrying capacity no greater than said known data

carrying capacity, wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using and characteristics of said steam of second data elements.

51. (Previously presented) The interface part according to claim 50, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used in the second mode.

52. (Previously presented) The interface part according to claim 51, wherein the signaling information is carried in one of: a horizontal and a vertical blanking period.

53. (Previously presented) The interface part according to claim 50, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet between image data.

54. (Previously presented) The interface part according to claim 53, said signaling information received across the interface specifies capabilities of the second audio-visual device.

55. (Previously presented) The interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data.

56. (Previously presented) The interface part according to claim 55, arranged for sending the left eye image data and the right eye image data sequentially.

57. (Previously presented) The interface part according to claim 56, wherein an indication of the left and right image data being indicated by signaling information carried directly adjacent a position of the image data.

58. (Previously presented) The interface part according to claim 55, arranged for sending the left eye image data and the right eye image data by line interleaving.

59. (Previously presented) The interface part according to claims 50, wherein the stereoscopic image data components are 2D image data and image depth data.

60. (Previously presented) The interface part according to claim 59, wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data.

61. (Currently amended) A digital display interface part for use in an audio-visual device, said interface part supporting a digital display interface having a known data carrying capacity between the audio-visual device and a second audio-visual device, and ~~transmitting~~ receiving uncompressed pixel information, the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract said image data, the processor being operable, in accordance with capabilities of said second audio-visual device, wherein

in a first mode the processor extracts pixel image data for a 2D image from a stream of first data elements at a data carrying capacity no greater than said known data carrying capability; and,

in a second mode, the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, wherein said components of said stereoscopic image data elements being transmitted in a first portion of said interface and in a second portion of said interface, each of said first portion and said second portion having a lesser data carrying capacity than said known data carrying capacity and a combined data carrying capacity no greater than said known data carrying capacity, the interface part further arranged to receive signaling information across the interface, the signaling information identifying which of said first mode and said second mode is used ~~the formatter is using~~ and characteristics of said steam of second data elements.

62. (Currently amended) The interface part according to claim 61, wherein the signaling information comprises:

information for enabling the ~~second~~ audio-visual device to determine a stereoscopic image format being used, and

the interface part arranged to determine said stereoscopic image format being used.

63. (Previously presented) The interface part according to claim 61, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is received in a Data Island Packet between image data.

64. (Previously presented) The interface part according to claim 61, wherein the stereoscopic image data components are left eye image data and right eye image data.

65. (Currently amended) A method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface having a known data carrying capacity, the method causing a processor in the digital interface part to execute the steps comprising:

receiving image data;

formatting the image data for transport over the interface, in accordance with capabilities of the second audio-visual device received in a signaling information, said formatting comprising:

generating, in a first mode, a stream of first data elements said first data elements comprising pixel data of a 2D image, at a data carrying capacity no greater than said known data carrying capacity; and,

generating, in a second mode, a stream of second data elements said second data elements comprising a multiplexed combination of components of a stereoscopic image, said components of said stereoscopic image data elements being transmitted in a first portion of said interface and in a second portion of said interface, each of said first portion and said second portion having a lesser data carrying capacity than said known data carrying capacity and a combined data carrying capacity no greater than said known data carrying capacity, wherein characteristics of said steam of second data elements is presented in a second ~~said~~ signaling information.

66. (Currently amended) The method according to claim 65, wherein the second signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used.

67. (Currently amended) A method of processing image data at a digital display interface part of an audio-visual device, said interface part supporting a digital display interface having a known data carrying capacity for carrying ~~transmitting~~ uncompressed pixel information, the method causing a processor in the digital display interface part to execute the steps comprising:

receiving signaling information and formatted image data from the interface;

extracting image data in accordance with capabilities of said audiovisual device, by:

extracting pixel image data for a 2D image from a stream of first data

elements at a data carrying capacity no greater than said known data carrying capability in a first mode; and,

demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image in a second mode, said components of said stereoscopic image data elements being transmitted in a first portion of said interface and in a second portion of said interface, each of said first portion and said second portion having a lesser data carrying capacity than said known data carrying capacity and a combined data carrying capacity no greater than said known data carrying capacity, wherein characteristics of said steam of second data elements are presented in said signaling information.

REMARKS

Entry of this Amendment and reconsideration are respectfully requested in view of the amendments made to the claims and for the remarks made herein.

Upon entry of the above amendments:

Claims 50-67 are pending.

Claims 61, 62, and 65-67 have been amended.

Claim 61 has been amended to replace the term "transmitting" with "receiving" as the interface part in this matter is related to the audio-visual device, which represents a receiving device. Claim 61 has been further amended to provide clarity to the signaling information providing information regarding which of the first and second modes is being used and the content of the components of the second mode.

Claim 62 has been amended to remove the term "second" as claim 62 depends from claim 61, which recites the operation of the audio visual device.

Claim 65 has been amended to distinguish between the signaling information associated with the capabilities of the second audio-visual device and the "second" signaling information provided by the audio-visual device, which contains information regarding the components of the second mode.

Claim 66 has been amended to recite the "second" signaling information.

Claim 67 has been amended to in a manner similar to claim 61.

Applicant respectfully requests that the amendments to the claims be entered as the amendments to the claims provide grammatical and logical corrections and require only a cursory examination by the Examiner. Applicant further requests that favorable review of the application be issued in view of the amendments made to the claims herein.

Applicant makes no statement regarding the patentability of the subject matter recited in the claims prior to this Amendment and has amended the claims solely to

facilitate expeditious prosecution of this patent application. Applicant respectfully reserves the right to pursue claims, including the subject matter encompassed by the originally filed claims, as presented prior to this Amendment, and any additional claims in one or more continuing applications during the pendency of the instant application.

In order to advance the prosecution of the matter, applicant respectively requests that any errors in form that do not alter the substantive nature of the arguments presented herein be transmitted telephonically to the applicant's representative so that such errors may be quickly resolved or pursuant to MPEP 714.03 be entered into the record to avoid continued delay of the prosecution of this matter any further.

MPEP 714.03 affords the Examiner the discretion, pursuant to 37 CFR 1.135 (c), to enter into the record a bona fide attempt to advance the application that includes minor errors in form.

However, if the Examiner believes that such minor errors in form cannot be entered into the record or that the disposition of any issues arising from this response may be best resolved by a telephone call, then the Examiner is invited to contact applicant's representative at the telephone number listed below to resolve such minor errors or issues.

No fees are believed necessary for filing this paper.

Respectfully submitted,

Michael E. Belk, reg. no. 33,357

Date: December 1, 2014

/Carl A. Giordano/

By: Carl A. Giordano
Attorney for Applicant
Registration No. 41,780
(845) 268 1806

Mail all correspondence to:
Michael E. Belk, Esq.
US PHILIPS CORPORATION
P.O. Box 3001
Briarcliff Manor, NY 10510-8001
Phone: (914) 333-9643
Fax: (914) 332-0615

Electronic Patent Application Fee Transmittal

Application Number:	12808685
Filing Date:	17-Jun-2010
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh Shepherd
Filer:	Michael E. Belk/Elissa DeLuccy
Attorney Docket Number:	2007P01979WOUS

Filed as Large Entity

Filing Fees for U.S. National Stage under 35 USC 371

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl Issue Fee	1501	1	960	960

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**960**

Electronic Acknowledgement Receipt	
EFS ID:	21303997
Application Number:	12808685
International Application Number:	
Confirmation Number:	5071
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh Shepherd
Customer Number:	24737
Filer:	Michael E. Belk/Elissa DeLuccy
Filer Authorized By:	Michael E. Belk
Attorney Docket Number:	2007P01979WOUS
Receipt Date:	26-JAN-2015
Filing Date:	17-JUN-2010
Time Stamp:	12:04:41
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$960
RAM confirmation Number	10196
Deposit Account	141270
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	2007P01979WOUS_Issue_Fee.pdf	94201 6f5d82270045930e35c7ecb0b4305b0a2e55ec82	no	1
Warnings:					
Information:					
2		2007P01979WOUS_312Amd.pdf	91735 1c8144e7524830f87ede1ffa5423b3035aee13da	yes	11

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment Submitted/Entered with Filing of CPA/RCE	1	1
	Claims	2	8
	Applicant Arguments/Remarks Made in an Amendment	9	11

Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30785 0bfaf26c463468d7e40280f7fa39ebdad9f5c966	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	216721		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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Alexandria, Virginia 22313-1450
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NOTICE OF ALLOWANCE AND FEE(S) DUE

24737 7590 10/29/2014

PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
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EXAMINER
PHAM, NAM D

ART UNIT	PAPER NUMBER
2487	

DATE MAILED: 10/29/2014

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/808,685	06/17/2010	Nicoll Burleigh Shepherd	2007P01979WOUS	5071

TITLE OF INVENTION: TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	01/29/2015

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 02/11)

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

24737 7590 10/29/2014
PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

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12/808,685	06/17/2010	Nicoll Burleigh Shepherd	2007P01979WOUS	5071

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nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	01/29/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
PHAM, NAM D	2487	348-046000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status. — NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/808,685	06/17/2010	Nicoll Burleigh Shepherd	2007P01979WOUS	5071

24737 7590 10/29/2014

PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

EXAMINER	
PHAM, NAM D	

ART UNIT	PAPER NUMBER
2487	

DATE MAILED: 10/29/2014

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. 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, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. 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.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 12/808,685	Applicant(s) SHEPHERD, NICOLL BURLEIGH	
	Examiner NAM PHAM	Art Unit 2487	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *Examiner's Amendment filed on 14/10/2014* .
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *50-67*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☒ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 04/18/2014
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☒ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

NAM PHAM Examiner, Art Unit 2487	/Dave Czekaj/ Supervisory Patent Examiner, Art Unit 2487

The present application is being examined under the pre-AIA first to invent provisions.

Examiner's Amendment

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Carl Giordano on October 14, 2014.

The application has been amended as follows:

In the claims:

50. (Currently amended) A digital display interface part, for use in a first audio-visual device, for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface having a known data carrying capacity for transmitting uncompressed pixel information, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter, in accordance with signal information received from the second audio-device, is operable in:

a first mode to generate a stream of first data elements, said first data element comprising pixel data of a 2D image, at a data carrying capacity no greater than said known data carrying capacity; and,

a second mode to generate a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, wherein said components of said stereoscopic image elements being transmitted in a first portion ~~segment~~ of said interface and in a second portion ~~segment~~ of said interface, each of said first portion ~~segment~~ and said

second portion ~~segment~~ having a lesser data carrying capacity than said known data carrying capacity and a combined data carrying capacity no greater than said known data carrying capacity, wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using and characteristics of said steam of second data elements.

52. (Currently amended) The interface part according to claim 51, wherein the signaling information is carried in one of: a horizontal [[or]] and a vertical blanking period.

56. (Currently amended) The interface part according to claim 55, arranged for sending the left eye image data and the right eye image data sequentially.

58. (Currently amended) The interface part according to claim 55, arranged for sending the left eye image data and the right eye image data by line interleaving.

61. (Currently amended) A digital display interface part for use in an audio-visual device, said interface part ~~for~~ supporting a digital display interface having a known data carrying capacity between the audio-visual device and a second audio-visual device, ~~the digital display interface, of a known capacity, for~~ and transmitting uncompressed pixel information, the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract said image data, the processor being operable, in accordance with capabilities of said second audio-visual device, wherein

in a first mode, the processor extracts pixel image data for a 2D image from a stream of first data elements at a data carrying capacity no greater than known data carrying capability; and,

in a second mode, the processor demultiplexes components of a stereoscopic

image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, wherein said components of said stereoscopic image data elements being transmitted in a first portion ~~segment~~ of said interface and in a second portion ~~segment~~ of said interface, each of said first portion ~~segment~~ and said second portion ~~segment~~ having a lesser data carrying capacity than said known data carrying capacity and a combined data carrying capacity no greater than said known data carrying capacity, the interface part arranged to receive signaling information across the interface, the signaling information identifying which mode the formatter is using and characteristics of said steam of second data elements.

62. (Currently amended) The interface part according to claim 61, wherein the signaling information comprises:

information for enabling the second audio-visual device to determine a stereoscopic image format being used, and

the interface part arranged to determine said stereoscopic image format being used.

65. (Currently amended) A method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface[[,]] having a known data carrying capacity [[,]] for transmitting uncompressed pixel information, the method causing a processor in the digital interface part to execute the steps comprising:

receiving image data;

formatting the image data for transport over the interface, in accordance with capabilities of the second audio-visual device received in a signaling information, said formatting comprising:

generating, in a first mode, a stream of first data elements said first data elements comprising pixel data of a 2D image, at a data carrying capacity no greater than said

known data carrying capacity; and,

generating, in a second mode, a stream of second data elements said second data elements comprising a multiplexed combination of components of a stereoscopic image, said components of said stereoscopic image data elements being transmitted in a first portion ~~segment~~ of said interface and in a second portion ~~segment~~ of said interface, each of said first portion ~~segment~~ and said second portion ~~segment~~ having a lesser data carrying capacity than said known data carrying capacity and a combined data carrying capacity no greater than said known data carrying capacity, wherein characteristics of said steam of second data elements is presented in said signaling information.

67. (Currently amended) A method of processing image data at a digital display interface part of an audio-visual device, said interface part supporting a ~~the~~ digital display interface having a known data carrying capacity for transmitting uncompressed pixel information, the method causing a processor in the digital display interface part to execute the steps comprising:

receiving signaling information and formatted image data from the interface;

extracting image data in accordance with capabilities of said audiovisual device, by:

extracting pixel image data for a 2D image from a stream of first data elements at a data carrying capacity no greater than known data carrying capability in a first mode; and,

demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image in a second mode, said components of said stereoscopic image data elements being transmitted in a first portion ~~segment~~ of said interface and in a second portion ~~segment~~ of said interface, each of said first portion ~~segment~~ and said second portion ~~segment~~ having a lesser data carrying capacity than said known data carrying capacity and a combined data carrying capacity no greater than said known data carrying capacity, wherein characteristics of said steam of second data elements are presented in said signaling information.

Allowable Subject Matter

The following is an examiner's statement of reasons for allowance:

Ha (US 20060279750 A1) discloses an image display mode conversion apparatus and method, the apparatus having a display unit displaying image data included in an image signal, an image characteristic parameter detector detecting an image characteristic parameter which is information regarding whether the image data included in the image signal represents a two-dimensional (2D) image or a three-dimensional (3D) image, and an operation mode conversion determining unit receiving the detected image characteristic parameter, determining whether or not an operation mode of the display unit should be converted, and outputting an operation mode conversion signal to the display unit according to the determination result. Therefore, it is possible to provide more convenience to users in various fields, such as a 3D image broadcasting and so on, by implementing the image display mode conversion apparatus in a digital broadcast standard system [abstract]. Ha (US 20060279750 A1) does not disclose specifics about the interface having its known data carrying capacity operating in two different modes of transmitting 2D/3D image as claimed. While the second data elements have a capacity that is no greater than the corresponding first data elements. A further search was conducted which failed to yield any prior art. Therefore, the prior art fails to teach or render obvious these limitations taken within the others in the claim.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comment of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications form the examiner should be directed to Nam Pham, whose can be contacted by phone at (571)270-7352. The examiner can normally be reached on Mon—Thurs.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, CZEKAJ DAVID, can be reached on (571)272-7327.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) AT 866-217-9197 (too free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Nam Pham/
Examiner, Art Unit 2487

/Dave Czekaj/
Supervisory Patent Examiner, Art Unit 2487

Notice of References Cited	Application/Control No. 12/808,685	Applicant(s)/Patent Under Reexamination SHEPHERD, NICOLL BURLEIG	
	Examiner NAM PHAM	Art Unit 2487	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2006/0279750 A1	12-2006	Ha, Tae-Hyeun	358/001.2
*	B	US-6,914,637 B1	07-2005	Wolf et al.	348/473
*	C	US-2006/0044388 A1	03-2006	Kim et al.	348/042
*	D	US-2006/0192776 A1	08-2006	Nomura et al.	345/419
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12808685	SHEPHERD, NICOLL BURLEIGH
	Examiner	Art Unit
	NAM PHAM	4184

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
348	46	09/05/2012	/N.P./

SEARCH NOTES		
Search Notes	Date	Examiner
Inventor search	06/19/2013	/N.P./
East search	12/24/2013	/N.P./

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
Interference search		10/08/2014	/N. P./

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12808685	SHEPHERD, NICOLL BURLEIGH
	Examiner	**Art Unit**
	NAM PHAM	4184

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	09/05/2012	06/19/2013	12/24/2013	10/08/2014					
1	50	✓	✓	✓	=					
2	51	✓	✓	✓	=					
3	52	✓	✓	✓	=					
4	53	✓	✓	✓	=					
5	54	✓	✓	✓	=					
6	55	✓	✓	✓	=					
7	56	✓	✓	✓	=					
8	57	✓	✓	✓	=					
9	58	✓	✓	✓	=					
10	59	✓	✓	✓	=					
11	60	✓	✓	✓	=					
12	61	✓	✓	✓	=					
13	62	✓	✓	✓	=					
14	63	✓	✓	✓	=					
15	64	✓	✓	✓	=					
16	65	✓	✓	✓	=					
17	66	✓	✓	✓	=					
18	67	✓	✓	✓	=					

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	12808685
	Filing Date	2010-06-17
	First Named Inventor	Nicholl B. Shepherd
	Art Unit	2487
	Examiner Name	Nam D. Pham
	Attorney Docket Number	2007P01979WOUS

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	1	20070296859	A1	2007-12-27	SUZUKI	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2003111101	JP	A	2003-04-11	MASUTANI ET AL		☒
	2	2006295289	JP	A	2006-10-26	TAKADA ET AL		☒
	3	2007325101	JP	A	2007-12-13	MATSUURA		☒

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Art Unit	2487
	Examiner Name	Nam D. Pham
	Attorney Docket Number	2007P01979WOUS

	4	2008117289	JP	A	2008-05-22	KUSAKARI		☒

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	1		☐

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EXAMINER SIGNATURE

Examiner Signature	/Nam Pham/	Date Considered	10/08/2014

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	First Named Inventor	Nicholl B. Shepherd
	Art Unit	2487
	Examiner Name	Nam D. Pham
	Attorney Docket Number	2007P01979WOUS

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Michael E. Belk/	Date (YYYY-MM-DD)	2014-04-18
Name/Print	Michael E. Belk	Registration Number	33,357

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. 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, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	15125	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same interface	US-PGPUB; USPAT	OR	ON	2014/10/08 07:35
L2	253	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same interface same transmi$5 near5 image	US-PGPUB; USPAT	OR	ON	2014/10/08 07:37
L3	14	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same interface same transmi$5 near5 image same (segment or portion or capacity)	US-PGPUB; USPAT	OR	ON	2014/10/08 07:47
L4	3	L3 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2014/10/08 07:49
L5	81	L2 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2014/10/08 07:51
L15	1	Shepherd NEAR2 Nicoll NEAR2 Burleigh	US-PGPUB; USPAT	OR	ON	2014/10/08 09:38
L16	0	(interface same stereoscop$3 same image same capacity same first same second).clm.	US-PGPUB; USPAT	OR	ON	2014/10/08 09:39
S1	758	348/46.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/08/29 15:10
S2	688	video adj summary	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/08/29 15:12
S3	39	(video adj summary) SAME signal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/08/29 15:17
S4	3	(video adj summary) SAME (content adj signal)	US-PGPUB; USPAT; USOCR; FPRS;	OR	ON	2012/08/29 15:50

			EPO; JPO; DERWENT; IBM_TDB			
S5	16	(video adj summary) SAME (classif$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/08/29 16:03
S6	751	348/46.ccls.	US-PGPUB; USPAT	OR	ON	2012/08/31 15:17
S7	225	digital adj display adj interface	US-PGPUB; USPAT	OR	ON	2012/08/31 15:23
S8	16	S7 AND (2D OR 3D)	US-PGPUB; USPAT	OR	ON	2012/08/31 15:31
S9	7	S7 AND (stereoscop$3)	US-PGPUB; USPAT	OR	ON	2012/08/31 15:36
S10	131	S7 AND mode	US-PGPUB; USPAT	OR	ON	2012/08/31 15:39
S11	5	interface AND stereocop$3	US-PGPUB; USPAT	OR	ON	2012/08/31 16:00
S12	26078	display adj interface	US-PGPUB; USPAT	OR	ON	2012/08/31 16:02
S13	5401	S12 AND ((transmit OR generate) adj (data OR image))	US-PGPUB; USPAT	OR	ON	2012/08/31 16:03
S14	4631	S13 AND digital	US-PGPUB; USPAT	OR	ON	2012/08/31 16:03
S15	3293	S14 AND format	US-PGPUB; USPAT	OR	ON	2012/08/31 16:04
S16	2364	S15 AND mode	US-PGPUB; USPAT	OR	ON	2012/08/31 16:04
S17	2308	S16 AND first	US-PGPUB; USPAT	OR	ON	2012/08/31 16:04
S18	2234	S17 AND second	US-PGPUB; USPAT	OR	ON	2012/08/31 16:04
S19	442	S18 and (2D OR 3D)	US-PGPUB; USPAT	OR	ON	2012/08/31 16:05
S20	422	S19 AND signal	US-PGPUB; USPAT	OR	ON	2012/08/31 16:05
S21	418	S20 AND information	US-PGPUB; USPAT	OR	ON	2012/08/31 16:06
S22	247	S21 AND pixel	US-PGPUB; USPAT	OR	ON	2012/08/31 16:06
S23	4191	left adj eye adj image	US-PGPUB; USPAT	OR	ON	2012/09/04 07:54
S24	3410	(left adj eye adj image) SAME (right adj eye adj image)	US-PGPUB; USPAT	OR	ON	2012/09/04 07:54
S25	610	(left adj eye adj image) SAME (right adj eye adj image) SAME "2"$1D	US-PGPUB; USPAT	OR	ON	2012/09/04 07:55
S26	461	S25 AND stereoscop$3	US-PGPUB; USPAT	OR	ON	2012/09/04 07:56
S27	451	S26 AND display	US-PGPUB; USPAT	OR	ON	2012/09/04 07:56
S28	228	S27 AND interface	US-PGPUB;	OR	ON	2012/09/04

			USPAT			07:56
S29	175	S28 AND mode	US-PGPUB; USPAT	OR	ON	2012/09/04 07:57
S31	4	S29 AND (signaling adj information)	US-PGPUB; USPAT	OR	ON	2012/09/04 08:21
S32	37	data adj island adj packet	US-PGPUB; USPAT	OR	ON	2012/09/05 08:56
S33	610	(left adj eye adj image) SAME (right adj eye adj image) SAME "2"$1D	US-PGPUB; USPAT	OR	ON	2012/09/05 09:30
S34	461	S33 AND stereoscop$3	US-PGPUB; USPAT	OR	ON	2012/09/05 09:30
S35	451	S34 AND display	US-PGPUB; USPAT	OR	ON	2012/09/05 09:30
S36	318	S35 AND mode	US-PGPUB; USPAT	OR	ON	2012/09/05 09:30
S37	2	"20090080853"	US-PGPUB; USPAT	OR	ON	2012/09/06 11:32
S38	1	"20020093812"	US-PGPUB; USPAT	OR	ON	2012/09/06 13:31
S39	2	"20080037033"	US-PGPUB; USPAT	OR	ON	2012/09/06 13:35
S40	9	"6320641"	US-PGPUB; USPAT	OR	ON	2012/09/06 13:36
S41	1	"7668382"	US-PGPUB; USPAT	OR	ON	2012/09/06 13:52
S42	2915	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same mode$1 same (transmit$5 or transfer$5)	US-PGPUB; USPAT	OR	ON	2013/06/05 13:33
S43	11	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same mode$1 same (transmit$5 or transfer$5) same un$1compress$3	US-PGPUB; USPAT	OR	ON	2013/06/05 13:35
S44	9	S43 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/05 13:40
S45	1637	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same mode$1 same (transmit$5 or transfer$5 or send$5) same image$1	US-PGPUB; USPAT	OR	ON	2013/06/05 13:57
S46	783	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same mode$1 same (transmit$5 or transfer$5 or send$5) same image$1 same (generat$4 or produc$4)	US-PGPUB; USPAT	OR	ON	2013/06/05 14:02
S47	25	S46 AND HDMI$1	US-PGPUB; USPAT	OR	ON	2013/06/05 14:04
S48	1	S47 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/05 14:04
S49	83	S45 AND HDMI$1	US-PGPUB; USPAT	OR	ON	2013/06/05 14:05
S50	2	S49 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/05 14:05

S51	476	S46 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/05 14:15
S52	14	S51 AND un$1compress$5	US-PGPUB; USPAT	OR	ON	2013/06/05 14:16
S53	154	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same image$1 same HDMI$1	US-PGPUB; USPAT	OR	ON	2013/06/05 14:38
S54	3	S53 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/05 15:09
S55	12611	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same image$1 same mode$1	US-PGPUB; USPAT	OR	ON	2013/06/05 15:13
S56	1179	("3"$1d or three$1dimension$3 or "3"$1demension$3 or steoscop$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same image$1 same mode$1 same interfac$4	US-PGPUB; USPAT	OR	ON	2013/06/05 15:15
S57	286	("3"$1d or three$1dimension$3 or "3"$1demension$3 or steoscop$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same image$1 same mode$1 same interfac$4 same (transfer$4 or transmit$4 or send$4)	US-PGPUB; USPAT	OR	ON	2013/06/05 15:17
S58	175	S57 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/05 15:19
S59	236	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same signal same capabilit$3 same (sen$4 or receiv$4)	US-PGPUB; USPAT	OR	ON	2013/06/19 08:50
S60	153	S59 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/19 08:52
S61	25	(US-20030231191-$ or US-20040181806-$ or US-20040218599-$ or US-20050184993-$ or US-20100315489-$ or US-20080240152-$ or US-20080008172-$ or US-20070286246-$ or US-20070242068-$ or US-20100027113-$ or US-20030128871-$ or US-20050030301-$ or US-20080013001-$ or US-20070165304-$ or US-20070097024-$ or US-20060279750-$ or US-20070296721-$).did. or (US-8068485-$ or US-5644324-$ or US-6094182-$ or US-6911975-$ or US-7098888-$ or US-7362324-$ or US-6914637-$ or US-7088398-$).did.	US-PGPUB; USPAT	OR	ON	2013/06/19 08:52
S62	11	S61 AND capabilit$4	US-PGPUB; USPAT	OR	ON	2013/06/19 08:53
S63	5443	("3"$1d or three$1dimension$3 or "3"$1demension$3 or stereoscop$3) with ("2"$1d or two$1dimension$3 or "2"$1demension$3) with (size$1 or capabilit$3)	US-PGPUB; USPAT	OR	ON	2013/06/19 09:11
S64	988	("3"$1d or three$1dimension$3 or "3"$1demension$3 or stereoscop$3) with ("2"$1d or two$1dimension$3 or "2"$1demension$3) with (size$1 or	US-PGPUB; USPAT	OR	ON	2013/06/19 09:14

		capabilit$3) with (great$1 or small$4 or sam$1 or reduc$4)				
S65	123	S64 AND (transmitter$1 or encoder$1) and (receiver$1 or decoder$1)	US-PGPUB; USPAT	OR	ON	2013/06/19 09:16
S66	56	S65 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/19 09:16
S67	829	3d same 2d same size same (size or capability or capacity)same (smaller or greater or bigger)	US-PGPUB; USPAT	OR	ON	2013/12/23 11:47
S68	404	3d same 2d same size same (size or capability or capacity)same (smaller or greater or bigger) same image	US-PGPUB; USPAT	OR	ON	2013/12/23 11:47
S69	404	3d same 2d same size same (size or capability or capacity) same (smaller or greater or bigger) same image	US-PGPUB; USPAT	OR	ON	2013/12/23 11:48
S70	48	3d same 2d same size same (size or capability or capacity) same (smaller or greater or bigger) same image same (interface or transmit$4 or send$4)	US-PGPUB; USPAT	OR	ON	2013/12/23 11:49
S71	32	S70 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/12/23 11:50
S72	4	"3"$1dimension$3 same "2"$1dimension$3 same size same (size or capability or capacity) same (smaller or greater or bigger) same (content or image) same (interface or transmit$4 or send$4)	US-PGPUB; USPAT	OR	ON	2013/12/23 12:12
S73	4	"3"$1dimension$3 same "2"$1dimension$3 same (size or capability or capacity) same (smaller or greater or bigger) same (content or image) same (interface or transmit$4 or send$4)	US-PGPUB; USPAT	OR	ON	2013/12/23 12:20
S74	51	"3"$1dimension$3 same "2"$1dimension$3 same (size or capability or capacity) same (smaller or greater or bigger) same (content or image)	US-PGPUB; USPAT	OR	ON	2013/12/23 12:22
S75	50	"3"$1dimension$3 same "2"$1dimension$3 same (content or size or capability or capacity) same (smaller or greater or bigger) same (image)	US-PGPUB; USPAT	OR	ON	2013/12/23 12:23
S76	35	S74 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/12/23 12:23
S77	793	("3"$1d or "3"$1dimension$3) same ("2"$1d or "2"$1dimension$3) same (size or capability or capacity) same (smaller or greater or bigger) same (content or image)	US-PGPUB; USPAT	OR	ON	2013/12/23 13:55
S78	231	("3"$1d or "3"$1dimension$3) same ("2"$1d or "2"$1dimension$3) same (size or capability or capacity) same (smaller or greater or bigger) same (content or image) same (send$3 or sent or transmit$4 or communicat$3 or display$4)	US-PGPUB; USPAT	OR	ON	2013/12/23 14:21
S79	117	S78 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/12/23 14:23
S80	245	("3"$1d or "3"$1dimension$3) same ("2"$1d or "2"$1dimension$3) same (size	US-PGPUB; USPAT	OR	ON	2013/12/23 14:23

		or capability or capacity) same (smaller or greater or bigger) same (content or image) same (send$3 or sent or transmit$4 or communicat$3 or display$4 or interfac$4)				
S81	5537	("3"$1d or "3"$1dimension$3 or stereoscop$3) with ("2"$1d or "2"$1dimension$3) with conver$5	US-PGPUB; USPAT	OR	ON	2013/12/23 15:57
S82	550	("3"$1d or "3"$1dimension$3 or stereoscop$3) with ("2"$1d or "2"$1dimension$3) with conver$5 same (size or scal$3)	US-PGPUB; USPAT	OR	ON	2013/12/23 15:58
S83	247	S82 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/12/23 16:00
S84	176	S83 AND (greater or smaller or bigger)	US-PGPUB; USPAT	OR	ON	2013/12/23 16:00
S85	53	stereoscop$3 near3 encod$3 same resolution	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/12/24 09:16
S86	19	S85 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/12/24 09:16
S87	251	stereoscop$3 SAME (interlac$4 or interleav$3 or down$1sampl$3) same resolution	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/12/24 09:28
S88	193	stereoscop$3 SAME (interlac$4 or interleav$3 or down$1sampl$3) same resolution same image	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/12/24 09:28
S89	93	S88 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/12/24 09:28
S90	1	"13067880"	US-PGPUB; USPAT	OR	ON	2014/08/11 16:22

10/8/2014 9:40:14 AM
C:\Users\npham\Documents\EAST\Workspaces\12808685.wsp

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12808685	SHEPHERD, NICOLL BURLEIGH
	Examiner	**Art Unit**
	NAM PHAM	2487

CPC						
Symbol					**Type**	**Version**
H04N		13	/	0048	F	2013-01-01
H04N		13	/	0059	I	2013-01-01
H04N		2213	/	003	A	2013-01-01
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CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
			/					
			/					

/NAM PHAM/ Examiner.Art Unit 2487	10/08/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	18	
/Dave Czekaj/ Supervisory Patent Examiner, Art Unit 2487		O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	50	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12808685	SHEPHERD, NICOLL BURLEIGH
	Examiner	**Art Unit**
	NAM PHAM	2487

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION										
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED					
348	46	H	0	4	N	13 / 02 (2006.01.01)						

CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
348	E13.074				

/NAM PHAM/ Examiner.Art Unit 2487	10/08/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	18	
/Dave Czekaj/ Supervisory Patent Examiner, Art Unit 2487		O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	50	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12808685	SHEPHERD, NICOLL BURLEIGH
	Examiner	**Art Unit**
	NAM PHAM	2487

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	50	17	66												
2	51	18	67												
3	52														
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12	61														
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14	63														
15	64														
16	65														

/NAM PHAM/ Examiner.Art Unit 2487	10/08/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	18	
/Dave Czekaj/ Supervisory Patent Examiner, Art Unit 2487		O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	50	1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	Shepherd, N. B.	Attn. No.: 2007P01979WOUS	
SERIAL NO.:	12/808,685	EXAMINER:	Pham, N.D.
FILED:	June 17, 2010	ART UNIT:	2487
		CONFIRMATION No.: 5071	

FOR: ***TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE***

Mail Stop: Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SUPPLEMENTAL AMENDMENT

Dear Sir:

In response to a telephonic communication initiated by the Examiner on August 12, 2014, the Applicant hereby submits this paper, and requests amendment of the above-identified application as follows wherein:

Amendments made to the Claims begin on page 2,

Remarks begin on page 9.

IN THE CLAIMS:
Kindly replace the claims of record with the following full set of claims:

1-49. (Canceled)

50. (Currently amended) A digital display interface part, for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface having a known capacity for transmitting uncompressed pixel information, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter, in accordance with signal information received from the second audio-device, is operable in:

a first mode to generate a stream of first data elements, said first data element comprising ~~which carry~~ pixel data of a 2D image; and,

a second mode to generate a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, wherein said components of said stereoscopic image elements being transmitted in a first segment of said interface and in a second segment of said interface, each of said first segment and said second segment having a lesser capacity than said known capacity and a combined capacity no greater than said known capacity, wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying

which mode the formatter is using and characteristics of said steam of second data elements, ~~and wherein the second data elements have a capacity that is no greater than the corresponding first data elements~~.

51. (Previously presented) The interface part according to claim 50, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used in the second mode.

52. (Previously presented) The interface part according to claim 51, wherein the signaling information is carried in a horizontal or vertical blanking period.

53. (Previously presented) The interface part according to claim 50, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet between image data.

54. (Previously presented) The interface part according to claim 53, said signaling information received across the interface specifies capabilities of the second audio-visual device.

55. (Previously presented) The interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data.

56. (Previously presented) The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data sequentially.

57. (Previously presented) The interface part according to claim 56, wherein an indication of the left and right image data being indicated by signaling information carried directly adjacent a position of the image data.

58. (Previously presented) The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data by line interleaving.

59. (Previously presented) The interface part according to claims 50, wherein the stereoscopic image data components are 2D image data and image depth data.

60. (Previously presented) The interface part according to claim 59, wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data.

61. (Currently amended) A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and a second audio-visual device, the digital display interface, of a known capacity, for transmitting uncompressed pixel information the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract said image data, the processor being operable, in accordance with capabilities of said second audio-visual device, wherein

in a first mode, ~~in which~~ the processor extracts pixel image data for a 2D image from a stream of first data elements; and,

in a second mode, ~~in which~~ the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, wherein said components of said stereoscopic image data elements being transmitted in a first segment of said interface and in a second segment of said interface, each of said first segment and said second segment having a lesser capacity than said known capacity and a combined capacity no greater than said known capacity, the interface part arranged to receive signaling information across the interface, the signaling information identifying which mode the formatter is using and characteristics of said steam of second data elements~~, and wherein the second data elements have a capacity that is no greater than the corresponding first data elements~~.

62. (Currently amended) The interface part according to claim 61, wherein the signaling information comprises:

information for enabling the second audio-visual device to determine a stereoscopic image format being used, and

the interface part arranged to determine [[a]] said stereoscopic image format being used.

63. (Previously presented) The interface part according to claim 61, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is received in a Data Island Packet between image data.

64. (Currently amended) The interface part according to claim [[50]] 61, wherein the stereoscopic image data components are left eye image data and right eye image data.

65. (Currently amended) A method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface, having a known capacity, for transmitting uncompressed pixel information, the method causing a processor in the digital interface part to execute the steps comprising:

receiving image data;

formatting the image data for transport over the interface, in accordance with capabilities of the second audio-visual device received in a signaling information, said formatting comprising ~~by~~:

generating, in a first mode, a stream of first data elements ~~which carry~~ said first data elements comprising pixel data of a 2D image at said known capacity ~~in a first mode~~; and,

generating, in a second mode, a stream of second data elements said second data elements comprising ~~which carry~~ a multiplexed combination of components of a stereoscopic image, said components of said stereoscopic image data elements being transmitted in a first segment of said interface and in a second segment of said interface, each of said first segment and said second segment having a lesser capacity than said known capacity and a combined capacity no greater than said known capacity, ~~in a second mode~~, wherein characteristics of said steam of second data elements is presented in said signaling information ~~and the second data elements have a capacity that is no greater than the corresponding first data elements~~.

66. (Previously presented) The method according to claim 65, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used.

67. (Currently amended) A method of processing image data at a digital display interface part of an audio-visual device, the digital display interface having a known capacity for transmitting uncompressed pixel information, the method causing a processor in the digital display interface part to execute the steps comprising:

receiving signaling information and formatted image data from the interface;

extracting image data in accordance with capabilities of said audiovisual device, by:

extracting pixel image data for a 2D image from a stream of first data

elements in a first mode; and,

demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image in a second mode, said components of said stereoscopic image data elements being transmitted in a first segment of said interface and in a second segment of said interface, each of said first segment and said second segment having a lesser capacity than said known capacity and a combined capacity no greater than said known capacity, wherein characteristics of said steam of second data elements are presented in said signaling information ~~and wherein the second data elements have a capacity that is no greater than the corresponding first data elements~~.

REMARKS

Entry of this Amendment and reconsideration are respectfully requested in view of the amendments made to the claims and for the remarks made herein.

Claims 50-67 are pending.

Claims 50-67 stand rejected.

Claims 50, 61, 63 and 67 are independent claims.

Claims 50, 61, 62, 63, 65 and 67 have been amended.

Claims 50-67 stand rejected under 35 USC 103(a) as being unpatentable over Ha (US 20060279750) in view of Wolf (US 6914637), Kim (US 20060044388) and Nomura (US 20060192776).

In the telephonic communication, the Examiner indicated that the element ",wherein the second data elements have a capacity that is no greater than the corresponding first data elements" was too broad. The Examiner suggested that further detail regarding how the 3D image occupies less capacity than the 2D image (i.e., second data elements v. first data elements).

A review of the specification reveals that the invention teaches that the 3D image may be multiplexed such that a first portion of the 3D image (e.g., left eye or 2D image) is transmitted in one-half of the interface and a second portion of the 3D image (e.g., right eye or depth data) is transmitted in the second half of the interface. (see for example, page 10, lines 24-30, "Figure 4 shows a way in which stereoscopic left eye/right eye data can be multiplexed. The components of the left eye data (R,G,B or Y,Cr,Cb) are sent in a first portion of each data-carrying element, and then immediately followed by the components of the right eye data (R,G,B or Y,Cr,Cb). Both left eye and right eye are either sent within the same packet, consecutive image data packets, or parts of consecutive image data packets. As an example, where a 16-bit per color per

pixel mode is used, bits 0-7 can carry the left image Y data and bits 8-15 carry the right image Y data."

In view of the above teaching in the specification and the Examiner's suggest to provide detail regarding the element of ",wherein the second data elements have a capacity that is no greater than the corresponding first data elements," the independent claims have been amended to provide further clarity to the subject matter claimed as the invention. More specifically, the independent claims have been amended to recite:

", components of said stereoscopic image elements data elements being transmitted in a first segment of said interface and in a second segment of said interface, each of said first segment and said second segment having a lesser capacity than said known capacity and a combined capacity no greater than said known capacity."

Applicant respectfully requests that the amendments to the claims be entered and the application be evaluated in view of the amendments made to the claims herein.

In addition, claims 65 and 67 have been amended to recite a method … causing a processor in the digital display interface part to execute the steps recited in the claims.

No new matter has been added. Support for the amendment may be found at least on page 12, lines 1-9, "AV device 20 includes a processor 21 applies suitable processing to the data to render a 3D image. In the case of stereoscopic display, where a user is simultaneously or sequentially presented with separate left and right eye images, processor 21 constructs the separate left eye/right eye images and outputs them 24 at the required time. For sequential stereoscopic displays, a further output 23 is provided to synchronize operation of shuttered glasses. In the case of an autostereoscopic display, such as a display using a ventricular screen, processor 21 constructs the image data which is required to be output 24 to the display elements to generate the autostereoscopic display. Interface part 22 and processor 21 use the signaling information sent across the interface to:"

Applicant submits that the amendments made to the claims are consistent with the Examiner's suggestion to amend the claims to provide further clarity to the claim element of "the second data elements have a capacity that is no greater than the corresponding first data elements."

Applicant makes no statement regarding the patentability of the subject matter recited in the claims prior to this Amendment and has amended the claims solely to facilitate expeditious prosecution of this patent application. Applicant respectfully reserves the right to pursue claims, including the subject matter encompassed by the originally filed claims, as presented prior to this Amendment, and any additional claims in one or more continuing applications during the pendency of the instant application.

In order to advance the prosecution of the matter, applicant respectively requests that any errors in form that do not alter the substantive nature of the arguments presented herein be transmitted telephonically to the applicant's representative so that such errors may be quickly resolved or pursuant to MPEP 714.03 be entered into the record to avoid continued delay of the prosecution of this matter any further.

MPEP 714.03 affords the Examiner the discretion, pursuant to 37 CFR 1.135 (c), to enter into the record a bona fide attempt to advance the application that includes minor errors in form.

However, if the Examiner believes that such minor errors in form cannot be entered into the record or that the disposition of any issues arising from this response may be best resolved by a telephone call, then the Examiner is invited to contact applicant's representative at the telephone number listed below to resolve such minor errors or issues.

No fees are believed necessary for filing this paper.

Respectfully submitted,

Michael E. Belk, reg. no. 33,357

Date: August 15, 2014

/Carl A. Giordano/

By: Carl A. Giordano
Attorney for Applicant
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Fax: (914) 332-0615

Electronic Acknowledgement Receipt	
EFS ID:	19892028
Application Number:	12808685
International Application Number:	
Confirmation Number:	5071
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh Shepherd
Customer Number:	24737
Filer:	Michael E. Belk/Elissa DeLuccy
Filer Authorized By:	Michael E. Belk
Attorney Docket Number:	2007P01979WOUS
Receipt Date:	18-AUG-2014
Filing Date:	17-JUN-2010
Time Stamp:	15:50:59
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2007P01979WOUS_Supp_Amd.pdf	460118 3ebd953f8bf334063c9ddd5c5c308a44ffb923a9	yes	12

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Supplemental Response or Supplemental Amendment	1	1
	Claims	2	8
	Applicant Arguments/Remarks Made in an Amendment	9	12
Warnings:			
Information:			
	Total Files Size (in bytes):	460118	

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/808,685	Filing Date 06/17/2010	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)		
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

		(Column 1)		(Column 2)	(Column 3)		
AMENDMENT	08/18/2014	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0	X $80 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $420 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)		
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

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/DORIS BURNS/

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If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	12808685
	Filing Date	2010-06-17
	First Named Inventor	Nicholl B. Shepherd
	Art Unit	2487
	Examiner Name	Nam D. Pham
	Attorney Docket Number	2007P01979WOUS

U.S.PATENTS Remove

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	1	20070296859	A1	2007-12-27	SUZUKI	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2003111101	JP	A	2003-04-11	MASUTANI ET AL		☒
	2	2006295289	JP	A	2006-10-26	TAKADA ET AL		☒
	3	2007325101	JP	A	2007-12-13	MATSUURA		☒

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12808685
	Filing Date	2010-06-17
	First Named Inventor	Nicholl B. Shepherd
	Art Unit	2487
	Examiner Name	Nam D. Pham
	Attorney Docket Number	2007P01979WOUS

	4	2008117289	JP	A	2008-05-22	KUSAKARI		☒

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12808685
	Filing Date	2010-06-17
	First Named Inventor	Nicholl B. Shepherd
	Art Unit	2487
	Examiner Name	Nam D. Pham
	Attorney Docket Number	2007P01979WOUS

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Michael E. Belk/	Date (YYYY-MM-DD)	2014-04-18
Name/Print	Michael E. Belk	Registration Number	33,357

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METHOD, APPARATUS AND SYSTEM FOR PROCESSING STEREOSCOPIC IMAGE

No documents available for this priority number

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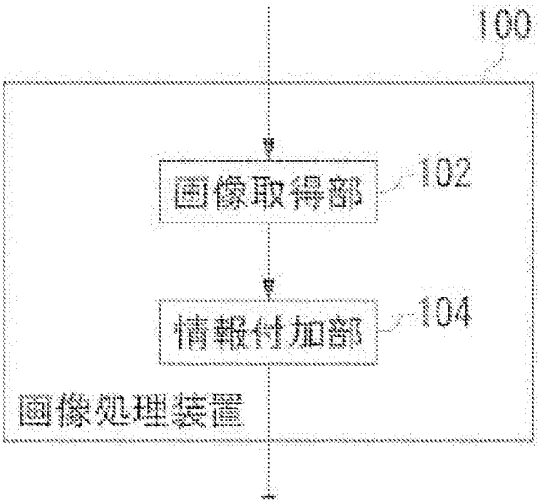
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Abstract of JP2003111101 (A)

PROBLEM TO BE SOLVED: To solve a problem wherein an infrastructure for accelerating distribution of stereoscopic image is not arranged. SOLUTION: An image processor 100 comprises an image acquisition section 102, and an information adding section 104. The image acquisition section 102 acquires a basic image capable of stereoscopic display externally and further acquires an original image being converted into a basic image. The information adding section 104 records information being referred during stereoscopic viewing, e.g. the arrangement and the estimated number of viewpoints, on the header of image data.



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DESCRIPTION JP2003111101

[0001]

BACKGROUND OF THE INVENTION The present relates to a three-dimensional image processing technology, in particular, the present invention relates to data structures and computer related programs how to process or display a three-dimensional image, equipment, and systems.

[0002]

I'm about to enter the broadband era say Description of the Prior Art In recent years, the Internet user population is rapidly increasing, as well as a new stage of Internet use.

Because communication bandwidth is spread dramatically in the broadband communication, delivery of heavy image data was often shunned conventional become popular.

The long and concepts "multimedia" and "video-on-demand" is been raised, but it was a situation that has become the broadband era, these words are experience Omotte realize a general user for the first time.

[0003]

Image, delivery of the moving image, especially if spreads, users seek to improve the quality and enhance the content of course.

These are the development of authoring tools for the digital video software of existing owes to such as the pursuit of image coding technology with low loss and high efficiency is large.

[0004]

An object of the invention is to provide such a situation, as one form of the near future image delivery service, a substantial delivery of (also referred to as "three-dimensional image" hereinafter) pseudo three-dimensional image, and is attracting attention in the art It is contemplated that capture market.

Three-dimensional image is attractive in applications that fulfill the desire of the user to determine the image more realistic, to pursue a sense of reality, such as movies and games in particular.

In a product presentation in (e-commerce) EC that appears three-dimensional image, and become the standard of one of the commerce in the 21st century addition, it is also useful for the realistic display of the product.

[0005]

However, it may be carried out when considering a new Internet businesses that deliver three-dimensional images, a model for the business also promote the infrastructure therefor is not present yet.

The present inventors are those in which none of the present invention by focusing on such a current situation, and its object is to provide a three-dimensional image processing techniques to allow the technical aspects of promoting the distribution of the stereoscopic image.

[0006]

For the understanding of the present invention means to solve the problem, we define the following concepts herein first.

The "stereoscopic image": the result rather than the image data itself, it is displayed in three dimensions, refer to the conceptual image and casting the eyes of the user.

More of image data that can be displayed as a three-dimensional image is referred to as will be described later as "multiplex image".

In other words, when you view the multiplex image, three-dimensional image can be seen.

"Parallax image": Normal, for stereoscopic vision with a feeling of depth, image to be and casting the left eye image to be and casting the right eye so that parallax may occur (hereinafter referred to as the right-eye image short) (hereinafter referred to as the left-eye image simply) a it is necessary to prepare.

Sometimes collectively referred to as parallax image pairs of the image causing a parallax as a left-eye image and right eye image, is referred to herein as the parallax images each image to be cause such disparity.

In other words, the left eye image is also right eye image is also a disparity image, respectively.

Besides these, in general, an image from each viewpoint, which is assumed in the stereoscopic image is the parallax images, respectively.

[0007]

"Basic image": for three-dimensional image is displayed, it means that the image processing has been performed previously, or image, of the object constituting the processing required for stereoscopic viewing.

As a specific example, other parallax images separate format described below, as a side-by-side format or a multiplex format (also referred to as "synthetic image") on image Deki been synthesized in any form is a plurality of parallax images already I include the.

One of the aspects of the structure of the basic image: "side-by-side format."

Form was synthesized juxtaposed in both their horizontal or vertical parallax images.

Usually juxtaposing the parallax image that has been thinning.

For example, to configure by juxtaposing two parallax images in the horizontal direction, thins one every pixel in the horizontal direction parallax images, respectively.

I also referred to as a "side-by-side image" simply the basic image of the side-by-side format.

[0008]

One of the aspects of the structure of the basic image: "multiplex format".

The format of final image data for displaying a stereoscopic image.

I also referred to as a "multiplex image" simply the basic image of multiplex format.

One of the aspects of the structure of the basic image: "separate form".

It is of two-dimensional images alone, it is stereoscopically in combination with two-dimensional image of the other is assumed to refer to each of the plurality of two-dimensional images thereof.

I also referred to as a "separate image" simply the basic image of "separate form".

Separate images Unlike the side-by-side images and multiplexing the image and not a composite image.

[0009]

Perspective see it is assumed in the three-dimensional image: "point of view".

Number of parallax images and the number of point of view usually equal.

When there is parallax images of two eye image and the right eye image, the number of viewpoint is "2".

However, point of view, even in two, assumed position of the user's head is one.

Similarly, when displaying a three-dimensional image in consideration of the user's movement in the lateral direction, for example, assume viewpoint va least 4, vb, vc, and vd in the lateral direction, Ia, Ib, Ic, Id parallax image viewed from each Assuming, for example, three-dimensional image with a feeling of depth by the parallax image of three sets (Ia, Ib) (Ib, Ic) (Ic, Id) of can be displayed.

Further, if in order to generate a stereoscopic image that wrap around the vertical direction, and

using the four images as viewed from the direction of the relative on four images as viewed from the direction of the bottom in the same manner in this state, The number of point of view is "8".

[0010]

Group as defined above, embodiments of the present invention relates to a stereoscopic image processing method.

This method can be regarded as a technology on the encoding side should be called the starting point of the distribution of the stereoscopic image.

This method is for adding a (also referred to as "three-dimensional information" hereinafter) information for basic image for displaying a stereoscopic image, to be referred to in the context of a predetermined in a series of processes for displaying the stereoscopic image some.

[0011]

By "addition", can be incorporated into the basic image, or may be incorporated in a region of the header and other basic image is, or is associated with the basic image short to be incorporated, such as a separate file associated with the basic image it is sufficient to provide the relationship.

Examples of "When given in a series of processes for displaying a stereoscopic image" is a scene, for example, converted to multiplex images side-by-side images.

[0012]

According to this method, by referring to the stereo information, it is possible to display a stereoscopic image in a proper way.

In order to be prepared foundation many images in this way, it is possible to three-dimensional display information various terminals takes out the data, the method serves as a basic technology for stereoscopic image distribution.

For example, the method is available in the stereoscopic image server.

[0013]

Another aspect of the present invention relates to the structure of the image data generated by the method described above.

Information to be referred to in the context of a predetermined in a series of processes for displaying the main data of the basic image for displaying a stereoscopic image, the stereoscopic image, namely the data structure, the sub data held in the three-dimensional information and is formed as a combination of.

The main data may be one that has been compressed in a predetermined manner the basic image.

By "combination", in addition to the case of integral, both sufficient that associates made some to both.

With this data structure, as described above, the stereoscopic display is easily realized by the display side.

[0014]

Another aspect also relates to a stereoscopic image processing method of the present invention further.

This method shall be utilized in interpreting the data structures described above, ie, may be regarded as a technique for decoding side to display a stereoscopic image in general.

This method is one in which information to be referred is added to the basic image for displaying a stereoscopic image, at the scene of a predetermined in a series of processes for displaying the stereoscopic image, that is, detecting the three-dimensional information.

To facilitate detection, the addition of the three-dimensional information may be made in accordance with a predetermined format that is agreed with the encoding side in advance.

Further, the method may be converted to another aspect of the configuration of the base image based on the three-dimensional information is detected.

[0015]

Another aspect also relates to a stereoscopic image processing method of the present invention further.

When dealing with three-dimensional image by the device having a memory, the system retains to the memory the basic image of a manner different configurations of the basic image to be finally displayed on the screen, the method reads it as appropriate It is intended to use this in.

For example, multiplex even though the image is used for the display of three-dimensional image, when you want treated in the expansion to the other three-dimensional image, there may be more of a side-by-side format is convenient than a multiplexed format.

In that case, the high-speed processing can be realized and if I hold the side-by-side images to memory.

[0016]

Another aspect also relates to a stereoscopic image processing method of the present invention further.

This method, informational use was added to the basic image for displaying a stereoscopic image, at the scene of a predetermined in a series of processes for displaying the stereoscopic image, that detects three-dimensional information, the information I want to adjust the brightness of the display screen of a three-dimensional image based on.

For example, it is possible to put the information on the number of viewpoints as the three-dimensional information, which is assumed in the stereoscopic image may be adjusted according to the number of luminance.

[0017]

And is "4" if the number of viewpoints, multiplex images are formed by combining the parallax four images.

The number of pixels viewed from a viewpoint of any one remains at 1/4 when viewing a two-dimensional image of the normal of the four perspectives.

Accordingly, brightness of the screen is 1/4 of the theoretical normal.

Therefore, treatment for increasing the brightness of the screen of the display device according to the number of viewpoints is enabled.

This processing is done by the cooperation of the circuit for adjusting the brightness and software for detecting a number of viewpoints.

[0018]

Another aspect relates to a three-dimensional image processing apparatus to the present invention.

It is intended to prepare the encoding side the stereo image, an image acquisition unit for acquiring a basic image for displaying a stereoscopic image, the basic image acquired, the device is set to display the stereoscopic image information to be referred to in the context of a given in the process, that includes an information adding unit for adding the three-dimensional information.

And may generate a basic image itself, and the image acquisition unit can input the basic image of the ready-made.

[0019]

Another aspect also relates to three-dimensional image processing apparatus to the present invention.

It is to carry out a pre-treatment therefor, or, actually displays a stereoscopic image, an image acquisition unit for acquiring a basic image for displaying a stereoscopic image, the apparatus was attached to the base image that is acquired, information to be referred to in the context of a predetermined in a series of processes for displaying the stereoscopic image, that includes an information detecting unit that detects three-dimensional information.

For example, the image acquisition unit inputs or get a basic image from such as a recording medium or network.

Well, the image acquisition unit and also information detected include an image input unit for inputting image data which has been compressed in advance, and an image decompression unit for generating a basic image by decompressing the image data input It may include a brightness adjusting unit for adjusting the luminance of the display screen of the stereoscopic image bets.

[0020]

Another aspect relates to a stereoscopic image processing system to the present invention.

Wherein the display device and the synthesis device of the stereoscopic image, the synthesizer, the system information on the basic image for displaying a stereoscopic image, to be referred to in the context of a predetermined in a series of processes for displaying the stereoscopic image , that incorporates a three-dimensional information, and performs image processing appropriate to the basic image based on this by detecting the three-dimensional information, the display device displays the stereoscopic image.

Examples of the image processing, there is a change of mode of the structure of the basic image.

The system may be a server-client system.

The system can contribute to promoting the distribution of three-dimensional image.

[0021]

Another aspect relates to a stereoscopic image processing method of the present invention further.

Information to be referred to in the context of a given in the series of processing for displaying a stereoscopic image by taking a basic image for displaying a stereoscopic image, and examining the part of the basic image, the method, namely It is to estimate the three-dimensional information.

Unlike the case you have described up to now, you are thinking of processing in the case of three-dimensional information is not added explicitly here.

Therefore, a portion of the basic image is examined actually.

By way of example, to determine the region of some of the basic image, which is estimated whether or not the side-by-side images.

[0022]

According to this method, even if the three-dimensional information is not given explicitly, it is possible to know that the basic image.

Thus it is possible to make use of the previous image that was created by a general method, effective use of software assets can be achieved.

[0023]

Note, also intended to methods, apparatuses combination of any of the components described above, the representation of the present invention, a system, computer program, recording medium, such as a transmission medium, it is effective as an embodiment of the present invention.

[0024]

When an image is displayed on the LCD [embodiment of the invention, usually, the smallest unit of display is a dot.

However, a single pixel is formed of three dots corresponding to the RGB gathered, pixels are conscious as the smallest unit of processing in image processing or image display normal.

[0025]

However, when displaying the stereoscopic image LCD, it is necessary to consider another.

Through an optical filter, such as a parallax barrier or lenticular lens, left-eye image and right eye image, and reaches the user's eyes with a parallax.

In pixels, that is, when are alternately arranged in three units of dots image of left and right eyes, between the visible area is only the left-eye image and the visible area only the right eye image, the visible area of the image of both occurs, colors mixed, I will be very hard to see.

Therefore, the arrangement of the alternating dot-unit is a minimum display physical elements is desirable.

Therefore, the multiplex image as a basic image to be three-dimensional display, and are alternately arranged left-eye image and right eye image dot by dot is used in many cases.

[0026]

If the parallax image consists of only two pieces of the left eye image and the right eye image, that is, when the horizontal number of viewpoints is "2", multiplex image shall be sufficient to Haisure in stripes in dot units left eye image and the right eye image.

However, the number of viewpoints is "4", to display a stereoscopic image in consideration of the viewpoint movement in the horizontal direction by using parallax four images, as shown in FIG 1, the parallax barrier that is placed in front of the screen 10 By 12, it appears that only the dots of the parallax images corresponding VP1 ~ 4 from the viewpoint of the first to fourth.

The screen 10 shows denoted by the "1" of dots first parallax images corresponding to the viewpoint VP1 first, and the same applies to the following viewpoint.

In this example, the disparity image of the first to fourth are arranged in stripes in the order in dot units, multiplex image is formed.

[0027]

Further, when considering the viewpoint also moves in the vertical direction, the parallax barrier 12 is the pin hole arranged in a matrix instead of the stripe, it becomes a matrix multiplex images even replaced dot by dot.

Figure 2 shows an example of a multiplex image 20 in the case of "4" in both the horizontal number of viewpoints, the vertical viewing points.

Here, regions, denoted (i, j) and shows dots to appear from the first view point j in the vertical

direction and the i-th viewpoint in the horizontal direction.

As in the figure, the horizontal direction, i is changed cyclically 1,2,3,4,1, ... and, in the vertical direction, j is 1,2,3,4,1 similarly , ... I will change cyclically and.

[0028]

When considering the use promotion of the stereoscopic image, may be sent to the required terminal multiplex image 20 shown in FIG 2.

Because if the multiplex image 20, it is the final form to the stereoscopic already, it is sufficient if just display it on the terminal side.

At this time, I have to assume the existence of the optical filter of the parallax barrier, etc. for stereoscopic viewing of course.

[0029]

However, the present inventor has recognized that one problem arises here.

That is, when transmitting, it is to be compressed image data of course, in the case of multiplex image 20, and that the lossy compression of normal typified JPEG format (Joint Photographic Expert Group) is not available in nature.

This is because the plurality of parallax images are multiplexed, since the image of the view that each different, they are essentially independent of considering the pixel level, it is compressed by a method that relies on spatial frequency such as JPEG, the pains In spite of using parallax images independent from the viewpoint, the high frequency component is stripped between the images thereof, stereoscopic display correct result can not be performed.

In particular, when arranged alternately on a pixel-by-pixel basis the image of independent, high-frequency component is very fine because the resulting number, this problem is fatal in some cases.

Bandwidth of the network is said to have spread, when it can be compressed without problems, it becomes that it can not be compressed by the basic image for a stereoscopic image, a normal image is a drag on the spread.

[0030]

So, I can be considered as a compressible format, use of the side-by-side image is higher in the case of send or save.

Figure 3 shows a side-by-side image 30 having four perspectives in both the horizontal and vertical directions.

Here, regions, denoted (i, j) and represents the parallax one image to be visible from the j-th viewpoint in the vertical direction and the i-th viewpoint in the horizontal direction.

That side-by-side images 30, which was synthesized in the form of juxtaposed in both directions or one direction of the horizontal or vertical parallax images, if Kiritore from the side-by-side images 30 that each parallax image functions as a single image.

[0031]

However, since the parallax images may be compatible with only one of the viewing point of the 4 × 4 = 16, may be a size of 1/16 of the image size to be displayed as a stereoscopic image, the original of the same size as the three-dimensional image, usually from the image, for each of the horizontal and vertical directions, and is generated by selecting one dot 4 of every other dot.

In terms of easy-to-understand example, the case of multiplex image consisting of only the left eye image and the right eye image of "2", well, the number of viewpoints is visible only dot in the even-numbered columns from the left eye only dot in the odd-numbered columns if Miele from the right eye Bayoi.

Thus, good, the left-eye image may also be taken out only the even-numbered columns in the same manner as long as it has been decimated to 1/2 in the horizontal direction is taken out by an odd number of columns of the original image in advance the right-eye image.

In general the number of point of view is 'n' may be in the 1 / n of the image size of the original, and then returns to the image size of the original just if juxtaposition as tile parallax images of all the parallax images that make up the side-by-side image.

[0032]

In the case of side-by-side images 30, the parallax images are independent with the exception of the boundary, even when lossy compression, adverse effect occurs only at the boundary portion at best.

Therefore, it is compressed by JPEG or the like side-by-side 30, or easily transmit through the network, usually will be able to store a number in a small storage.

Thus, side-by-side image 30 is suitably spread surface, but there are drawbacks to the contrary, it is that it requires a special viewer.

That is, the display device of any three-dimensional display can not be and is not converted to multiplex the image and finally the conversion process to multiplex the image is required of side-by-side images 30.

[0033]

In addition to the two forms having the advantages and disadvantages of the above, the spread surface, is considered a separate image as a form of a third view of the preparation images.

Separate images may form a three-dimensional image as a collection, but only two-dimensional images of normal by itself.

Figure 4 shows the relationship between the three-dimensional image and a separate 16 images.

Of the 16 pieces, separate images 32, labeled such as "image viewpoint of (4,2)", which has assumed the (4,2) viewpoint, the image size is the same as the original image.

Therefore, separate 16 images is easy to understand considering the camera images taken while the user moves respectively.

[0034]

Thus, since its size may remain at the time of shooting, without requiring processing such as thinning synthesis, preparation is easy to separate the image.

Further, to remain in its original state, can be used separately alone each image.

However, in the case of a stereoscopic display, it takes a parallax 16 images in total, as well as being disadvantageous in terms of transmission and storage, a special viewer is required again.

[0035]

It is a major form three possible when the spread of the three-dimensional image or more.

These variants as described Finally, below, when the basic image is represented by one of three types of these will be described the three-dimensional image processing method for implementing technical stereoscopic display and promote.

Hereinafter, the horizontal viewpoint number "2", the vertical number of viewpoints illustrates a case of "1" for the sake of simplicity.

[0036]

Respectively, of the basic image according to the present embodiment, Figure 5, Figure 6, Figure 7 schematically shows the data structure of separate images 60 and 62 set at 50, 2 pieces side by side images 40, multiplexed images.

[0037]

As shown in FIG 5, the side-by-side images 40, one synthesized horizontally with the first parallax image 44 is a left-eye image and a second parallax image 46 is a right-eye image, the header region 42 to be described later to the image data is added have been.

Header region 42 follow the same format is also added to the multiplexed image 50 in FIG 6 as well.

The separate images 60, 62 in two of FIG 7, the header region 42 are respectively added.

In either case, the data structure, the sub-holding the information to be referenced to the main

data is a basic image for displaying a stereoscopic image, at the scene of a predetermined in a series of processes for displaying the stereoscopic image It can be considered as combination of the data.

When it is one of the main data is compressed by a predetermined method the basic image, the sub-data may be stored in the header area as defined in the compression method.

If the provisions of the header area already exists, I can be out of the area, for example to use a user-defined area.

[0038]

Figure 8 schematically shows a detailed structure of the header region 42.

In this figure, each region holds three-dimensional information below.

I will show aspects of the configuration and dimensions of the basic image with three bits: 70 (1) DIM area.

Reserve 1xx:: 011 Side-by-side image of the three-dimensional image: 010 multiplex image of the three-dimensional image: 001 two-dimensional image in general that can not be stereoscopic or separate image: 000 as an example of the type reserved reserve, as a side-by-side image while juxtaposed the plurality of parallax images, but is juxtaposed remains of the original image without thinning any parallax images and their "Joint image", the parallax image to be displayed alternately in a time division parallax images in even and odd fields It is believed that indicates that it is like "field sequential image".

It is observed in the cross method or the parallel method is often "Joint image", since it can also be tools for converting side-by-side image by thinning at the viewer, it is converted to a multiplex image directly, it is effective as one format .

[0039]

I will show the presence of the border processing of side-by-side image in one bit: (2) BDL region 72.

DIM is meaningful when the "01x".

No one border processing: 0 Gotoku above Yes border processing, when lossy compression side-by-side image, image may be adversely affected by the boundary.

To alleviate this, it shows the processing shown in the next section as to whether or not made.

[0040]

I will show the contents of the boundary treatment of side-by-side image of two bits: 74 (3) HDL area.

BDL is meaningful when the "1".

11 is placed by copying the pixels of the edge: 10 Add black frame: 01 Add a white frame: 00 to reduce the adverse effect of reserve compression and mixed in a plurality of parallax images to put white frame, a black frame or the like in the boundary portion reduce.

There is an effect of the same copy of the pixels in the end.

[0041]

I specify the number of pixels of border processing of side-by-side image of two bits: 76 (4) WDT area.

BDL is meaningful when it is "1".

I will show a horizontal view number is expected to three-dimensional image in 8-bit: 78 (5) VPH area number of pixels: 00-11.

It may be described manually when you create a basic image, and software to generate the basic image may be automatically generated.

I shows a vertical view number is expected to three-dimensional image in 8-bit: 80 (6) VPV area horizontal number of viewpoints: 00000001-11111111 reserve or unknown: 00000000.

The vertical number of viewpoints, when the 00000001, VPV and VPH may determine the two-dimensional image of the normal that can not be stereopsis basic image together: 00000001-

11111111 reserve or unknown: 00000000.

[0042]

I will show a sequence of horizontal direction of a plurality of parallax images in one bit: (7) ODH area 82.

1 the same as the sequence of the camera at the time of photography: 0 that is opposite to the alignment of the camera during shooting, parallax image when it is "0", was captured by the camera of most left during shooting ODH is best left side in the basic image as it is It is recorded in, and are sequentially recorded later.

Because it is unlikely that the normal arrangement is that random, and may be a provision of two kinds.

[0043]

I will show a sequence of vertical direction of a plurality of parallax images in one bit: (8) ODV region 84.

1 as the sequence of camera shooting: 0 it is considered VPV and VPH on the number of viewpoints GyakuNao to the alignment of the camera shooting, the above is 8 bits wide, it is too usually enough, the most significant of these It may be assigned ODH, the ODV each bit.

[0044]

Each separate image indicates whether the image of the ordinal number of the viewpoint position in the horizontal direction 8 bits: 86 (9) PSH region.

Makes sense when the "000" is DIM.

The position in the horizontal direction, the origin was determined for each separate image, well, that, for example, also incorporates the header area 42 separate absolute values, such as the coordinates of the point of the upper left corner of the image: 00000001-11111111 reserve or unknown: 00000000 If, leading to high-speed processing.

[0045]

Each separate image indicates whether the image of the ordinal number of the viewpoint position in the vertical direction by 8 bits: 88 (10) PSV region.

Separedo image that has been referred to as "the point of view of the image (4,2)" in Figure 4 is made to the description of PSH = 4, PSV = 2 For example, the position in the vertical direction: 00000001-11111111 reserve or unknown: 00000000.

[0046]

The above is an example of the header region 42.

Will be described an apparatus for implementing a flow of a stereoscopic image using the region.

Figure 9 shows the configuration of the image processing apparatus 100 that generates the region.

An image acquisition unit 102 acquires the basic image for displaying a stereoscopic image, the basic image acquired scene predetermined in a series of processes for displaying a stereoscopic image, the apparatus 100 includes a display side after such and an information adding unit 104 adds the three-dimensional information to be referred in the context of generating a multiplexed image in device.

In terms of hardware, it can be implemented by LSI CPU of any computer, memory and other, this configuration is realized by a program with the three-dimensional information and additional functions basic image generation features that are memory-loaded in terms of software It is however, depicts functional blocks that are realized in cooperation with them here.

Thus, the hardware only, software only, or functional blocks may be implemented in a variety of forms by combinations thereof, which can be appreciated by those skilled in the art.

Accordingly, those below, not explicitly shown the name of configuration, may be considered such as is done by the control unit centered on the CPU.

[0047]

Enter the original image from an image source such as a digital camera user and the network, the image acquisition unit 102 generates a basic image by processing, or the basic image as it is.

For example, if a separate image is required, may be used as the basic image as the original image simply.

On the other hand, if the side-by-side image is required, it is synthesized by a plurality of juxtaposed the original image.

If multiplex image is required, I reconstruct in a matrix and stripes parallax images from each viewpoint.

[0048]

Furthermore, the image acquisition unit 102 compresses as needed basis images obtained.

It may prohibit compressed when it is determined prior to that, it is determined affect whether leaving the quality of the stereoscopic image compression, and leaves.

For example, when compressing For spatial frequency multiplexed images may be compressed after or prohibit compressed and converted into side-by-side image once it.

[0049]

Or recorded on a storage device which adds the header information described above to the basic image so obtained, not shown, the image data for stereoscopic display is obtained as a result, the information adding unit 104, a predetermined network I deliver to the point.

As described above, according to the apparatus 100, it is possible for a person who wishes to stereoscopic display, to prepare the basic image with a three-dimensional information in advance.

[0050]

The image acquisition unit 102, not necessarily to get to the first original image necessarily.

The input from the network, such as those that are multiplexed image it already detects the three-dimensional information, it is determined that it is a multiplex image, recognizes that it is not suitable for compression as is, it processing compressed after conversion to the side-by-side image, and rewrites the stereoscopic information is also possible.

In this case, the device 100 can also be used as the contact point of the three-dimensional image distribution.

[0051]

On the other hand, FIG 10 shows a configuration of the image processing apparatus 200 of the decoding side to perform a stereoscopic display in practice.

An image acquisition unit 202 acquires the basic image for displaying a stereoscopic image, the apparatus 200, the reference is added to the basic image obtained at the scene of a predetermined in a series of processes for displaying a stereoscopic image I and information detection unit 204 that detects what to do three-dimensional information.

The apparatus 200 is a terminal of the user side is typically the image acquisition unit 202 acquires the basic image of the three-dimensional information has already been added.

When inputting the image data that has been pre-compressed, the image acquisition unit 202 may reproduce or generate a basic image by stretching it.

[0052]

It then parses the header area added to the basic image information detection unit 204 to detect three-dimensional information.

From the three-dimensional information of the detection that the basic image is not multiplexed image if found, it is converted to a multiplexed image the basic image, the apparatus 200 displays a stereoscopic image.

As an optional feature that, among the three-dimensional information that is specifically detected

based on the vertical view number and the horizontal number of viewpoints, according to discussion of the luminance of the above, the display screen of the device 200 the device 200 (not shown) It may be increased brightness.

[0053]

The device 200 may be used not only display of a stereoscopic image simply store the basic image of course, to edit.

Upon storage, and may be stored in terms of converting the side-by-side picture Other This was rewritten three-dimensional information basic image is in the multiplex image.

Sometimes when editing, for example, want to scale the image.

At that time, the processing to be multiplexed image since complicated, it is converted into side-by-side images once this is subjected to predetermined image processing Thereafter, it may be displayed back to the multiplex image sequence.

[0054]

Note that in order to achieve the convenience of image processing such edit other images in the form of multiplexed images except Retain the storage memory or other always side-by-side images in particular, the apparatus 200, it appropriately as required may be read and use.

[0055]

As additional configurations of the apparatus 200, by providing a characteristic acquiring unit that acquires the data characteristics such as the optimum viewing distance and view point number with the display device, the convenience is further increased.

For example, when that of the display device and the expected number of viewpoints of the basic image are different, it is possible to provide a display image selecting unit for automatically selecting a parallax image to be displayed from the basic image based on the characteristics of the.

Expected number of viewpoints of basic image is "4", it of the display device is "2", I choose the two parallax images from the four.

Not necessarily the viewpoint successive parallax these two images, to emphasize a three-dimensional impression, it is also possible to select two images that flew viewpoint rather.

"2" is that of the display device a number of views of the basic image is "4", is space available stereoscopic viewing screen front by twice portions display the same parallax image.

[0056]

The image processing device 200, if provided with a position detector for detecting the head position of the observer viewing the display screen further, the display image selecting unit changes the parallax image to be selected according to the head position , it is possible to show an image crowded around the viewer.

[0057]

Also, if possible optical filter is replaced, for example, the display portion of the device 200 may be provided to unit optically reading the display including information such as the number of viewpoints is pattern-printed on the optical filter.

When indicating the discrepancy between the view number of the parallax image, data read may be displayed and optimized appropriately parallax images as described above, or may be displayed to prompt the replacement of the optical filter.

[0058]

Figure 11 shows the configuration of a network system 300 for the three-dimensional image distribution.

Synthesizer 302 is an image processing apparatus 100 of FIG 9, and acts as a starting point for the distribution here.

On the other hand, the display device 304 is an image processing apparatus 200 in FIG 10, and

acts as the end point of the flow.

As in the figure, by having the storage device 306 synthesizer 302 many records basic image, and acts as the image server, the user can be readily obtained via the network 308 of the Internet and other three-dimensional image of the desired .

[0059]

Or more, I has been described in conjunction with the embodiments of the present invention.

These embodiments are illustrative and that the scope of the present invention also such variations will be appreciated by those skilled in the art that various modifications are possible in the combination of each component and process thereof By the way I am certain.

Below, I'll give a few such cases.

[0060]

Features of the image processing apparatus 100 and 200 in FIG 10 and FIG 9 may be provided to the user in the form of a computer program, respectively.

If the user wishes to create their own basic image, may be provided to the user in terms trimmed as authoring tool the function of the image processing apparatus 100 in FIG.

[0061]

The bits including the number of degrees of freedom is large, of course the structure of the header area 42 shown in FIG.

For example, it is possible to further incorporate conditions such optical filters, such as lenticular lens and parallax barrier suitable for viewing the copyright information and the basic image of the basic image to be observed by the user as, 3D images can be satisfied.

Examples of "optical filter conditions to be satisfied", the distance between the point of view of the disparity image, that is, such as the angle of view of the camera at the time of shooting and

distance between eyes.

These conditions are essential parameters for the design of the optical filter if you want to play to scale in the longitudinal direction of the stereoscopic image.

Also in selection of an image when a number of views of the basic image of the above is greater than the number of viewpoints of the display device, it can be referred to so as to select the image that gives a more natural three-dimensional effect.

[0062]

Was the multiplexed image stereoscopic image to be eventually displayed in the embodiment, the image to be displayed varies with the observation method.

Therefore, it may be displayed in a conversion process to an image with various image is compatible with the observation method.

For example, when using a liquid crystal shutter glasses, the image to be displayed is a field sequential image.

Further, the head mounted display, a stereoscopic image to be displayed becomes a separate image, of the type having a display unit separate to correspond to the right and left eyes is transmitted to the display unit, respectively, by the image output unit separately.

I can also use the head-mounted display of one display device displays a side-by-side image.

In this case, it may be constituted by optical means, and the image is separated into left and right halves, as is observed is enlarged in the horizontal direction.

Further, in the observation method crossing method, and parallel method, it may be displayed joint image.

[0063]

In an embodiment, the device side for displaying a stereoscopic image, that is, the image processing apparatus 200 in FIG 10, treatment was initiated on the assumption that three-dimensional information is added to the basic image.

However, if there is a basic image existing not according to the present embodiment if, because it does not have a header area characteristic of the embodiment is provided with a test-estimation processing unit for checking the basic image, which image it is possible to estimate the three-dimensional information on the side of the processing apparatus 200.

For example, whether or not the side-by-side images, divided into n equal parts and m equally dividing the horizontal and vertical directions and image may be evaluated while changing the values of m and n the similarity of the image of each region .

Degree of approximation of the part is higher each region or for a set of n and some m, which can be estimated to be side-by-side image horizontal number of viewpoints m, the vertical number of viewpoints n.

For example, evaluation of the degree of approximation, by the sum of squared differences of pixel values.

In addition to this, it can try to act a differential filter to the basic image, a boundary line between regions emerge also be considered, there may estimate whether the side-by-side images can be thereby.

[0064]

According to the present invention, the distribution of the three-dimensional image can be promoted.

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CLAIMS JP2003111101

[0001]

Three-dimensional image processing method which comprises adding information on the basic image for displaying a stereoscopic image, to be referred to in the context of a predetermined in a series of processes for displaying the stereoscopic image.

[0002]

The method of claim 1, characterized in that the information to be the reference, the information about the dimensions of the base image is included.

[0003]

The method of claim 1, characterized in that the information to be the reference, the information about the mode of construction of the base image is included.

[0004]

Or a side-by-side format that combines the basic image is juxtaposed a plurality of parallax images, information relating to the embodiments, or a multiplex format were synthesized to form the three-dimensional display can finally plurality of parallax images The method of claim 3,

wherein the information indicating whether a type other than these, and the like.

[0005]

The method of claim 1, characterized in that the information to be the reference, information about the number of viewpoints that are assumed in the three-dimensional image is included.

[0006]

The method of claim 1, characterized in that the information to be the reference, the information about the arrangement of the base image is included.

[0007]

The method of claim 1, characterized in that the information to be the reference, the information about the position of the stereoscopic image of the base image is included.

[0008]

That it is formed as a combination of the sub data that holds information to be referred to in the context of a predetermined main data of the basic image for displaying a stereoscopic image, in a series of processes for displaying the stereoscopic image data structure for the stereoscopic image features.

[0009]

The main data is one which has been compressed by a predetermined method the basic image, wherein the sub data is the data structure according to claim 8, characterized in that it is stored in the header area for the compressed data.

[0010]

Three-dimensional image processing method characterized by detecting the information to be referred is added to the base image for displaying a stereoscopic image, at the scene of a predetermined in a series of processes for displaying the stereoscopic image.

[0011]

The method of claim 10, characterized in that it converts to another aspect of the structure of the basic image on the basis of information to be the reference for the detected].

[0012]

When it has been found that the information to be the reference is detected, it is not in multiplexed form the basic image is synthesized in a three-dimensional display ready form claims, characterized in that it is converted to multiplex form which The method according to claim 11.

[0013]

When compressing, wherein the basic image, and in that it based on the information to be the reference of the detected and compressed as is the basic image to determine whether or not affect the stereoscopic image The method of claim 10.

[0014]

When it is determined that the compression as is the wherein the basic image is to affect the three-dimensional image, converting it to another aspects of the structure of the basic image on the basis of information to be the reference of the detected The method of claim 13, wherein.

[0015]

The method according to any one of the preceding claims 10, characterized in that to get the basic image by extending it by obtaining image data that has already compressed].

[0016]

When performing predetermined image processing on] the basic image, and the process is from the information to be the reference is detected, if found to be side-by-side format that synthesized the basic image is juxtaposed a plurality of images to claim 10, wherein applying the processing after converting the side-by-side format Once this is performed, if found to be multiplex format synthesized stereoscopic display ready form multiple images of the basic image the method described.

[0017]

When dealing with three-dimensional image by the device having a memory, the system retains to the memory the basic image of a manner different configurations of the basic image to be finally displayed on the screen to read and use it appropriately three-dimensional image processing method, which is characterized by.

[0018]

Different embodiments, wherein the method according to claim 17, characterized in that a side-by-side format that was synthesized by juxtaposing a plurality of parallax images.

[0019]

Detecting the information to be referred is added to the base image for displaying a stereoscopic image, at the scene of a predetermined in a series of processes for displaying the stereoscopic image, the stereoscopic image based on the information three-dimensional image processing method characterized by adjusting the luminance of the display screen.

[0020]

Information about the number of viewpoints that are assumed in the three-dimensional image is contained in the information to be] the reference, the method according to claim 19, characterized in that it is adjusted depending on the number of the luminance.

[0021]

Information adding information and image acquisition unit for acquiring a basic image for displaying a stereoscopic image, the basic image obtained, to be referred to in the context of a predetermined in a series of processes for displaying the stereoscopic image three-dimensional image processing apparatus, characterized in that it comprises, an additional unit.

[0022]

Information to be referred to an image acquisition unit for acquiring a basic image for displaying a stereoscopic image, are added to the basic image obtained at the scene of a predetermined in a series of processes for displaying the stereoscopic image three-dimensional image processing apparatus, characterized in that it comprises an information detecting unit for detecting.

[0023]

Wherein said image acquisition unit, apparatus according to claim 22, characterized in that generating the basic image by inputting the image data that has been pre-compressed, decompressing the image data.

[0024]

A system including a display device and the synthesis device of stereoscopic images, the basic image for displaying a stereoscopic image, the composite device, referred to in the context of a predetermined in a series of processes for displaying the stereoscopic image Embedded what to do information, the display device, three-dimensional image processing system characterized in

that it performs image processing appropriate to the basic image based on this by detecting the information to be the reference, and displaying the stereoscopic image .

[0025]

And characterized in that it estimates the information to be referred to in the context of a predetermined in a series of processes for displaying the stereoscopic image by taking a basic image for displaying a stereoscopic image, to test the basic image three-dimensional image processing method for.

[0026]

Computer program characterized in that it allowed to run on a computer a process of adding information to the basic image for displaying a stereoscopic image, to be referred to in the context of a predetermined in a series of processes for displaying the stereoscopic image.

[0027]

Computer program characterized in that it allowed to detect the computer, information to be referred is added to the base image for displaying a stereoscopic image, at the scene of a predetermined in a series of processes for displaying the stereoscopic image.

[0028]

It is allowed to estimate the computer, information to be referred to in the context of a predetermined in a series of processes for displaying the stereoscopic image by taking a basic image for displaying a stereoscopic image, to test the basic image computer program which is characterized.

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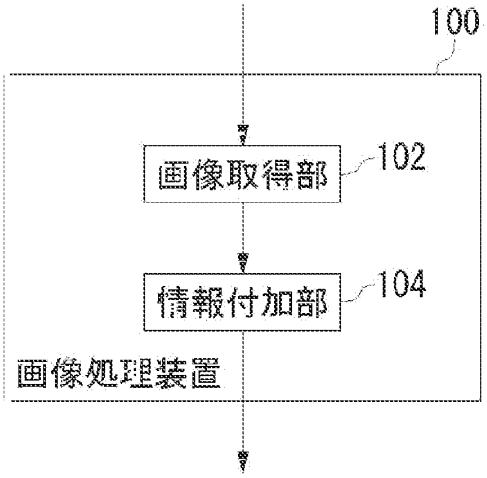
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最終頁に続く

(54)【発明の名称】　立体画像処理方法、装置、およびシステム

(57)【要約】
【課題】　立体画像の流通促進のためのインフラが整っていない。
【解決手段】　画像処理装置１００は、画像取得部１０２と情報付加部１０４を有する。画像取得部１０２は立体表示できる基礎画像を外部から取得し、またはオリジナル画像を取得してこれを基礎画像へ変換する。情報付加部１０４は、基礎画像の構成や想定視点数など、立体視の際に参照すべき情報を画像データのヘッダに記録する。



【特許請求の範囲】

【請求項１】　立体画像を表示するための基礎画像に、前記立体画像を表示するための一連の処理における所定の場面にて参照すべき情報を付加することを特徴とする立体画像処理方法。

【請求項２】　前記参照すべき情報に、前記基礎画像の次元に関する情報が含まれることを特徴とする請求項１に記載の方法。

【請求項３】　前記参照すべき情報に、前記基礎画像の構成の態様に関する情報が含まれることを特徴とする請求項１に記載の方法。

【請求項４】　前記態様に関する情報は、前記基礎画像が複数の視差画像を並置して合成したサイドバイサイド形式であるか、複数の視差画像を最終的に立体表示可能な形に合成したマルチプレクス形式であるか、またはそれら以外の形式であるかを示す情報が含まれることを特徴とする請求項３に記載の方法。

【請求項５】　前記参照すべき情報に、前記立体画像に想定された視点の数に関する情報が含まれることを特徴とする請求項１に記載の方法。

【請求項６】　前記参照すべき情報に、前記基礎画像の並びに関する情報が含まれることを特徴とする請求項１に記載の方法。

【請求項７】　前記参照すべき情報に、前記基礎画像の前記立体画像における位置に関する情報が含まれることを特徴とする請求項１に記載の方法。

【請求項８】　立体画像を表示するための基礎画像の主データと、前記立体画像を表示するための一連の処理における所定の場面にて参照すべき情報を保持する副データとの組合せとして形成されていることを特徴とする立体画像のためのデータ構造。

【請求項９】　前記主データは前記基礎画像を所定の手法にて圧縮したものであり、前記副データはその圧縮データに対するヘッダ領域に格納されることを特徴とする請求項８に記載のデータ構造。

【請求項１０】　立体画像を表示するための基礎画像に付加された、前記立体画像を表示するための一連の処理における所定の場面にて参照すべき情報を検出することを特徴とする立体画像処理方法。

【請求項１１】　検出された前記参照すべき情報をもとに前記基礎画像の構成の態様を別のものに変換することを特徴とする請求項１０に記載の方法。

【請求項１２】　検出された前記参照すべき情報から、前記基礎画像がそのまま立体表示可能な形に合成されたマルチプレクス形式ではないことが判明したとき、これをマルチプレクス形式に変換することを特徴とする請求項１１に記載の方法。

【請求項１３】　前記基礎画像を圧縮する際、検出された前記参照すべき情報をもとに、前記基礎画像を現状のまま圧縮することが前記立体画像に影響するか否かを判定することを特徴とする請求項１０に記載の方法。

【請求項１４】　前記基礎画像を現状のまま圧縮することが前記立体画像に影響すると判定されたとき、検出された前記参照すべき情報をもとに前記基礎画像の構成の態様を別のものに変換することを特徴とする請求項１３に記載の方法。

【請求項１５】　予め圧縮されていた画像データを取得してこれを伸張することによって前記基礎画像を取得することを特徴とする請求項１０から１４のいずれかに記載の方法。

【請求項１６】　前記基礎画像に対して所定の画像処理を施す際、検出された前記参照すべき情報から、前記基礎画像が複数の画像を並置して合成したサイドバイサイド形式であると判明すればそのまま当該処理を施し、前記基礎画像が複数の画像をそのまま立体表示可能な形に合成したマルチプレクス形式であると判明すれば一旦これをサイドバイサイド形式に変換した後に当該処理を施すことを特徴とする請求項１０に記載の方法。

【請求項１７】　メモリを有する装置にて立体画像を扱う際、画面に最終的に表示される基礎画像の構成の態様とは異なる態様の基礎画像を前記メモリへ保持しておき、適宜これを読み出して利用することを特徴とする立体画像処理方法。

【請求項１８】　前記異なる態様は、複数の視差画像を並置して合成したサイドバイサイド形式であることを特徴とする請求項１７に記載の方法。

【請求項１９】　立体画像を表示するための基礎画像に付加された、前記立体画像を表示するための一連の処理における所定の場面にて参照すべき情報を検出し、その情報をもとに前記立体画像の表示画面の輝度を調整することを特徴とする立体画像処理方法。

【請求項２０】　前記参照すべき情報には前記立体画像に想定された視点の数に関する情報が含まれ、前記輝度をその数に応じて調整することを特徴とする請求項１９に記載の方法。

【請求項２１】　立体画像を表示するための基礎画像を取得する画像取得部と、
取得された基礎画像に、前記立体画像を表示するための一連の処理における所定の場面にて参照すべき情報を付加する情報付加部と、
を含むことを特徴とする立体画像処理装置。

【請求項２２】　立体画像を表示するための基礎画像を取得する画像取得部と、
取得された基礎画像に付加された、前記立体画像を表示するための一連の処理における所定の場面にて参照すべき情報を検出する情報検出部と、
を含むことを特徴とする立体画像処理装置。

【請求項２３】　前記画像取得部は、予め圧縮されていた画像データを入力し、この画像データを伸張することによって前記基礎画像を生成することを特徴とする請求

項２２に記載の装置。
【請求項２４】　立体画像の合成装置と表示装置を含むシステムであって、
前記合成装置は、立体画像を表示するための基礎画像に、前記立体画像を表示するための一連の処理における所定の場面にて参照すべき情報を組み込み、
前記表示装置は、前記参照すべき情報を検出してこれをもとに前記基礎画像に適宜画像処理を施し、前記立体画像を表示することを特徴とする立体画像処理システム。
【請求項２５】　立体画像を表示するための基礎画像を取得し、この基礎画像を検査することによって前記立体画像を表示するための一連の処理における所定の場面にて参照すべき情報を推定することを特徴とする立体画像処理方法。
【請求項２６】　立体画像を表示するための基礎画像に、前記立体画像を表示するための一連の処理における所定の場面にて参照すべき情報を付加する処理をコンピュータに実行せしめることを特徴とするコンピュータプログラム。
【請求項２７】　立体画像を表示するための基礎画像に付加された、前記立体画像を表示するための一連の処理における所定の場面にて参照すべき情報を、コンピュータに検出せしめることを特徴とするコンピュータプログラム。
【請求項２８】　立体画像を表示するための基礎画像を取得し、この基礎画像を検査することによって前記立体画像を表示するための一連の処理における所定の場面にて参照すべき情報を、コンピュータに推定せしめることを特徴とするコンピュータプログラム。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】この発明は立体画像処理技術に関し、とくに、立体画像を処理または表示する方法、装置、システムおよび関連するコンピュータプログラムとデータ構造に関する。
【０００２】
【従来の技術】ここ数年、インターネット利用人口が急増し、インターネット利用の新たなステージともいえるブロードバンド時代に入ろうとしている。ブロードバンド通信では通信帯域が格段に広がるため、従来敬遠されがちだった重い画像データの配信も盛んになる。「マルチメディア」や「ビデオ・オン・デマンド」などの概念は提起されて久しいが、ブロードバンド時代になって、はじめてこれらのことばが一般のユーザに実感をもって体験される状況になった。
【０００３】画像、とくに動画像の配信が広がれば、ユーザは当然ながらコンテンツの充実と画質の向上を求める。これらは、既存の映像ソフトのデジタル化とそのためのオーサリングツールの開発、高効率かつロスの少ない画像符号化技術の追求などに負うところが大きい。
【０００４】
【発明が解決しようとする課題】こうした状況下、近い将来画像配信サービスのひとつの形態として、擬似三次元画像（以下単に「立体画像」ともいう）の配信が技術的に注目され、かつ相当の市場を獲得することが考えられる。立体画像は、よりリアルな映像を求めるユーザの希望を叶え、とくに映画やゲームなど臨場感を追求するアプリケーションでは魅力的である。さらに立体画像は、２１世紀の商取引のひとつの標準になると思われるＥＣ（電子商取引）における商品プレゼンテーションにおいて、商品のリアルな表示にも有用である。
【０００５】しかしながら、立体画像の配信という新しいネットビジネスを考えたとき、そのためのインフラストラクチャもビジネス推進のためのモデルもまだ存在しないといってもよい。本発明者はそうした現状に着目して本発明をなしたものであり、その目的は、立体画像の流通促進を技術的側面から可能にするための立体画像処理技術を提供することにある。
【０００６】
【課題を解決するための手段】本発明の理解のために、まず本明細書における以下の概念を定義する。
「立体画像」：　画像データそのものではなく、立体的に表示された結果、ユーザの目に投ずる画像を観念的に指す。立体画像として表示できる画像データのほうは、後述する「マルチプレクス画像」とよぶ。すなわち、マルチプレクス画像を表示すると、立体画像が見える。
「視差画像」：　通常、奥行き感のある立体視のためには、視差が生じるよう右目に投ずるべき画像（以下、単に右目画像という）と左目に投ずるべき画像（以下、単に左目画像という）を準備する必要がある。右目画像と左目画像のように視差を生じさせる画像の対を視差画像と総称する場合もあるが、本明細書では、視差を生じさせる原因となる画像それぞれを視差画像とよぶ。つまり、右目画像も左目画像もそれぞれ視差画像である。これら以外にも、一般には、立体画像において想定された各視点からの画像がそれぞれ視差画像となる。
【０００７】「基礎画像」：　立体画像が表示されるために、立体視に必要な処理をなす対象の画像、またはすでに処理がなされた画像をいう。具体的な例として、後述のセパレート形式の視差画像の他、マルチプレクス形式またはサイドバイサイド形式のごとく、すでに複数の視差画像が何らかの形で合成されてできた画像（これらを「合成画像」ともいう）を含む。
「サイドバイサイド形式」：　基礎画像の構成の態様のひとつ。複数の視差画像を水平方向、垂直方向またはそれらの両方向に並置して合成した形式。通常は間引きされた視差画像を並置する。例えば水平方向に２枚の視差画像を並置して構成する場合，それぞれの視差画像を水平方向に一画素ごとに間引く。サイドバイサイド形式の基礎画像を単に「サイドバイサイド画像」ともよぶ。

【０００８】「マルチプレクス形式」：　基礎画像の構成の態様のひとつ。立体画像を表示するための最終的な画像データの形式。マルチプレクス形式の基礎画像を単に「マルチプレクス画像」ともよぶ。

「セパレート形式」：　基礎画像の構成の態様のひとつ。単独の二次元画像だが、他の二次元画像と組み合わされて立体視されることが想定されており、それら複数の二次元画像のそれぞれを指す。「セパレート形式」の基礎画像を単に「セパレート画像」ともよぶ。セパレート画像はマルチプレクス画像やサイドバイサイド画像と違い、合成画像ではない。

【０００９】「視点」：　立体画像にはそれを見る視点が想定されている。視点の数と視差画像の数は通常等しい。左目画像と右目画像のふたつの視差画像があるとき、視点の数は「２」である。ただし、視点がふたつでも、ユーザの頭の想定位置はひとつである。同様に、左右方向のユーザの移動を考慮した立体画像を表示する場合、例えば左右方向に４つの視点ｖａ、ｖｂ、ｖｃ、ｖｄを想定し、それぞれから見える視差画像をＩａ、Ｉｂ、Ｉｃ、Ｉｄとすれば、例えば（Ｉａ，Ｉｂ）（Ｉｂ，Ｉｃ）（Ｉｃ，Ｉｄ）の３組の視差画像によって奥行き感のある立体画像が表示できる。この状態でさらに、上下方向に回り込んだ立体画像を生成するために、相対的に上の方向から見た４つの画像と、同様に下の方向から見た４つの画像を利用するとすれば、視点の数は「８」となる。

【００１０】以上の定義のもと、本発明のある態様は、立体画像処理方法に関する。この方法は、立体画像の流通の起点ともいうべき符号化側の技術と把握することができる。この方法は、立体画像を表示するための基礎画像に、その立体画像を表示するための一連の処理における所定の場面にて参照すべき情報（以下「立体情報」ともいう）を付加するものである。

【００１１】「付加する」とは、基礎画像の中に組み込んでもよいし、基礎画像のヘッダその他の領域に組み込んでもよいし、基礎画像と関連づけられた別ファイルなどに組み込んでもよく、要するに基礎画像との対応関係を設ければよい。「立体画像を表示するための一連の処理における所定の場面」の例は、例えばサイドバイサイド画像をマルチプレクス画像へ変換する場面である。

【００１２】この方法によれば、立体情報を参照することにより、適切な方法で立体画像を表示することができる。この方法で多数の基礎画像を準備すれば、種々の情報端末がそのデータを取りだして立体表示できるため、この方法は立体画像流通のための基礎技術として働く。この方法は、例えば立体画像サーバにて利用可能である。

【００１３】本発明の別の態様は、上述の方法によって生成された画像データの構造に関する。このデータ構造は、立体画像を表示するための基礎画像の主データと、その立体画像を表示するための一連の処理における所定の場面にて参照すべき情報、すなわち立体情報を保持する副データとの組合せとして形成されている。主データは基礎画像を所定の手法にて圧縮したものであってもよい。「組合せ」とは、両者が一体の場合の他、両者に何らかの関連づけがなされていればよい。このデータ構造によれば、上述のごとく、表示側にて容易に立体表示が実現する。

【００１４】本発明のさらに別の態様も立体画像処理方法に関する。この方法は、上述のデータ構造を解釈して利用するもの、すなわち一般には立体画像を表示する復号側の技術と把握することができる。この方法は、立体画像を表示するための基礎画像に付加された、その立体画像を表示するための一連の処理における所定の場面にて参照すべき情報、すなわち立体情報を検出するものである。検出を容易にするために、立体情報の付加は予め符号化側と合意された所定の形式にしたがってなされてもよい。この方法はさらに、検出された立体情報をもとに基礎画像の構成の態様を別のものに変換してもよい。

【００１５】本発明のさらに別の態様も立体画像処理方法に関する。この方法は、メモリを有する装置にて立体画像を扱う際、画面に最終的に表示される基礎画像の構成の態様とは異なる態様の基礎画像を前記メモリへ保持しておき、適宜これを読み出して利用するものである。例えば、立体画像の表示にマルチプレクス画像が用いられても、その立体画像に拡大その他の処理を施したいとき、マルチプレクス形式よりもサイドバイサイド形式のほうが好都合なことがある。その場合、メモリにはサイドバイサイド画像を保持しておけば処理の高速化が実現する。

【００１６】本発明のさらに別の態様も立体画像処理方法に関する。この方法は、立体画像を表示するための基礎画像に付加された、その立体画像を表示するための一連の処理における所定の場面にて参照すべき情報、すなわち立体情報を検出し、その情報をもとに立体画像の表示画面の輝度を調整する。たとえば、立体情報として、立体画像に想定された視点の数に関する情報を入れておき、輝度をその数に応じて調整してもよい。

【００１７】仮に視点数が「４」であると、４枚の視差画像を合成してマルチプレクス画像が形成される。４つの視点のうちいずれかひとつの視点から見える画素数は通常の二次元画像を見た場合の１／４にとどまる。したがって、画面の輝度は理論上通常の１／４となる。このため、視点数に応じて表示装置の画面の輝度を高める処理が有効になる。この処理は、例えば視点数を検出するソフトウエアと輝度を調整する回路の協働によってなされる。

【００１８】本発明のさらに別の態様は、立体画像処理装置に関する。この装置は、立体画像を準備する符号化側のものであり、立体画像を表示するための基礎画像を

取得する画像取得部と、取得された基礎画像に、その立体画像を表示するための一連の処理における所定の場面にて参照すべき情報、すなわち立体情報を付加する情報付加部とを含む。画像取得部は、自ら基礎画像を生成してもよいし、既製の基礎画像を入力してもよい。

【００１９】本発明のさらに別の態様も立体画像処理装置に関する。この装置は、立体画像を実際に表示し、またはそのための前処理を行うものであり、立体画像を表示するための基礎画像を取得する画像取得部と、取得された基礎画像に付加された、その立体画像を表示するための一連の処理における所定の場面にて参照すべき情報、すなわち立体情報を検出する情報検出部とを含む。画像取得部は、たとえばネットワーク経由または記録媒体などから基礎画像を取得または入力する。画像取得部は、予め圧縮されていた画像データを入力する画像入力部と、入力された画像データを伸張することによって基礎画像を生成する画像伸張部とを含んでもよく、検出された情報をもとに前記立体画像の表示画面の輝度を調整する輝度調整部を含んでもよい。

【００２０】本発明のさらに別の態様は、立体画像処理システムに関する。このシステムは立体画像の合成装置と表示装置を含み、合成装置は、立体画像を表示するための基礎画像に、その立体画像を表示するための一連の処理における所定の場面にて参照すべき情報、すなわち立体情報を組み込み、表示装置は、立体情報を検出してこれをもとに基礎画像に適宜画像処理を施し、立体画像を表示する。画像処理の例として、基礎画像の構成の態様の変更がある。本システムはサーバ・クライアントシステムであってもよい。本システムは立体画像の流通促進に寄与できる。

【００２１】本発明のさらに別の態様は立体画像処理方法に関する。この方法は、立体画像を表示するための基礎画像を取得し、この基礎画像の一部を検査することによって立体画像を表示するための一連の処理における所定の場面にて参照すべき情報、すなわち立体情報を推定するものである。いままでに述べた場合とは異なり、ここでは立体情報が明示的に付加されていない場合の処理を考えている。そのため、基礎画像の一部が実際に検査される。一例として、基礎画像上のいくつかの領域を調べることにより、これがサイドバイサイド画像であるか否かが推定される。

【００２２】この方法によれば、明示的に立体情報が与えられていない場合でも、基礎画像からそれを知ることができる。したがって一般的な手法で作成された過去の画像を利用することができ、ソフト資産の有効活用が図られる。

【００２３】なお、以上の構成要素の任意の組合せ、本発明の表現を方法、装置、システム、コンピュータプログラム、記録媒体、伝送媒体などの間で変換したものもまた、本発明の態様として有効である。

【００２４】

【発明の実施の形態】ＬＣＤに画像を表示するとき、通常、表示の最小単位はドットである。しかし、ＲＧＢに対応する３個のドットが集まってひとつのピクセルが形成され、通常の画像表示または画像処理ではピクセルが処理の最小単位として意識される。

【００２５】しかし、立体画像をＬＣＤに表示する場合、別の配慮が必要になる。右目画像と左目画像は、レンチキュラーレンズやパララックスバリアなどの光学フィルタを通して、視差をもってユーザの目に到達する。左右両目の画像をピクセル単位、すなわち３ドット単位で交互に配置すると、右目画像のみが見える領域と左目画像だけが見える領域との間に、両方の画像が見える領域が発生し、色も混ざり、非常に見にくくなる。そのため、物理的な最小表示要素であるドット単位による交互の配置が望ましい。そこで、立体表示すべき基礎画像として、ドット単位で右目画像と左目画像を交互に配置したマルチプレクス画像が利用されることが多い。

【００２６】視差画像が右目画像と左目画像の２枚のみからなる場合、すなわち水平視点数が「２」の場合、マルチプレクス画像は右目画像と左目画像をドット単位でストライプ状に配すれば足りる。しかし、視点数が「４」で、４枚の視差画像をもちいて水平方向の視点移動を考慮した立体画像を表示する場合、図１に示すごとく、画面１０の前におかれたパララックスバリア１２により、第１～第４の視点ＶＰ１～４からそれぞれ対応する視差画像のドットのみが見える。画面１０では、第１の視点ＶＰ１に対応する第１の視差画像のドットに「１」を付して示しており、以下の視点でも同様である。この例では、第１～第４の視差画像がドット単位で順にストライプ状に配され、マルチプレクス画像が形成される。

【００２７】さらに、垂直方向にも視点移動を考えたとき、パララックスバリア１２はストライプ状ではなくマトリクス状に並ぶピンホールになり、マルチプレクス画像もドット単位で入れ替わるマトリクス状になる。図２は、水平視点数、垂直視点数ともに「４」の場合のマルチプレクス画像２０の例を示す。ここで、（ｉ，ｊ）と表記される領域は、それぞれ水平方向の第ｉ視点、かつ垂直方向の第ｊ視点から見えるべきドットを示す。同図のごとく、水平方向には、ｉが１、２、３、４、１、・・・とサイクリックに変化し、同様に垂直方向には、ｊが１、２、３、４、１、・・・とサイクリックに変化する。

【００２８】立体画像の利用促進を考えた場合、図２に示すマルチプレクス画像２０を必要な端末に送信すればよい。マルチプレクス画像２０であれば、すでに立体視するための最終形式になっているため、端末側ではそれを単に表示すれば済む。もちろんこのとき、立体視のためにパララックスバリア等の光学フィルタの存在を仮定

している。

【0029】しかし本発明者は、ここでひとつ問題が生ずることを認識した。すなわち、送信に際して、当然ながら画像データを圧縮すべきであるが、マルチプレクス画像20の場合、JPEG (Joint Photographic Expert Group) を代表とする通常の非可逆圧縮が事実上利用できないことである。なぜなら、マルチプレクスされた複数の視差画像は、それぞれ違う視点の画像であるから、画素レベルで考えるとそれらは本質的に無関係であり、JPEG等の空間周波数に依拠する手法で圧縮すると、せっかく各視点からの独立した視差画像を利用したにも拘わらず、それらの画像間で高周波成分がそぎ落とされ、結果的に正しい立体表示ができなくなる。とくに、独立した画像を画素単位で交互に並べたとき、非常に細かい高周波成分が多数生じるから、この問題は場合により致命的である。ネットワークの帯域が広がっているとはいえ、通常の画像は問題なく圧縮できるときに、立体画像のための基礎画像だけは圧縮できないとなれば、普及の足かせとなる。

【0030】そこで、送信や保存の場合で圧縮可能な形式として、サイドバイサイド画像の利用度が高くなることが考えられる。図3は水平、垂直とも4つの視点をもつサイドバイサイド画像30を示す。ここで、(i, j) と表記される領域は、それぞれ水平方向の第i視点、かつ垂直方向の第j視点から見えるべき一枚の視差画像を示す。すなわちサイドバイサイド画像30は、視差画像を水平または垂直の一方向か両方向に並置する形で合成したものであり、各視差画像は、それをサイドバイサイド画像30から切り取れば、一枚の画像として機能する。

【0031】ただし、各視差画像は4×4=16の視点のひとつのみに対応すればよいため、立体画像として表示すべき画像サイズの1/16のサイズでよく、通常は立体画像と同じサイズのオリジナルの画像から、水平方向と垂直方向のそれぞれについて、4ドットおきに1ドットを選んで生成される。わかりやすい例でいえば、視点数が「2」の右目画像と左目画像だけからなるマルチプレクス画像の場合、右目からは奇数列のドットのみが見えればよく、左目からは偶数列のドットのみが見えればよい。したがって、右目画像は予めオリジナルの画像から奇数列だけを取り出して水平方向に1/2に間引かれたものであればよく、左目画像も同様に偶数列だけを取り出せばよい。一般に視点の数が「n」なら、サイドバイサイド画像を構成する各視差画像はオリジナルの画像サイズの1/nでよく、すべての視差画像をタイルのように並置すればちょうどオリジナルの画像サイズに戻る。

【0032】サイドバイサイド画像30の場合、各視差画像がその境界を除いて独立しているため、非可逆圧縮をしても、悪影響はせいぜい境界部分にしか生じない。そのため、通常はサイドバイサイド30をJPEG等によって圧縮し、ネットワークを介して容易に送信したり、小さなストレージでも多数保存できるようになる。このように、サイドバイサイド画像30は普及面で好適であるが、逆に欠点もあり、それは特別なビュアを要する点である。すなわち、いずれの表示装置でも、最終的にはマルチプレクス画像に変換しないと立体表示ができず、サイドバイサイド画像30からマルチプレクス画像への変換処理が必要になる。

【0033】以上の一長一短を有するふたつの形式に加え、普及面、とくに画像の準備の観点から第3の形式としてセパレート画像が考えられる。セパレート画像は、集合体として立体画像を形成できるが、単独では通常の二次元画像に過ぎない。図4は16枚のセパレート画像と立体画像との関係を示す。16枚のうち、例えば「視点(4, 2)の画像」と表記されたセパレート画像32は、視点(4, 2)を想定したもので、その画像サイズはオリジナルの画像と同じである。したがって、16枚のセパレート画像は、それぞれユーザが移動しながら撮影したカメラ画像と考えればわかりやすい。

【0034】このように、セパレート画像はそのサイズが撮影時のままでよいため、間引きや合成といった処理を必要とせず、準備は楽である。また、それぞれの画像はオリジナルの状態で残るため、単独で別途利用できる。しかし、立体表示の場合、全体で16枚の視差画像を要するため、伝送や保存の面では不利であり、また、やはり特別なビュアが必要になる。

【0035】以上が立体画像の普及にあたって考えられる主要な3形式である。これらの変形は最後に述べるとして、以下、基礎画像がこれらの3形式のいずれかで表現されているとき、普及促進および立体表示を技術的に実現するための立体画像処理方法を説明する。以下、簡単のために水平視点数が「2」、垂直視点数が「1」の場合を例示する。

【0036】図5、図6、図7はそれぞれ、本実施の形態に係る基礎画像のうち、サイドバイサイド画像40、マルチプレクス画像50、2枚でセットのセパレート画像60、62のデータ構造を模式的に示す。

【0037】図5に示すごとく、サイドバイサイド画像40は、左目画像である第1視差画像44と、右目画像である第2視差画像46を水平に合成したもので、その画像データに後述するヘッダ領域42が付加されている。同様に図6のマルチプレクス画像50にも同じフォーマットにしたがうヘッダ領域42が付加されている。図7のふたつのセパレート画像60、62には、それぞれヘッダ領域42が付加されている。いずれの場合も、このデータ構造は、立体画像を表示するための基礎画像である主データと、その立体画像を表示するための一連の処理における所定の場面にて参照すべき情報を保持する副データとの組合せと考えることができる。なお、こ

の主データが基礎画像を所定の手法にて圧縮したものである場合、副データはその圧縮手法において規定されるヘッダ領域に格納されてもよい。ヘッダ領域の規定がすでに存在する場合、その領域のうち例えばユーザ定義領域を利用することができる。

【００３８】図８はヘッダ領域４２の詳細構成を模式的に示す。同図において、各領域は以下の立体情報を保持する。

（１）ＤＩＭ領域７０：　３ビットで基礎画像の次元および構成の態様を示す。

０００：　セパレート画像または立体視できない二次元画像全般

００１：　三次元画像のうちマルチプレクス画像

０１０：　三次元画像のうちサイドバイサイド画像

０１１：　リザーブ

１ｘｘ：　リザーブ

リザーブされる形式の例として、サイドバイサイド画像のように複数の視差画像を並置しながら、ただしそれらの視差画像を一切間引かないオリジナル画像のまま並置する「ジョイント画像」や、偶数フィールドと奇数フィールドで視差画像を時分割で交互に表示すべき視差画像であることを示す「フィールドシーケンシャル画像」などが考えられる。「ジョイント画像」は平行法や交差法で観察されることが多いが、ビュアで間引きしてサイドバイサイド画像に変換したり、直接マルチプレクス画像へ変換することもできるため、ひとつのフォーマットとして有効である。

【００３９】（２）ＢＤＬ領域７２：　１ビットでサイドバイサイド画像の境界処理の有無を示す。ＤＩＭが「０１ｘ」のときに意味をもつ。

０：　境界処理なし

１：　境界処理あり

前述ごとく、サイドバイサイド画像を非可逆圧縮するとき、その境界部分で画像が悪影響を受ける。これを軽減するために、次項で示す処理がなされているか否かを示す。

【００４０】（３）ＨＤＬ領域７４：　２ビットでサイドバイサイド画像の境界処理の内容を示す。ＢＤＬが「１」のときに意味をもつ。

００：　白枠を入れる

０１：　黒枠を入れる

１０：　端の画素をコピーして入れる

１１：　リザーブ

圧縮による悪影響を低減するため、境界部分に白枠、黒枠等を入れて複数の視差画像の混じりを減らす。端の画素のコピーも同様の効果がある。

【００４１】（４）ＷＤＴ領域７６：　２ビットでサイドバイサイド画像の境界処理の画素数を指定する。ＢＤＬが「１」のとき意味をもつ。

００～１１：　画素数

（５）ＶＰＨ領域７８：　８ビットで立体画像に想定された水平視点数を示す。基礎画像の作成時に手動で記述してもよいし、基礎画像を生成するソフトウエアが自動生成してもよい。

００００００００：　不明またはリザーブ

００００００００１～１１１１１１１１：　水平視点数

（６）ＶＰＶ領域８０：　８ビットで立体画像に想定された垂直視点数を示す。

００００００００：　不明またはリザーブ

００００００００１～１１１１１１１１：　垂直視点数

なお、ＶＰＨとＶＰＶがともに００００００００１のとき、基礎画像は立体視のできない通常の二次元画像と判断してもよい。

【００４２】（７）ＯＤＨ領域８２：　１ビットで複数の視差画像の水平方向の並びを示す。

０：　撮影時のカメラの並びと同じ

１：　撮影時のカメラの並びと逆

つまり、ＯＤＨが「０」のとき、撮影時いちばん左側のカメラで撮影された視差画像がそのまま基礎画像においてもいちばん左側に記録されており、以降順に記録されている。通常並びがランダムということは考えにくいため、２種類の規定でよい。

【００４３】（８）ＯＤＶ領域８４：　１ビットで複数の視差画像の垂直方向の並びを示す。

０：　撮影時のカメラの並びと同じ

１：　撮影時のカメラの並びと逆

なお、前述の視点数に関するＶＰＨとＶＰＶがともに８ビットであり、通常は十分すぎると考えられるため、これらの最上位ビットをそれぞれＯＤＨ、ＯＤＶに割り当ててもよい。

【００４４】（９）ＰＳＨ領域８６：　８ビットで各セパレート画像が水平方向において何番目の視点位置の画像であるかを示す。ＤＩＭが「０００」のときに意味がある。

００００００００：　不明またはリザーブ

００００００００１～１１１１１１１１：　水平方向の位置

なお、各セパレート画像上に決められた原点、例えば画像の左上角の点の座標のような絶対値を別途ヘッダ領域４２に盛り込んでもよく、その場合、処理の高速化につながる。

【００４５】（１０）ＰＳＶ領域８８：　８ビットで各セパレート画像が垂直方向において何番目の視点位置の画像であるかを示す。

００００００００：　不明またはリザーブ

００００００００１～１１１１１１１１：　垂直方向の位置

例えば図４で「視点（４，２）の画像」と表記されたセパレード画像は、ＰＳＨ＝４、ＰＳＶ＝２という記述になる。

【００４６】以上がヘッダ領域４２の一例である。この領域を利用して立体画像の流通を実現するための装置を説明する。図９はこの領域を生成する画像処理装置１００の構成を示す。この装置１００は、立体画像を表示するための基礎画像を取得する画像取得部１０２と、取得された基礎画像に、立体画像を表示するための一連の処理における所定の場面、例えば後に表示側の装置にてマルチプレクス画像を生成する場面において参照すべき立体情報を付加する情報付加部１０４とを含む。この構成は、ハードウエア的には、任意のコンピュータのＣＰＵ，メモリ、その他のＬＳＩで実現でき、ソフトウエア的にはメモリのロードされた基礎画像生成機能および立体情報付加機能のあるプログラムなどによって実現されるが、ここではそれらの連携によって実現される機能ブロックを描いている。したがって、これらの機能ブロックがハードウエアのみ、ソフトウエアのみ、またはそれらの組合せによっていろいろな形で実現できることは、当業者には理解されるところである。したがって、以下、構成の名称を明示的に示さないものは、例えばＣＰＵを中心とする制御部によってなされると考えてよい。

【００４７】画像取得部１０２は、ネットワークやユーザのデジタルカメラなどの画像ソースからオリジナル画像を入力し、これをそのまま基礎画像とするか、または加工して基礎画像を生成する。例えばセパレート画像が必要な場合、単にオリジナル画像をそのまま基礎画像とすればよい。一方、サイドバイサイド画像が必要な場合、オリジナル画像を複数並置して合成する。マルチプレクス画像が必要な場合、各視点からの視差画像をストライプ状やマトリクス状に再構成する。

【００４８】画像取得部１０２はさらに、得られた基礎画像を必要に応じて圧縮する。それに先立ち、圧縮によって立体画像の画質に影響が出るか否かを判定し、出ると判定したときは圧縮を禁止してもよい。例えばマルチプレクス画像を空間周波数成分に関して圧縮する場合、圧縮を禁止したり、これを一旦サイドバイサイド画像へ変換した後圧縮してもよい。

【００４９】情報付加部１０４は、そうして得られた基礎画像に前述のヘッダ情報を付加し、その結果得られた立体表示のための画像データを図示しない記憶装置へ記録したり、ネットワーク経由で所定の個所へ配信する。以上、この装置１００によれば、立体表示を望む者のために、予め立体情報の付いた基礎画像を準備することができる。

【００５０】なお、画像取得部１０２は、必ずしもオリジナル画像を最初に入手するとは限らない。すでにマルチプレクス画像になっているものをネットワーク等から入力し、その立体情報を検出し、それがマルチプレクス画像であることを判定し、そのままの状態では圧縮の不向きであることを認識し、これをサイドバイサイド画像に変換した後圧縮し、立体情報を書き換えるといった処理も可能である。その場合、この装置１００は立体画像流通の中継点として利用することもできる。

【００５１】一方、図１０は、実際に立体表示を行う復号側の画像処理装置２００の構成を示す。この装置２００は、立体画像を表示するための基礎画像を取得する画像取得部２０２と、取得された基礎画像に付加された、立体画像を表示するための一連の処理における所定の場面にて参照すべき立体情報を検出する情報検出部２０４とを含む。この装置２００は典型的にはユーザ側の端末であり、画像取得部２０２は、すでに立体情報が付加された基礎画像を取得する。画像取得部２０２は、予め圧縮されていた画像データを入力したとき、これを伸張することによって基礎画像を生成または再生してもよい。

【００５２】つづいて、情報検出部２０４がその基礎画像に付加されたヘッダ領域をパースし、立体情報を検出する。検出した立体情報から、この基礎画像がマルチプレクス画像でないことが判明すれば、この装置２００はこの基礎画像をマルチプレクス画像へ変換し、立体画像を表示する。この装置２００はそのオプショナルな機能として、検出された立体情報のうちとくに水平視点数と垂直視点数をもとに、前述の輝度に関する考察にしたがい、この装置２００の表示画面（図示せず）の輝度を高めてもよい。

【００５３】この装置２００は、単に立体画像の表示だけでなく、当然ながら基礎画像を保存、編集することもできる。保存の際、基礎画像がマルチプレクス画像であればこれをサイドバイサイド画像その他へ変換し、立体情報を書き換えたうえで保存してもよい。編集の際、例えば画像を拡大縮小したいことがある。そのとき、マルチプレクス画像であると処理は煩雑であるから、これをいったんサイドバイサイド画像へ変換し、しかる後に所定の画像処理を施し、最後にマルチプレクス画像へ戻して表示してもよい。

【００５４】なおこの装置２００は、こうした編集その他の画像処理の便宜を図るべく、マルチプレクス画像以外の形式の画像、とくにサイドバイサイド画像を常時メモリその他の記憶装置に保持しておき、必要に応じて適宜これを読み出して利用すればよい。

【００５５】この装置２００の付加的な構成として、表示装置のもつ視点数や最適観察距離などの特性をデータとして取得する特性取得部を設ければ、さらに利便性が増す。例えば基礎画像の想定視点数と表示装置のそれとが異なる場合、前記の特性をもとに基礎画像から表示すべき視差画像を自動的に選択する表示画像選択部を設けることができる。基礎画像の想定視点数が「４」で、表示装置のそれが「２」であれば、４つの視差画像からふたつを選択する。これらふたつの視差画像は連続する視点のものである必要はなく、立体感を強調するには、むしろ視点を飛ばした２画像を選択してもよい。基礎画像の視点数が「２」で表示装置のそれが「４」であれば、

同じ視差画像を２回づつ表示することで画面正面に立体視が可能な領域を確保できる。

【００５６】さらにこの画像処理装置２００が、表示画面を見る観察者の頭部位置を検出する位置検出部を備えていれば、表示画像選択部は、頭部位置に合わせて選択すべき視差画像を変化させ、観察者に回りこんだ画像を見せることもできる。

【００５７】また、光学フィルタが取り替え可能な場合、例えばこの装置２００の表示部に、光学フィルタにパターン印刷された視点数などの情報を含む表示を光学的に読み取る読取部を設けてもよい。読み取られたデータが、視差画像の視点数との不一致を示唆するとき、上述のように視差画像を適宜最適選択および表示してもよいし、光学フィルタの取り替えを促す表示を行ってもよい。

【００５８】図１１は、立体画像流通のためのネットワークシステム３００の構成を示す。ここで合成装置３０２は図９の画像処理装置１００であり、流通の起点として作用する。一方、表示装置３０４は図１０の画像処理装置２００であり、流通の終点として作用する。同図のごとく、合成装置３０２が基礎画像を多数記録する記憶装置３０６をもち、画像サーバとして振る舞うことにより、ユーザは所望の立体画像をインターネットその他のネットワーク３０８を介して容易に取得することができる。

【００５９】以上、本発明を実施の形態をもとに説明した。これらの実施の形態は例示であり、それらの各構成要素や各処理プロセスの組合せにいろいろな変形例が可能なこと、またそうした変形例も本発明の範囲にあることは当業者に理解されるところである。以下、そうした例をいくつか挙げる。

【００６０】図９や図１０の画像処理装置１００、２００の機能はそれぞれコンピュータプログラムの形でユーザへ提供することができる。ユーザが基礎画像を自ら生成したい場合、図９の画像処理装置１００の機能をオーサリングツールとして整えたうえでユーザへ提供すればよい。

【００６１】図８で示したヘッダ領域４２の構成はビット数も含め、当然自由度が大きい。例えば、

・立体画像としてユーザから観察される基礎画像の著作権情報

・基礎画像を見るのにふさわしいパララックスバリアやレンチキュラーレンズなどの光学フィルタが満たすべき条件

などをさらに組み込むことができる。「光学フィルタが満たすべき条件」の例として、視差画像の視点間距離、すなわち眼間距離や撮影時のカメラの画角などがある。こうした条件は、立体画像を前後方向に正しいスケールで再生したい場合の光学フィルタの設計には必須のパラメータである。また、前述の基礎画像の視点数が表示装置の視点数より多い場合の画像の選択においても、より自然な立体感が得られる画像を自動的に選択するために参照することができる。

【００６２】実施の形態では最終的に表示する立体画像をマルチプレクス画像としたが、表示すべき画像は観察方法により変わる。したがって、さまざまな画像が観察方法に適合した画像に変換処理されて表示されてもよい。例えば液晶シャッタメガネを用いる場合、表示すべき画像はフィールドシーケンシャル画像である。また、ヘッドマウントディスプレイで、左右の目に対応して別々の表示手段をもつタイプのものでは、表示する立体画像はセパレート画像となり、別々の画像出力手段によりそれぞれの表示手段に送られる。表示装置がひとつのヘッドマウントディスプレイで、サイドバイサイド画像を表示することもできる。この場合、光学的な手段により、画像が左半分と右半分に分離され、かつ、水平方向に拡大されて観察されるように構成すればよい。さらに、交差法、平行法といった観察方法では、ジョイント画像を表示すればよい。

【００６３】実施の形態では、立体画像を表示する側の装置、すなわち図１０の画像処理装置２００は、基礎画像に立体情報が付加されている前提で処理を開始した。しかし、仮に本実施の形態によらない既存の基礎画像があれば、これは実施の形態に特徴的なヘッダ領域を有さないため、その基礎画像を検査する検査・推定処理部を設け、画像処理装置２００の側で立体情報を推定してもよい。例えばサイドバイサイド画像であるか否かは、画像を水平方向および垂直方向にそれぞれm等分およびn等分し、それぞれの領域の画像の近似度をmとnの値を変えながら評価してもよい。あるmとnの組について各領域またはその一部の近似度が高ければ、これは水平視点数m、垂直視点数nのサイドバイサイド画像と推定できる。近似度の評価は、例えば画素値の差分二乗和による。このほかにも、基礎画像に微分フィルタを作用させてみて、領域の境界線が浮かび上がることも考えられ、それによってサイドバイサイド画像であるか否かの推定ができる場合もある。

【００６４】

【発明の効果】本発明によれば、立体画像の流通が促進できる。

【図面の簡単な説明】

【図１】　ユーザが水平方向にマルチプレクスされた４枚の視差画像を立体視する状態を示す図である。

【図２】　マルチプレクス画像を示す図である。

【図３】　サイドバイサイド画像を示す図である。

【図４】　複数のセパレート画像の集合を示す図である。

【図５】　実施の形態によるサイドバイサイド画像の構成を模式的に示す図である。

【図６】　実施の形態によるマルチプレクス画像の構成

を模式的に示す図である。

【図７】　実施の形態によるセパレート画像の構成を模式的に示す図である。

【図８】　実施の形態によって基礎画像に付加されたヘッダ領域の構成図である。

【図９】　実施の形態に係る、画像流通の起点となる画像処理装置の構成図である。

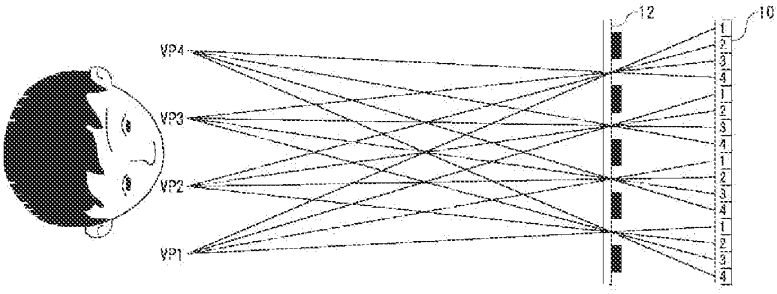
【図１０】　実施の形態に係る、画像流通の終点となる画像処理装置の構成図である。

【図１１】　図９の画像処理装置を合成装置、図１０の画像処理装置を表示装置とする画像流通のためのネットワークシステムの構成を示す図である。

【符号の説明】

１２　パララックスバリア、　２０，４０　マルチプレクス画像、　３０，５０　サイドバイサイド画像、　３２，６０，６２　セパレート画像、　４２　ヘッダ領域、　１００，２００　画像処理装置、　１０２，２０２　画像取得部、１０４　情報付加部、　２０４　情報検出部、　３００　ネットワークシステム、　３０２　合成装置、　３０４　表示装置、　３０６　記憶装置。

【図１】



【図３】

(1, 4)	(2, 4)	(3, 4)	(4, 4)
(1, 3)	(2, 3)	(3, 3)	(4, 3)
(1, 2)	(2, 2)	(3, 2)	(4, 2)
(1, 1)	(2, 1)	(3, 1)	(4, 1)

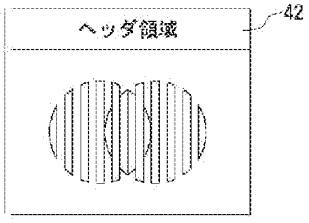
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【図２】

(1, 4)	(2, 4)	(3, 4)	(4, 4)	(1, 4)	(2, 4)	(3, 4)	(4, 4)	(1, 4)	(2, 4)	(3, 4)	(4, 4)	(1, 4)	(2, 4)	(3, 4)	(4, 4)
(1, 3)	(2, 3)	(3, 3)	(4, 3)	(1, 3)	(2, 3)	(3, 3)	(4, 3)	(1, 3)	(2, 3)	(3, 3)	(4, 3)	(1, 3)	(2, 3)	(3, 3)	(4, 3)
(1, 2)	(2, 2)	(3, 2)	(4, 2)	(1, 2)	(2, 2)	(3, 2)	(4, 2)	(1, 2)	(2, 2)	(3, 2)	(4, 2)	(1, 2)	(2, 2)	(3, 2)	(4, 2)
(1, 1)	(2, 1)	(3, 1)	(4, 1)	(1, 1)	(2, 1)	(3, 1)	(4, 1)	(1, 1)	(2, 1)	(3, 1)	(4, 1)	(1, 1)	(2, 1)	(3, 1)	(4, 1)
(1, 4)	(2, 4)	(3, 4)	(4, 4)	(1, 4)	(2, 4)	(3, 4)	(4, 4)	(1, 4)	(2, 4)	(3, 4)	(4, 4)	(1, 4)	(2, 4)	(3, 4)	(4, 4)
(1, 3)	(2, 3)	(3, 3)	(4, 3)	(1, 3)	(2, 3)	(3, 3)	(4, 3)	(1, 3)	(2, 3)	(3, 3)	(4, 3)	(1, 3)	(2, 3)	(3, 3)	(4, 3)
(1, 2)	(2, 2)	(3, 2)	(4, 2)	(1, 2)	(2, 2)	(3, 2)	(4, 2)	(1, 2)	(2, 2)	(3, 2)	(4, 2)	(1, 2)	(2, 2)	(3, 2)	(4, 2)
(1, 1)	(2, 1)	(3, 1)	(4, 1)	(1, 1)	(2, 1)	(3, 1)	(4, 1)	(1, 1)	(2, 1)	(3, 1)	(4, 1)	(1, 1)	(2, 1)	(3, 1)	(4, 1)
(1, 4)	(2, 4)	(3, 4)	(4, 4)	(1, 4)	(2, 4)	(3, 4)	(4, 4)	(1, 4)	(2, 4)	(3, 4)	(4, 4)	(1, 4)	(2, 4)	(3, 4)	(4, 4)
(1, 3)	(2, 3)	(3, 3)	(4, 3)	(1, 3)	(2, 3)	(3, 3)	(4, 3)	(1, 3)	(2, 3)	(3, 3)	(4, 3)	(1, 3)	(2, 3)	(3, 3)	(4, 3)
(1, 2)	(2, 2)	(3, 2)	(4, 2)	(1, 2)	(2, 2)	(3, 2)	(4, 2)	(1, 2)	(2, 2)	(3, 2)	(4, 2)	(1, 2)	(2, 2)	(3, 2)	(4, 2)
(1, 1)	(2, 1)	(3, 1)	(4, 1)	(1, 1)	(2, 1)	(3, 1)	(4, 1)	(1, 1)	(2, 1)	(3, 1)	(4, 1)	(1, 1)	(2, 1)	(3, 1)	(4, 1)
(1, 4)	(2, 4)	(3, 4)	(4, 4)	(1, 4)	(2, 4)	(3, 4)	(4, 4)	(1, 4)	(2, 4)	(3, 4)	(4, 4)	(1, 4)	(2, 4)	(3, 4)	(4, 4)
(1, 3)	(2, 3)	(3, 3)	(4, 3)	(1, 3)	(2, 3)	(3, 3)	(4, 3)	(1, 3)	(2, 3)	(3, 3)	(4, 3)	(1, 3)	(2, 3)	(3, 3)	(4, 3)
(1, 2)	(2, 2)	(3, 2)	(4, 2)	(1, 2)	(2, 2)	(3, 2)	(4, 2)	(1, 2)	(2, 2)	(3, 2)	(4, 2)	(1, 2)	(2, 2)	(3, 2)	(4, 2)
(1, 1)	(2, 1)	(3, 1)	(4, 1)	(1, 1)	(2, 1)	(3, 1)	(4, 1)	(1, 1)	(2, 1)	(3, 1)	(4, 1)	(1, 1)	(2, 1)	(3, 1)	(4, 1)

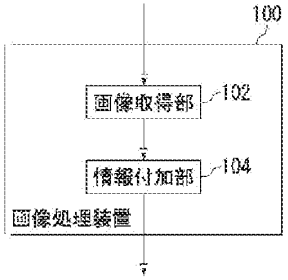
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【図６】

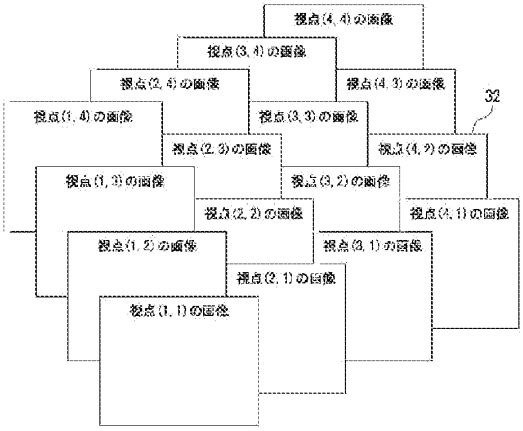


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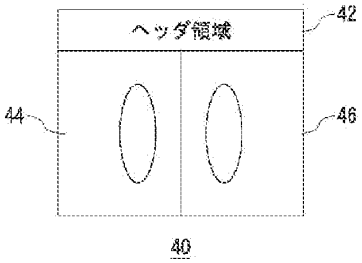
【図９】



【図4】

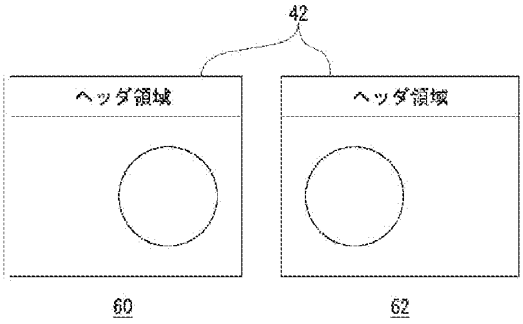


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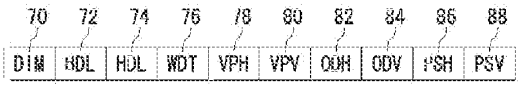
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【図7】



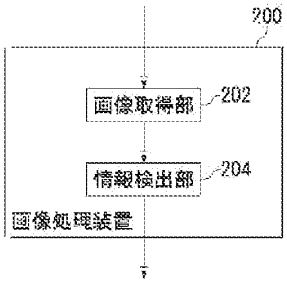
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【図8】

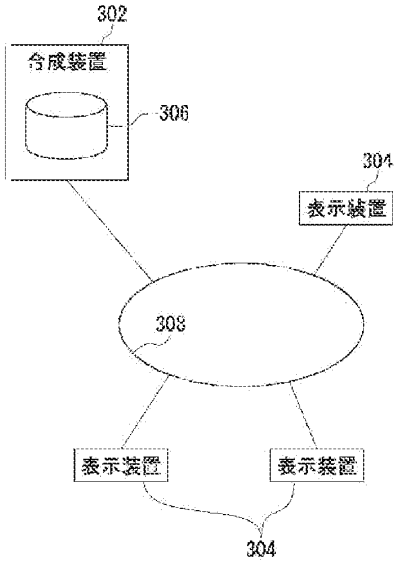


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【図10】



【図11】



フロントページの続き

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5C061 AA03 AA06 AA07 AA08 AA13
AB08 AB20 AB21 AB24

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Bibliographic data: JP2006295289 (A) — 2006-10-26

THREE-DIMENSIONAL DISPLAY METHOD, IMAGE FORMING APPARATUS, AND IMAGE DISPLAY

No documents available for this priority number

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Classification: - international: ***G02B27/22; G09G3/20; G09G3/36; G09G5/00; G09G5/10; G09G5/36; H04N13/00***

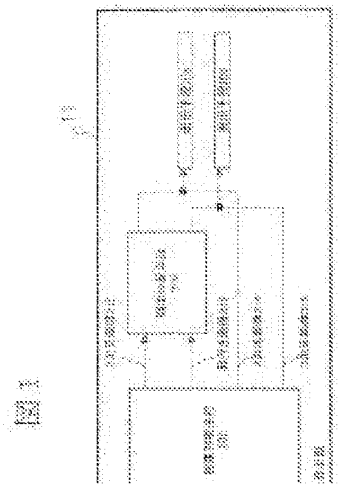
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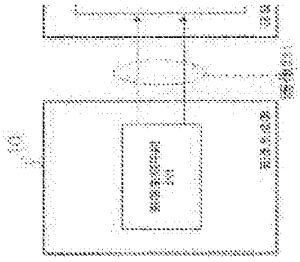
Application number: JP20050109594 20050406

Priority number (s): JP20050109594 20050406

Also published as: JP4451804 (B2)

Abstract of JP2006295289 (A)





PROBLEM TO BE SOLVED: To perform switching automatically between a case that DFD system three-dimensional display is presented by distributing luminance based on a two-dimensional image and a depth image and a case that DFD system three-dimensional display is presented by displaying independent two-dimensional images as they are. ; SOLUTION: On the image creating side, an image determining transferred to the image display side is buried with an identification image for determining whether the image is composed of a two-dimensional image and a depth image or composed of a plurality of independent two-dimensional images. On the image display side, decision is made whether a transferred image is composed of a two-dimensional image and a depth image or composed of a plurality of independent two-dimensional images, and switching is conducted automatically between a case that DFD system three -dimensional display is presented by distributing luminance based on the two-dimensional image and the depth image and a case that DFD system three-dimensional display is presented by displaying independent two-dimensional images as they are. ; COPYRIGHT: (C)2007,JPO&INPIT

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DESCRIPTION JP2006295289

[0001]

The present invention, and three-dimensional display method, the DFD display method, relates to an image display device and image generating apparatus, in particular, in the image display side, the image transferred from the image generation side, or the depth image, a two-dimensional image technique effectively when automatically determining whether a two-dimensional image on its own.

[0002]

It can be suppressed conflicts in physiological factors between stereoscopic, conveniently, capable of three-dimensional display without using the stereo glasses, the present inventors have found that three-dimensional DFD of (Depth-Fused-3D) mode (Patent Document 1, Patent Document 2) has proposed a display device.

Displays the 2-dimensional image on the display surface a plurality of three-dimensional display device has already been proposed that the aforementioned three-dimensional image by changing to the display surface for each luminance of the two-dimensional image displayed on the display surface of the plurality It is intended to display the.

[0003]

Note, there are the following prior art documents related to the present invention.

No. 3460671 Patent Specification No. 3022558 discloses patent patent

[0004]

The three-dimensional display method described above, a method of transferring the image data for performing three-dimensional display, it is transferred to the image display side of the depth image and the two-dimensional image from the image generation side, by performing the distribution of brightness in the image display side the method is transferred to the image display side and a method of displaying a two-dimensional image with multiple independent finished the distribution of the brightness already from the image generation side, displays the image display side is known.

However, (the depth image and the two-dimensional image and two-dimensional image that is independent of s) are mixed, when it is transferred to the image display side of the image producer, the image display side, or the image of the two had to be can not identify the image of what is being transmitted, switch manually.

The present invention has been made in order to solve the problems of the related art, the image display side, the image transferred from the image producer, an object of the present invention, or the depth image, a two-dimensional image , and is to provide the technology that can be determined automatically whether a two-dimensional image which is independent to perform three-dimensional display of the DFD method in a manner corresponding to each image.

And other objects and novel features of the of the present invention will become apparent from the accompanying drawings and the description of the present specification.

[0005]

Among the inventions disclosed in this application will be briefly described a typical, they are as follows.

In order to solve the aforementioned problems, the image display side, the present invention provides a two-dimensional image that displays a two-dimensional image respectively on the display surface of the plurality are arranged in the depth different positions as viewed from the observer, appears A three-dimensional display method can be varied independently for each display surface for each transparency or luminance, and displays a three-dimensional image, the

image generation side, the image to be transferred to the image display side, the two-dimensional on the image display side is embedded in an image to be transferred to the image display side, the identification image to determine, or is composed of a depth image and the image, or is composed of a sequence of images of independent image is transferred, in the image display side, based on the identification image is embedded in the image transferred from the image producer, is the transfer, or is composed of a depth image and the two-dimensional image, independent If configured by the depth image and the two-dimensional image, the image to determine is composed of multiple two-dimensional images that have been the transfer, luminance, respectively in each of the display surfaces for each based on the depth image Alternatively, when configured with a plurality of two-dimensional images of the image to be displayed on each display plane the 2-dimensional image obtained by changing the permeability, is the transfer is independent, and each two-dimensional image of the plurality and in that to be displayed on the display surface, respectively.

[0006]

Further, in the present invention, as the identification image, that the pixel or frame of the first 2D image is switched to the depth image, the pixel or the last frame of the depth image, and embeds the identification signal indicative of the depth image I characterized.

Further, in the present invention, as the identification image, embedded identification signal indicating that the depth image to a pixel or frame of the first 2D image is switched to the depth image, and further, the pixels or frames depth image is continued and characterized in that it also embed information on the number.

Further, in the present invention, as the identification image, and is characterized by embedding an identification signal always pixel or frame depth image is transferred.

Further, in the present invention, as the identification image, and in that the frame immediately before the image is switched, embed map image that specifies an area is a depth image.

Further, in the present invention, as the identification image, and in that the first pixel of each line, is embedded position information at the start and end points of the depth image.

[0007]

To briefly explain the effects obtained by a typical one of the inventions disclosed in the present

application, they are as follows.

According to the present invention, in the image display side, the image transferred from the image generation side, to determine automatically or the depth image, a two-dimensional image, or a two-dimensional image which is independent to each image it is possible to perform three-dimensional display of the DFD system in a way that is dependent.

[0008]

Hereinafter, will be described in detail embodiments of the present invention with reference to the drawings.

In all the drawings for explaining the embodiments, parts having identical functions are given the same reference numerals, and description thereof is not repeated.

First, I will explain three-dimensional display device of DFD type forming the basis of the present invention.

11 [an example of the three-dimensional display device of the type DFD] is a diagram for explaining an example of the three-dimensional display device of the type DFD.

A plurality of surfaces, for example, sets (101, 102) (display surface 101 is closer to the viewer 100 from the display surface 102) and the display surface, three-dimensional display device shown in Figure 11, these front of the observer 100 In order to display a two-dimensional image of the plurality of display surface (101, 102), to construct the optical system 103 using various optical elements and a two-dimensional display device.

The two-dimensional display device includes, for example, using CRT, liquid crystal displays, LED displays, plasma display, EL display, FED display, DMD, projection type display, or a line drawing display, such as an oscilloscope, as the optical element, For example, to use a lens, a total reflection mirror, a partially reflecting mirror, songs mirrors, prisms, polarizing element, and a wave plate.

Note that FIG 11, it also is of the same configuration as that described in Patent Document 1 described above, how to set the display surface, see Patent Document 1 described above.

The three-dimensional display device shown in FIG 11, as shown in FIG 12, the viewing direction of the two eyes of 100 observer, a display surface of the above to (101, 102), a three-dimensional object 104 to be presented to the viewer 100 and generates the image that is projected

(hereinafter, referred to as "2D Ka-zo") and (105, 106).

The method of generating 2D of images, for example, or a method, the synthesis of 2-dimensional images of a plurality of sheets taken from a different direction, or a method using a two-dimensional image obtained by the camera 3D object 104 from the viewing direction There are a variety of methods such as a method of using a modeling and synthesis technology using computer graphics.

[0009]

As shown in FIG 11, both the 102 display surface with each display surface 101, and overlap when viewed from a point on the line connecting the right and left eyes of the viewer 100, the 2D Ka-zo a (105, 106) I want to display on.

For example, it is made possible to control the arrangement of the position of the center of gravity and the center position of each 2D Ka-zo of (105, 106), the scaling of each image.

On a device having such a structure, while maintaining a constant brightness overall as seen from the observer 100, the luminance of each 2D Ka-zo of (105, 106), is changed in response to the depth position of the three-dimensional object 104 By and display the three-dimensional image of a three-dimensional object 104.

I will describe an example of how to change the brightness of each of the 2D Ka-zo (105, 106).

Here, because it is a black and white drawing, for clarity, in the drawings, there is shown darker higher luminance.

For example, if in the display surface 101 is a three-dimensional object 104, as shown in FIG 13, equal to the luminance of a three-dimensional object 104 and luminance of the 2D Ka-zo 105 on this, the 2D 102 on display screen Let me be zero brightness of Ka-zo 106.

Then, for example, in the case at a position closer a little on the display surface 102 side of the display surface 101 away slightly from the viewer 100 is three-dimensional object 104, as shown in FIG 14, the luminance of the 2D Ka-zo 105 The slightly lower, to increase the brightness of the little 2D Ka-zo 106.

[0010]

Then, for example, in the case at a position closer and further on the display surface 102 side of the display surface 101 away further from the viewer 100 is three-dimensional object 104, as shown in FIG 15, the luminance of the 2D Ka-zo 105 The further reduced, further increase the brightness of the 2D Ka-zo 106.

Further, for example, when in the display surface 102 is a three-dimensional object 104, as shown in FIG 16, equal to the luminance of a three-dimensional object 104 and luminance of the 2D Ka-zo 106 on this, 101 on the display surface Let me be zero brightness of 2D Ka-zo 105.

2D Ka-zo even (105, 106), as if the viewer 100 by displaying in this way, the illusion or psychological factors or physiological observer (human) 100, it's displayed I feel three-dimensional object 104 as positioned in the middle of a (101, 102) the display surface.

For example, in the case of displaying 2D Ka-zo equal luminance substantially (105) surface (101, 102), and so there is a three-dimensional object 104 near the middle of the depth position of (101, 102) a display surface I feel at.

In this case, the three-dimensional object 104 is perceived with a three-dimensional impression to the viewer 100.

[0011]

In the above description, for example, for example, has been described primarily on how to express by using a two-dimensional image displayed on the (101, 102) the display surface, but is shown in FIG 11, the depth position of the three-dimensional whole object The three-dimensional display device, for example, can be used as a way to express the depth of three-dimensional object itself has to be clear.

on the device having the structure shown in FIG 11, an important key point in the case of expressing the depth of three-dimensional object itself has is viewed from the viewer 100, the luminance of each site 2D Ka-zo of (105, 106) It is to remain fixed luminance overall, is changed in correspondence to the depth position of each piece part 104 three-dimensional object.

In the description above, it is described that is between the two surfaces is an object to be presented to the observer, and describes only two surfaces mainly in the surface to place the two-dimensional image, the two-dimensional even when the position of an object to present a different number of surfaces to place the image, or more than this, that it is possible to display the three-dimensional image by the same method are possible is evident.

For example, a three-dimensional object in the first surface 3 of the second between the plane of the middle, and the surface farther from the observer 100 between 3 Tsude, the surface close to the viewer 100 and the surface of the intermediate If the dimension object is present, the surface closer to the observer 100, on the surface of the intermediate, to display the 2D of images of a three-dimensional object of the first, the surface of the intermediate, to the surface is far from the observer 100 By displaying the 2D image of the three-dimensional object in the second, it is possible to display a three-dimensional image of a three-dimensional object the first and second.

Furthermore, for the case of 2D of images to move in three dimensions, it is possible by the video reproduction by the display surface as in the case of the two-dimensional display device of the normal with respect to movement in the horizontal and vertical direction of the observer, For movement in the depth direction, while maintaining a constant brightness overall as seen from the observer 100, the luminance of each 2D Ka-zo of (105, 106), and the temporal change in the depth position in the three-dimensional image By varying Correspondingly, it is possible to express the three-dimensional video image is clear.

[0012]

17 [Another example of 3-dimensional display device of the type DFD] is a diagram for explaining another example of the three-dimensional display device of the type DFD underlying the present invention.

In front of the observer 100, the transmission type display device of the plurality, for example, (111, 112) three-dimensional display device shown in Figure 17, the observer than the transmissive type display device 112 (transmission type display device 111 transmission type display device to be) close to 100, and various optical elements, to construct an optical system 103 using the light source 110.

That is, in this embodiment, in which instead of the display surface in FIG 11 described above in (101, 102), is used (111, 112) transmissive type display device.

The transmissive-type display device as (111, 112), for example, twisted nematic liquid crystal display, in-plane type liquid crystal display, homogeneous liquid crystal display, a ferroelectric liquid crystal displays, guest - host type liquid crystal display, polymer-dispersed liquid crystal l use a combination of these displays, or holographic polymer-dispersed liquid crystal display,.

Further, as the optical element, for example, to use a lens, a total reflection mirror, a partially reflecting mirror, a curved mirror, a prism, a polarizing element, and a wave plate.

In FIG 17, the backlight (light source) 110, also shows a case in which it is disposed in the rearmost from the viewer 100, Figure 17, the same configuration as the one described in Patent Document 2 above of those.

[0013]

Also in the three-dimensional display device shown in FIG 17, as shown in FIG 12 described above, as viewed from the observer 100, a three-dimensional object 104 to be presented to the viewer 100, the transmissive display device (111, 112) to generate (107,108) 2D Ka-zo you have projection.

As shown in Figure 17, the 2D Ka-zo a (107, 108), to both of the transmissive display device 112 with each of the transmission-type display device 111, from a point on the line connecting the right and left eyes of the viewer 100 so as to overlap to look, to be displayed as (107,108) 2D Ka-zo.

For example, this is made possible by controlling the arrangement of the position of the center of gravity and the center position of each 2D Ka-zo of (107, 108), the enlargement / reduction ratio for each image.

On the device having the above configuration, the image seen by the observer 100 is generated by light in the light emitted from the light source 110, passes through the 2D Ka-zo 108 and transmitted through the 2D Ka-zo 107.

The three-dimensional display device shown in FIG 17, on a device having the above configuration, while maintaining a constant brightness overall as seen from the observer 100, the distribution of transmittance of each 2D Ka-zo of (107, 108) , by changing in correspondence with the depth position of the three-dimensional object 104, and displays a three-dimensional image of a three-dimensional object that exists between the transmission type display device 112 and transmissive type display device 111.

[0014]

I will describe an example of how to change the permeability of each of the 2D Ka-zo (107, 108).

For example, when in the transmissive-type display apparatus 111 is three-dimensional object 104, and sets the brightness of the 2D Ka-zo 107 is equal to the luminance of a three-dimensional

object 104, the transmission of the 111 on the transmissive display device , for example, I will be the maximum value of the transmission-type display device 112, the transparency of the part of the 2D Ka-zo 108 of 112 on the transmission type display device.

Then, for example, three-dimensional object 104 is moved away slightly from the viewer 100, when it is in a position closer slightly transmissive type display device 112 side of the transmission type display device 111, 2D of 111 on the transmission type display device This increases slightly the permeability of the portion of the image 107, to reduce a little the transparency of the part of the 2D Ka-zo 108 of 112 on the transmission type display device.

Then, for example, three-dimensional object 104 away than the viewer 100, when it is in a position closer more transmissive type display device 112 side of the transmission type display device 111, the 2D of 111 on the transmission type display device The further increase the permeability of the portion of the image 107, thereby further reducing the permeability of a portion of the 2D Ka-zo 108 112 on the transmission type display device.

Further, for example, when in the transmissive-type display apparatus 112 is three-dimensional object 104, the luminance of the 2D Ka-zo 108 is equal to the luminance of a three-dimensional object 104, the transmission of the 112 on the transmissive display device set, for example, is the maximum value of the transmission-type display device 111, the permeability of the portion of the 2D Ka-zo 107 111 on the transmissive display device.

[0015]

2D Ka-zo even (107, 108), as if the viewer 100 by displaying in this way, by illusion or psychological factors or physiological observer (human) 100, it's displayed I feel three-dimensional object 104 as positioned in the middle of a (111, 112) transmissive type display device.

That is, for example, in the case of displaying 2D Ka-zo of equal brightness approximately (107, 108) to (111, 112) transmission type display device, three near the middle of the depth position of (111, 112) transmission type display device I feel like there is a dimension object 104.

In this case, the three-dimensional object 104 is perceived with a three-dimensional impression to the viewer 100.

In the above description, for example, for example, has been described primarily on how to express by using a two-dimensional image displayed on the (111, 112) transmissive type display device, the depth position of the three-dimensional object overall, Figure Also in the three-dimensional display device shown in 17, by a procedure similar to the method described in 3-

dimensional display device shown in FIG 11, for example, can be used as a way to express the depth of three-dimensional object itself has to be clear.

Further, in the three-dimensional display device shown in FIG 17, when the 2D of image is moved in three dimensions, as in the case of two-dimensional display device of the normal with respect to movement in the horizontal and vertical directions of the observer 100 Also, is possible by the video reproduction by the transmissive display device, with respect to movement in the depth direction, by performing time-wise change of the transmittance in transmissive type display device of the plurality of videos 3D stereoscopic It can be expressed is clear.

[0016]

The three-dimensional display device DFD type, and displays a three-dimensional image by changing to the display surface for each luminance as viewed from the observer 100 on each display surface.

That is, the three-dimensional display device shown in FIG 11, while keeping constant the luminance overall as seen from the observer 100, the distribution of luminance of each 2D Ka-zo of (105, 106), the depth of the three-dimensional object 104 Displaying a three-dimensional image by changing according to the position.

Further, the three-dimensional display device shown in FIG 17, while keeping constant the luminance overall as seen from the observer 100, the distribution of transmittance of each 2D Ka-zo of (107, 108), the 3D object 104 Displaying a three-dimensional image can be varied corresponding to the depth position.

Thus, the three-dimensional display device shown in FIG 11, the 2D Ka-zo displayed on the surface of the far three-dimensional object 104, the luminance of the 2D of image displayed on the surface closer to the three-dimensional object 104 The relative increase than luminance, in a three-dimensional display device shown in FIG 17, the three-dimensional object 104, the transmittance of the 2D of image displayed on the transmissive type display device that is closer to the three-dimensional object 104 but differs in that is smaller than the permeability of 2D image displayed on the transmissive display device further away.

Accordingly, the three-dimensional display device shown in FIG 17, or if, by using a procedure similar to the three-dimensional display device shown in FIG 11, representing the depth of the three-dimensional object itself has, represent video three-dimensional images In the case of, in the three-dimensional display device shown in FIG 11, in the case of increasing the brightness of the 2D of image displayed on the display screen, the transmittance of the 2D of image displayed on

the transmissive display device In addition, decrease, in the three-dimensional display device shown in FIG 17, in the case of reducing the luminance of the 2D of image displayed on the display surface, and the transmittance of the 2D of image displayed on the transmissive display device it is sufficient to increase.

[0017]

[Embodiment 1] FIG 1 is a block diagram showing a schematic configuration of a three-dimensional display system for realizing the three-dimensional display method of the embodiment of the present invention.

The three-dimensional display system of the present embodiment, an image 211 generated by the image generating unit 201 of the image generation device 10 is transferred to the image display device 11, and displayed on (204, 205) the display means.

In the present embodiment, the image display device 11, it is determined by 202 image determination unit, the type of image 211 transferred from the image generating unit 201 of the image generating apparatus 10, the depth image and the two-dimensional image (two-dimensional image 212, In the case of a depth image 213), and is converted into a sequence of images by the luminance distribution section 203, and displayed on (204, 205) the display means.

In the image display device 11, it is determined 202 by the image determining unit, two-dimensional image independent (two-dimensional image 214,2-dimensional image 215, a type of image 211 transmitted from the image generating unit 201 of the image generating apparatus 10 In the case of a), it is displayed on the display means (204, 205) without performing the processing of the luminance distribution section 203.

(Including, for example, analog RGB, such as those used in personal computers, DVI, and LVDS) in a way of transferring the image signal of each R, G, and B, for transferring the image signals of two systems, It will transfer the signal (, B1, R2, G2, B2 R1, G1) 6 kinds in total.

Therefore, it will utilize the signals of all six kinds of when transferring (RGB + RGB) 2-dimensional image that is independent, but four types of signals in the case of transmitting an image depth image and the two-dimensional image (RGB + Z) I will be the two signals without using surplus only.

By using this signal is left over, it is determined that whether the image (RGB + RGB), and whether the image (RGB + Z).

[0018]

The depth image 213, it is intended to replace the information of brightness (Z X, Y, a Z) depth information of a three-dimensional object, it is configured as a gray image brightness.

Note, for example, when shooting with a camera three-dimensional object from the viewing direction, is measured by the distance measuring device, a distance to the three-dimensional object from a camera position, depth information of the 3D object, and the distance data can be generated based on.

As mentioned above, or luminance, of each 2D Ka-zo of (105, 106), an important point of the three-dimensional display device underlying the present invention, the permeability of each of the 2D Ka-zo (107, 108) , and is to remain fixed overall luminance as viewed from the observer 100, is changed in response to the depth position of the three-dimensional object 104.

Therefore, as the image to be transmitted to the image display device 11 from the image generating apparatus 10 is used and the depth image 213 and the two-dimensional image 212, the image display device 11, and generates a 2-dimensional image displayed on the display screen It is possible.

For example, if there is a three-dimensional object 104 in the middle of the depth position of (101, 102) the display surface, the image generating apparatus 10, an image, a depth image 213 obtained by replacing the information of the luminance information in the depth direction of the three dimensional object I is transmitted to the display device 11.

Then, on the basis of the depth image 213, is divided into one-to-one luminance information transferred, the display unit in two (204,205) 2D Ka-zo equal brightness substantially the image display device 11, 105 and 106 it is possible by displaying, be such that there is a three-dimensional object near the middle of the depth position of (204, 205) display means two, and displays a three-dimensional image.

[0019]

In the present embodiment, the image determining unit 202, a method for determining the type of image, and embeds the identification image using two signals which remained of the signal lines used to transfer the depth image.

As shown in FIG 2, an image to be embedded, embedding identification image of starting and end points, the frame of the end of the (RGB + Z) to the frame of the start of the (RGB + Z).

For example, as shown in FIG 3, the identification image, all the alternating maximum brightness and (11111111/8bit), minimum brightness, etc.) (00000000/8bit the signals (one pattern does not appear much in an ordinary two-dimensional image Place the pixels, and the like) to the opposite pattern of minimum brightness of the opposite, so that the maximum luminance into another signal, to identify and to determine the start and end points.

This pattern is selected that is not limited to those illustrated here, it does not appear in an ordinary two-dimensional image as possible.

There is also a method of embedding a number of frames embedded identification image of the starting point to the beginning of the frame (RGB + Z), is continued therein, and switches by the number of the frame.

Further, the identification image to be embedded, as shown in FIG 4, in the case of (RGB + Z), the embedded identification image always, there is a method of identifying.

For example, as shown in FIG 5, a pattern which does not appear much on the normal two-dimensional image and to identify and to determine that it is the (RGB + Z).

Alternatively, there is a method, as shown in FIG 6, and embed the image obtained by inverting the depth image.

In this method, in order to be judged after reading one frame identified image frame buffer for one frame is required, the delay of one frame is also generated on the display.

In order to minimize the delay, without the entire frame identification image, for example, only one first line, and by limiting the like only a few pixels of the first, and only one line (the first minimum frame buffer, It is possible to be a) and only a few pixels of the first, to reduce the delay between the display.

[0020]

In Example 2 This example, in the frame, for each pixel or each region, and switches or (RGB + RGB), and (RGB + Z), the map that specifies the region is a depth image using a frame Insert an image, it is determined in the region of the frame after the next based on the map image.

Embed into two signals that are surplus, the identification image indicating that the map image, for example, as shown in FIG 7, a pattern which does not appear much on the normal two-dimensional image, it is determined to be a map image and to identify and order.

In the example of Figure 7, region area, expressed in map image in "white" is represented by "black", a region which is the depth image represents each region is a two-dimensional image.

There is a method of using, for example, reverse image of the map image identification image.

By using a method without the display immediately, and displays via a frame memory for one frame in the image determination unit 202, when the frame is determined to be the map image, the image is a map image In order to avoid to be displayed directly, without displaying this frame, and displays it holds the image of the previous frame.

In accordance with map image, in the image determination means 202, I switched image image through the brightness distribution means 203 for each pixel or area or (RGB + Z), does not pass through the brightness distribution means 203 or (RGB + RGB) from the next frame.

I repeat map image until the next this.

In the case of the (RGB + RGB), the entire surface, as shown in Figure 7, it can be realized by the entire surface is the same map image as the identification image.

Conversely, the entire surface (RGB + Z) is the same.

Thus, switching in units of pixels or regions is possible in the frame.

[0021]

In Example 3 the present embodiment, in order to switch the (RGB + Z), it is determined to identify by embedding an identification signal in one pixel, or the (RGB + RGB) for each pixel.

signal embedding embeds the identification signal of the starting and end points, the pixel at the end of (RGB + Z) to the pixel at the beginning of (RGB + Z) as shown in FIG.

For example, as shown in FIG 8, the signal of one (1, the signal 01010101/8bit, another identification signal is reversed so 10101010/8bit pattern does not appear much on the pixels of the ordinary two-dimensional image It is the identification for a) such as the pattern, and determines the start and end points.

Identification signal may also be used those obtained by inverting the bits of the two-dimensional image.

This pattern is selected that is not limited to those illustrated herein, does not appear in the pixels of the ordinary two-dimensional image as possible.

Further, the embedded identification signal, as shown in FIG 9, in the case of (RGB + Z), the embedded identification signal always, there is also a method of identifying.

For example, as shown in FIG 9, the signal (one, the signal 01010101/8bit, another to the opposite pattern to that 10101010/8bit pattern does not appear much on the pixels of the ordinary two-dimensional image , or as the like) alternately for each pixel it is allowed to identify and to determine that it is a (RGB + Z).

Or, a method of embedding such a pixel obtained by inverting the pixels of the depth image.

[0022]

Further, the transmission path is 8 bits (for example, 6 bits) to, as shown in FIG 10, the identification signal to be embedded identification signal whenever the (RGB + Z) when the number of bits of the image is small Embed the identification signal to the two low-order bits of all pixels that do not need to display the image further (to alternate with 10 ****** For example, a 01 ******: * is optional) to embed With, there is also a method of identifying.

In this method, in order to be judged after reading one pixel identified image buffer of one pixel is necessary.

This method can be established that as compared with the case of embedding only in the pixel in the depth image, the same pattern occurs in the ordinary two-dimensional image is low, to prevent misjudgment.

(Eg, 8bit) bits of the image is not reduced even if, by embedding the same manner the lower bits less noticeable, to improve the accuracy of identification are also possible.

Further, since the identification signal of the pixel that switches (RGB + Z) from (RGB + RGB), pixels, embedded information what pixels of maintaining or (RGB + Z) of the pixel, it is determined without embedding an identification signal always I can also be.

Further, in order as an identification signal (the first pixel of the line scan) the leftmost pixel of each line indicating the presence position of the depth image of the line, for example, (such as the number of pixels from the left) starting signal to the signal 2 , there is a method to embed (such as the number of pixels from the right edge or the number of pixels, from the left edge) end point signal to signal 3, to determine whether the depth image which range in the line.

[0023]

In the description up to above, it has been described to be embedded identification signal in the image of RGB, it is also possible to embed an identification signal in a similar manner to the portion of the blank period and the sync signal of the image.

As described above, according to the present embodiment, when the image display side, it transfers the depth image and the two-dimensional image from the image generation side, the three-dimensional display of the DFD method by the luminance distribution in the image display side and, the identification image is embedded in the image, the switching of the case where the image display side, and transfers the two-dimensional image that is independent from the image generation side, the three-dimensional display of DFD system by displaying as an image display side it is possible to carry out automatically.

Described above in detail based on the embodiments, the invention made by the present inventors, but the present invention is not intended to be limited to the embodiments, and that various modifications may be made without departing from the spirit It is needless to say that.

[0024]

Is a block diagram showing a schematic configuration of a three-dimensional display system for realizing the three-dimensional display method of the embodiment of the present invention.

In the three-dimensional display method of the first embodiment of the present invention, is a diagram for explaining an example of the identification images embedded in the image to be transferred to the image display device from the image generating device.

In the three-dimensional display method of the first embodiment of the present invention, is a diagram for explaining another example of the identification image to be embedded in an image to be transferred to the image display device from the image generating device.

In the three-dimensional display method of the first embodiment of the present invention, is a diagram for explaining another example of the identification image to be embedded in an image to be transferred to the image display device from the image generating device.

In the three-dimensional display method of the first embodiment of the present invention, is a diagram for explaining another example of the identification image to be embedded in an image to be transferred to the image display device from the image generating device.

In the three-dimensional display method of the first embodiment of the present invention, is a diagram for explaining another example of the identification image to be embedded in an image to be transferred to the image display device from the image generating device.

In the three-dimensional display method of the second embodiment of the present invention, is a diagram for explaining another example of the identification image to be embedded in an image to be transferred to the image display device from the image generating device.

In the three-dimensional display method of the third embodiment of the present invention, is a diagram for explaining another example of the identification image to be embedded in an image to be transferred to the image display device from the image generating device.

In the three-dimensional display method of the third embodiment of the present invention, is a diagram for explaining another example of the identification image to be embedded in an image to be transferred to the image display device from the image generating device.

In the three-dimensional display method of the third embodiment of the present invention, is a diagram for explaining another example of the identification image to be embedded in an image to be transferred to the image display device from the image generating device.

Is a diagram showing a schematic configuration of a three-dimensional display device underlying the present invention.

In the three-dimensional display device underlying the present invention, is a diagram for explaining a method of generating 2D of images to be displayed on the display screen.

Is a diagram for explaining the display principle of the three-dimensional display device underlying the present invention.

Is a diagram for explaining the display principle of the three-dimensional display device underlying the present invention.

Is a diagram for explaining the display principle of the three-dimensional display device underlying

the present invention.

Is a diagram for explaining the display principle of the three-dimensional display device underlying the present invention.

Is a diagram for explaining another example of the three-dimensional display device DFD type underlying the present invention.

[0025]

110 backlight 201 image 202 image generating means 111 and 112 determine the transmission type display device 105,106,107,108 2D Ka-zo 104 three-dimensional object optical system 103 101, 102 100 display surface observer 11 image display device 10 image generation device image depth image 213 212,214,215 204 and 205 two-dimensional image display means 211 means 203 brightness distribution means

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CLAIMS JP2006295289

[0001]

In the image display side, displays a two-dimensional image respectively on the display surface of the plurality are arranged in the depth different positions as viewed from the observer, respectively, to the respective display surfaces for each transparency or brightness of the two-dimensional image to be displayed A three-dimensional display method is varied independently, displaying a three-dimensional image, the image generation side, the image to be transferred to the image display side, or is composed of a depth image and the two-dimensional image, transferred to the image display side is embedded in the image to be transferred to the image display side, the identification image to determine which consists of two-dimensional images of a plurality of independent, in the image display side, the image producer determination, or is composed of a depth image and the two-dimensional image, an image based on the identification image that is embedded in an image that has been transferred from the said transfer, or is composed of two-dimensional images of a plurality of independent If configured by the depth image and the two-dimensional image, the image is, was the transfer, the said two-dimensional image obtained by changing the transparency or luminance, respectively in each of the display surfaces for each based on the depth image If configured in the sequence of images of images displayed on the display screen, is the transfer is independent, three-dimensional, characterized in that the respectively displayed on the respective display surface a two-dimensional image of the plurality display method.

[0002]

Examples of the identification image, claim 1, characterized in that the pixel or frame of the first 2D image is switched to the depth image, the pixel or the last frame of the depth image and

embedding an identification signal indicative of the depth image The three-dimensional display method according to.

[0003]

The embedded identification signal indicating that as the identified image is a depth image to a pixel or frame of the first 2D image is switched to the depth image, and further, can be embedded and information on the number of pixels or frames depth image is continued The three-dimensional display method of claim 1, wherein the.

[0004]

Examples of the identification image, the three-dimensional display method according to claim 1, characterized in that embedding an identification signal always pixel or frame depth image is transferred.

[0005]

Examples of the identification image, the three-dimensional display method according to claim 1, characterized in that the frame immediately before the image is switched, embed map image that specifies an area is a depth image.

[0006]

Examples of the identification image, the three-dimensional display method according to claim 1, characterized in that the first pixel of each line, is embedded position information at the start and end points of the depth image.

[0007]

Each displayed a two-dimensional image on the display surface a plurality of in depth different

positions as viewed from the observer, independently for each display surface for each transparency or brightness of the two-dimensional image displayed on the display screen the the image display apparatus for displaying a three dimensional image is varied, an image generating apparatus for transferring an image, the image to be transferred to the image display device, consisting of or the depth image and the two-dimensional image or, it is characterized in that it comprises means for transferring to the image display device is embedded in the image to be transferred to the image display device, an identification image to determine which consists of two-dimensional images of a plurality of independent image generator.

[0008]

Based on the image transferred from the image generating device, each displayed a two-dimensional image on the display surface a plurality of in depth different positions as viewed from the observer, or transmission luminance of the two-dimensional image displayed on the display screen the An image display apparatus for displaying a three-dimensional image by changing independently for each display surface every time, the display unit constituting the display surface of the plurality are arranged in the depth different positions as viewed from the observer and, or alternatively, consisting of or the depth image and the two-dimensional image, an image based on the identification image is embedded in the image transferred from said image generating apparatus, which is the transfer is a two-dimensional image of the plurality of independent determining means for determining whether the structure, when in said discriminating means, the image that is the transfer is determined to be composed of the depth image and the two-dimensional image, wherein the display means every time based on the depth image luminance distribution means for displaying on the respective display means the two-dimensional image obtained by changing the transparency or luminance, respectively, in the determination unit, and consists of two-dimensional images of a plurality of images which are the transfer is independent An image display device, wherein when it is determined, and a means for displaying each of the respective display unit a two-dimensional image of the plurality.

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(54)【発明の名称】３次元表示方法、画像生成装置、および画像表示装置

(57)【要約】
【課題】　２次元画像と奥行き画像とに基づき輝度分配してＤＦＤ方式の３次元表示を行う場合と、独立した２次元画像をそのまま表示しＤＦＤ方式の３次元表示を行う場合との切り替えを自動的に行う。
【解決手段】　画像生成側において、２次元画像と奥行き画像とから構成されるか、あるいは、独立した複数の２次元画像で構成されるかを判別するための識別画像を、画像表示側に転送する画像に埋め込み、画像表示側において、画像生成側から転送された画像に埋め込まれた識別画像に基づき、転送された画像が、２次元画像と奥行き画像とから構成されるか、あるいは、独立した複数の２次元画像で構成されるかを判別し、２次元画像と奥行き画像とに基づき輝度分配してＤＦＤ方式の３次元表示を行う場合と、独立した２次元画像をそのまま表示しＤＦＤ方式の３次元表示を行う場合との切り替えを自動的に行う。
【選択図】　図１

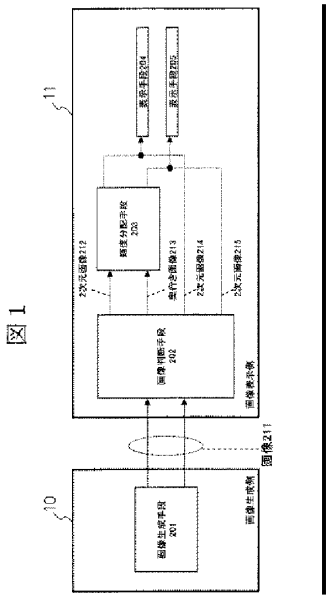


図１

【特許請求の範囲】
【請求項1】
画像表示側において、観察者から見て異なった奥行き位置に配置される複数の表示面にそれぞれ２次元像を表示し、表示される２次元像の輝度あるいは透過度を前記各表示面毎にそれぞれ独立に変化させて、３次元立体像を表示する３次元表示方法であって、
画像生成側において、画像表示側に転送する画像が、２次元画像と奥行き画像とから構成されるか、あるいは、独立した複数の２次元画像で構成されるかを判別するための識別画像を、前記画像表示側に転送する画像に埋め込んで前記画像表示側に転送し、
前記画像表示側において、前記画像生成側から転送された画像に埋め込まれた識別画像に基づき、前記転送された画像が、２次元画像と奥行き画像とから構成されるか、あるいは、独立した複数の２次元画像で構成されるかを判別し、
前記転送された画像が、２次元画像と奥行き画像とから構成される場合には、前記奥行き画像に基づき前記各表示面毎にそれぞれ輝度あるいは透過度を変化させた前記２次元画像を前記各表示面に表示し、
前記転送された画像が独立した複数の２次元画像で構成される場合には、前記複数の２次元画像を前記各表示面にそれぞれ表示することを特徴とする３次元表示方法。
【請求項2】
前記識別画像として、２次元像が奥行き画像に切り替わった最初のフレームあるいは画素と、奥行き画像の最後のフレームあるいは画素に、奥行き画像であることを示す識別信号を埋め込むことを特徴とする請求項１に記載の３次元表示方法。
【請求項3】
前記識別画像として、２次元像が奥行き画像に切り替わった最初のフレームあるいは画素に奥行き画像であることを示す識別信号を埋め込み、さらに、奥行き画像が継続されるフレーム数あるいは画素数の情報も埋め込むことを特徴とする請求項１に記載の３次元表示方法。
【請求項4】
前記識別画像として、奥行き画像が転送されるフレームあるいは画素に常に識別信号を埋め込むことを特徴とする請求項１に記載の３次元表示方法。
【請求項5】
前記識別画像として、画像が切り替わる直前のフレームに、奥行き画像である領域を指定するマップ画像埋め込むことを特徴とする請求項１に記載の３次元表示方法。
【請求項6】
前記識別画像として、ライン毎の最初の画素に、奥行き画像の始点と終点の位置情報を埋め込むことを特徴とする請求項１に記載の３次元表示方法。
【請求項7】
観察者から見て異なった奥行き位置にある複数の表示面に２次元像をそれぞれ表示し、当該各表示面に表示される２次元像の輝度あるいは透過度を前記各表示面毎にそれぞれ独立に変化させて３次元立体像を表示する画像表示装置に対して、画像を転送する画像生成装置であって、
前記画像表示装置に転送する画像が、２次元画像と奥行き画像とから構成されるか、あるいは、独立した複数の２次元画像で構成されるかを判別するための識別画像を、前記画像表示装置に転送する画像に埋め込んで前記画像表示装置に転送する手段を備えることを特徴とする画像生成装置。
【請求項8】
画像生成装置から転送される画像に基づき、観察者から見て異なった奥行き位置にある複数の表示面に２次元像をそれぞれ表示し、当該各表示面に表示される２次元像の輝度あるいは透過度を前記各表示面毎にそれぞれ独立に変化させて３次元立体像を表示する画像表示装置であって、
観察者から見て異なった奥行き位置に配置される複数の表示面を構成する表示手段と、

前記画像生成装置から転送された画像に埋め込まれた識別画像に基づき、前記転送された画像が、２次元画像と奥行き画像とから構成されるか、あるいは、独立した複数の２次元画像で構成されるかを判別する判別手段と、

前記判別手段において、前記転送された画像が２次元画像と奥行き画像とから構成されると判別された場合に、前記奥行き画像に基づき前記各表示手段毎にそれぞれ輝度あるいは透過度を変化させた前記２次元画像を前記各表示手段に表示する輝度分配手段と、

前記判別手段において、前記転送された画像が独立した複数の２次元画像で構成されると判別された場合に、前記複数の２次元画像を前記各表示手段にそれぞれ表示する手段とを【発明の詳細な説明】する画像表示装置。

【技術分野】

【0001】

本発明は、ＤＦＤ表示方式の３次元表示方法、および、画像生成装置と画像表示装置に係り、特に、画像表示側において、画像生成側から転送された画像が、２次元画像と奥行き画像、あるいは、独立した２次元画像であるかを自動的に判別する際に有効な技術に関する。

【背景技術】

【0002】

本発明者らは、立体視の生理的要因間での矛盾を抑制でき、かつ、簡便に、立体メガネを用いないで３次元表示が可能な、ＤＦＤ（Depth-Fused-3D）方式の３次元表示装置を提案している（特許文献１，特許文献２参照）。

前述した提案済みの３次元表示装置は、複数の表示面に２次元像を表示し、この複数の表示面に表示される２次元像の輝度を各表示面毎に変化させて３次元立体像を表示するものである。

【0003】

なお、本願発明に関連する先行技術文献としては以下のものがある。

【特許文献1】特許第３０２２５５８号明細書

【特許文献2】特許第３４６０６７１号明細書

【発明の開示】

【発明が解決しようとする課題】

【0004】

前述した３次元表示方法により、３次元表示を行うための画像データの転送方法として、画像生成側から２次元画像と奥行き画像を画像表示側に転送し、画像表示側において輝度の分配を行って表示する方法と、画像生成側から既に輝度の分配を済ませた複数の独立した２次元画像を画像表示側に転送し、画像表示側において表示する方法とが知られている。

しかし、この２種類の画像（２次元画像と奥行き画像、および、複数の独立した２次元画像）が混在して、画像生成側から画像表示側に転送された場合に、画像表示側において、どちらの画像が伝送されているかの識別ができず、手動で切り替える必要があった。

本発明は、前記従来技術の問題点を解決するためになされたものであり、本発明の目的は、画像表示側において、画像生成側から転送された画像が、２次元画像と奥行き画像、あるいは、独立した２次元画像であるかを自動的に判別して、それぞれの画像に応じた方法でＤＦＤ方式の３次元表示を行うことが可能となる技術を提供することにある。

本発明の前記ならびにその他の目的と新規な特徴は、本明細書の記述及び添付図面によって明らかにする。

【課題を解決するための手段】

【0005】

本願において開示される発明のうち、代表的なものの概要を簡単に説明すれば、下記の通りである。

前述の課題を解決するために、本発明は、画像表示側において、観察者から見て異なった奥行き位置に配置される複数の表示面にそれぞれ２次元像を表示し、表示される２次元

像の輝度あるいは透過度を前記各表示面毎にそれぞれ独立に変化させて、３次元立体像を表示する３次元表示方法であって、画像生成側において、画像表示側に転送する画像が、２次元画像と奥行き画像とから構成されるか、あるいは、独立した複数の２次元画像で構成されるかを判別するための識別画像を、前記画像表示側に転送する画像に埋め込んで前記画像表示側に転送し、前記画像表示側において、前記画像生成側から転送された画像に埋め込まれた識別画像に基づき、前記転送された画像が、２次元画像と奥行き画像とから構成されるか、あるいは、独立した複数の２次元画像で構成されるかを判別し、前記転送された画像が、２次元画像と奥行き画像とから構成される場合には、前記奥行き画像に基づき前記各表示面毎にそれぞれ輝度あるいは透過度を変化させた前記２次元画像を前記各表示面に表示し、前記転送された画像が独立した複数の２次元画像で構成される場合には、前記複数の２次元画像を前記各表示面にそれぞれ表示することを特徴とする。

【0006】

また、本発明では、前記識別画像として、２次元像が奥行き画像に切り替わった最初のフレームあるいは画素と、奥行き画像の最後のフレームあるいは画素に、奥行き画像であることを示す識別信号を埋め込むことを特徴とする。

また、本発明では、前記識別画像として、２次元像が奥行き画像に切り替わった最初のフレームあるいは画素に奥行き画像であることを示す識別信号を埋め込み、さらに、奥行き画像が継続されるフレーム数あるいは画素数の情報も埋め込むことを特徴とする。

また、本発明では、前記識別画像として、奥行き画像が転送されるフレームあるいは画素に常に識別信号を埋め込むことを特徴とする。

また、本発明では、前記識別画像として、画像が切り替わる直前のフレームに、奥行き画像である領域を指定するマップ画像埋め込むことを特徴とする。

また、本発明では、前記識別画像として、ライン毎の最初の画素に、奥行き画像の始点と終点の位置情報を埋め込むことを特徴とする。

【発明の効果】

【0007】

本願において開示される発明のうち代表的なものによって得られる効果を簡単に説明すれば、下記の通りである。

本発明によれば、画像表示側において、画像生成側から転送された画像が、２次元画像と奥行き画像、あるいは、独立した２次元画像であるかを自動的に判別して、それぞれの画像に応じた方法でＤＦＤ方式の３次元表示を行うことが可能となる。

【発明を実施するための最良の形態】

【0008】

以下、図面を参照して本発明の実施例を詳細に説明する。

なお、実施例を説明するための全図において、同一機能を有するものは同一符号を付け、その繰り返しの説明は省略する。

始めに、本発明の基本となるＤＦＤ型の３次元表示装置について説明する。

［ＤＦＤ型の３次元表示装置の一例］

図１１は、ＤＦＤ型の３次元表示装置の一例を説明するための図である。

図１１に示す３次元表示装置は、観察者１００の前面に複数の面、例えば、表示面（１０１，１０２）（表示面１０１が表示面１０２より観察者１００に近い）を設定し、これらの表示面（１０１，１０２）に複数の２次元像を表示するために、２次元表示装置と種々の光学素子を用いて光学系１０３を構築する。

前記２次元表示装置としては、例えば、ＣＲＴ、液晶ディスプレイ、ＬＥＤディスプレイ、プラズマディスプレイ、ＥＬディスプレイ、ＦＥＤディスプレイ、ＤＭＤ、プロジェクション方式ディスプレイ、オシロスコープのような線描画型ディスプレイなどを用い、光学素子としては、例えば、レンズ、全反射鏡、部分反射鏡、曲鏡、プリズム、偏光素子、波長板などを用いる。

なお、図１１は、前述の特許文献１に記載されているものと同じ構成のものであり、また、この表示面の設定方法については、前述の特許文献１を参照されたい。

図１１に示す３次元表示装置では、図１２に示すように、観察者１００に提示したい３次元物体１０４を、観察者１００の両眼の視線方向から、前述の表示面（１０１，１０２）へ射影した像（以下、「２Ｄ化像」と呼ぶ）（１０５，１０６）を生成する。

この２Ｄ化像の生成方法としては、例えば、視線方向から３次元物体１０４をカメラで撮影した２次元像を用いる方法、あるいは別の方向から撮影した複数枚の２次元像から合成する方法、あるいはコンピュータグラフィックによる合成技術やモデル化を用いる方法など種々の方法がある。

【0009】

図１１に示すように、前記２Ｄ化像（１０５，１０６）を、各々表示面１０１と表示面１０２の双方に、観察者１００の右眼と左眼とを結ぶ線上の一点から見て重なるように表示する。これは、例えば、２Ｄ化像（１０５，１０６）の各々の中心位置や重心位置の配置と、各々の像の拡大・縮小を制御することで可能となる。

かかる構成を有する装置上で、２Ｄ化像（１０５，１０６）の各々の輝度を、観察者１００から見た総体的な輝度を一定に保ちつつ、３次元物体１０４の奥行き位置に対応して変えることで、３次元物体１０４の３次元立体像を表示する。

その２Ｄ化像（１０５，１０６）の各々の輝度の変え方の一例について説明する。なお、ここでは、白黒図面であるため、分かりやすいように、以下の図面では、輝度の高い方を濃く示してある。

例えば、３次元物体１０４が表示面１０１上にある場合には、図１３に示すように、この上の２Ｄ化像１０５の輝度を３次元物体１０４の輝度に等しくし、表示面１０２上の２Ｄ化像１０６の輝度はゼロとする。

次に、例えば、３次元物体１０４が観察者１００より少し遠ざかって表示面１０１より表示面１０２側に少し寄った位置にある場合には、図１４に示すように、２Ｄ化像１０５の輝度を少し下げ、２Ｄ化像１０６の輝度を少し上げる。

【0010】

次に、例えば、３次元物体１０４が観察者１００よりさらに遠ざかって表示面１０１より表示面１０２側にさらに寄った位置にある場合には、図１５に示すように、２Ｄ化像１０５の輝度をさらに下げ、２Ｄ化像１０６の輝度をさらに上げる。

さらに、例えば、３次元物体１０４が表示面１０２上にある場合には、図１６に示すように、この上の２Ｄ化像１０６の輝度を３次元物体１０４の輝度に等しくし、表示面１０１上の２Ｄ化像１０５の輝度はゼロとする。

このように表示することにより、観察者（人）１００の生理的あるいは心理的要因あるいは錯覚により、表示しているのが２Ｄ化像（１０５，１０６）であっても、観察者１００にはあたかも表示面（１０１，１０２）の中間に３次元物体１０４が位置しているように感じられる。

例えば、表示面（１０１，１０２）にほぼ等輝度の２Ｄ化像（１０５，１０６）を表示した場合には、表示面（１０１，１０２）の奥行き位置の中間付近に３次元物体１０４があるように感じられる。この場合に、この３次元物体１０４は、観察者１００には立体感を伴って知覚される。

【0011】

なお、前記説明においては、例えば、３次元物体全体の奥行き位置を、例えば、表示面（１０１，１０２）に表示した２次元像を用いて表現する方法について主に述べたが、図１１に示す３次元表示装置は、例えば、３次元物体自体が有する奥行きを表現する方法としても使用できることは明らかである。

３次元物体自体が有する奥行きを表現する場合における重要な要点は、図１１に示す構成を有する装置上で、２Ｄ化像（１０５，１０６）の各々の部位の輝度を、観察者１００から見た総体的な輝度を一定に保ちつつ、３次元物体１０４の各部位が有する奥行き位置に対応して変えることである。

なお、前述の説明では、２次元像を配置する面の中で主に２つの面に関してのみ記述し、かつ観察者に提示する物体が２つの面の間にある場合について述べたが、２次元像を配

置する面の個数がこれよりも多く、あるいは提示する物体の位置が異なる場合であっても、同様な手法により３次元立体像を表示することが可能であることは明らかである。

例えば、面が３つで、観察者１００に近い面と、中間の面との間に第１の３次元物体が、中間の面と、観察者１００に遠い面との間に第２の３次元物体が存在する場合には、観察者１００に近い面と、中間の面とに、第１の３次元物体の２Ｄ化像を表示し、中間の面と、観察者１００に遠い面とに第２の３次元物体の２Ｄ化像を表示することで、第１および第２の３次元物体の３次元立体像を表示することができる。

さらに、２Ｄ化像が３次元的に移動する場合に関しては、観察者の左右上下方向への移動に関しては通常の２次元表示装置の場合と同様に表示面内での動画再生によって可能であり、奥行き方向への移動に関しては、２Ｄ化像（１０５，１０６）の各々の輝度を、観察者１００から見た総体的な輝度を一定に保ちつつ、３次元立体像の奥行き位置の時間的変化に対応して変化させることにより、３次元像の動画を表現できることは明らかである。

【0012】

［ＤＦＤ型の３次元表示装置の他の例］

図１７は、本発明の前提となるＤＦＤ型の３次元表示装置の他の例を説明するための図である。

図１７に示す３次元表示装置は、観察者１００の前方に、複数の透過型表示装置、例えば、透過型表示装置（１１１，１１２）（透過型表示装置１１１が透過型表示装置１１２より観察者１００に近い）と、種々の光学素子と、光源１１０を用いて光学系１０３を構築する。即ち、本実施例では、前述の図１１における表示面（１０１，１０２）に代えて、透過型表示装置（１１１，１１２）を用いるものである。

前記透過型表示装置（１１１，１１２）としては、例えば、ツイストネマティック型液晶ディスプレイ、イン・プレイン型液晶ディスプレイ、ホモジニアス型液晶ディスプレイ、強誘電液晶ディスプレイ、ゲストーホスト型液晶ディスプレイ、高分子分散型液晶ディスプレイ、ホログラフィック高分子分散型液晶ディスプレイ、あるいはこれらの組み合わせなどを使用する。また、光学素子としては、例えば、レンズ、全反射鏡、部分反射鏡、曲面鏡、プリズム、偏光素子、波長板などを用いる。

なお、図１７では、バックライト（光源）１１０が、観察者１００から見て最も後方に配置された場合を示し、また、図１７は、前述の特許文献２に記載されているものと同じ構成のものである。

【0013】

図１７に示す３次元表示装置においても、前述の図１２に示すように、観察者１００に提示したい３次元物体１０４を、観察者１００から見て、前記透過型表示装置（１１１，１１２）へ射影した２Ｄ化像（１０７，１０８）を生成する。

前記２Ｄ化像（１０７，１０８）を、図１７に示すように、各々透過型表示装置１１１と透過型表示装置１１２との双方に、観察者１００の右眼と左眼を結ぶ線上の一点から見て重なるように、２Ｄ化像（１０７，１０８）として表示する。

これは、例えば、２Ｄ化像（１０７，１０８）の各々の中心位置や重心位置の配置と、各々の像の拡大／縮小率を制御することで可能となる。

前記構成を有する装置上で、観察者１００が見る像は、光源１１０から射出された光で、２Ｄ化像１０８を透過し、さらに２Ｄ化像１０７を透過した光によって生成される。

図１７に示す３次元表示装置では、前記構成を有する装置上で、２Ｄ化像（１０７，１０８）の各々の透過度の配分を、観察者１００から見た総体的な輝度を一定に保ちつつ、３次元物体１０４の奥行き位置に対応して変えて、透過型表示装置１１１と透過型表示装置１１２との間に存在する３次元物体の３次元立体像を表示する。

【0014】

その２Ｄ化像（１０７，１０８）の各々の透過度の変え方の一例について説明する。

例えば、３次元物体１０４が透過型表示装置１１１上にある場合には、透過型表示装置１１１上の透過度を、２Ｄ化像１０７の輝度が３次元物体１０４の輝度に等しくなるよう

に設定し、透過型表示装置１１２上の２Ｄ化像１０８の部分の透過度を、例えば、その透過型表示装置１１２の最大値とする。

次に、例えば、３次元物体１０４が観察者１００より少し遠ざかって、透過型表示装置１１１より透過型表示装置１１２側に少し寄った位置にある場合には、透過型表示装置１１１上の２Ｄ化像１０７の部分の透過度を少し増加させ、透過型表示装置１１２上の２Ｄ化像１０８の部分の透過度を少し減少させる。

次に、例えば、３次元物体１０４が観察者１００よりさらに遠ざかって、透過型表示装置１１１より透過型表示装置１１２側にさらに寄った位置にある場合には、透過型表示装置１１１上の２Ｄ化像１０７の部分の透過度をさらに増加させ、透過型表示装置１１２上の２Ｄ化像１０８の部分の透過度をさらに減少させる。

さらに、例えば、３次元物体１０４が透過型表示装置１１２上にある場合には、透過型表示装置１１２上の透過度を、２Ｄ化像１０８の輝度が３次元物体１０４の輝度に等しくなるように設定し、透過型表示装置１１１上の２Ｄ化像１０７の部分の透過度を、例えば、透過型表示装置１１１の最大値とする。

【0015】

このように表示することにより、観察者（人）１００の生理的あるいは心理的要因あるいは錯覚により、表示しているのが２Ｄ化像（１０７，１０８）であっても、観察者１００にはあたかも透過型表示装置（１１１，１１２）の中間に３次元物体１０４が位置しているように感じられる。

即ち、例えば、透過型表示装置（１１１，１１２）にほぼ等輝度の２Ｄ化像（１０７，１０８）を表示した場合には、透過型表示装置（１１１，１１２）の奥行き位置の中間付近に３次元物体１０４があるように感じられる。この場合に、この３次元物体１０４は、観察者１００には立体感を伴って知覚される。

なお、前述の説明においては、例えば、３次元物体全体の奥行き位置を、例えば、透過型表示装置（１１１，１１２）に表示した２次元像を用いて表現する方法について主に述べたが、図１７に示す３次元表示装置においても、図１１に示す３次元表示装置で説明した方法と同様の手法により、例えば、３次元物体自体が有する奥行きを表現する方法としても使用できることは明らかである。

また、図１７に示す３次元表示装置においても、２Ｄ化像が３次元的に移動する場合には、観察者１００の左右上下方向への移動に関しては通常の２次元表示装置の場合と同様に透過型表示装置内での動画再生によって可能であり、また、奥行き方向への移動に関しては、複数の透過型表示装置における透過度の変化を時間的に行うことで、３次元立体像の動画を表現することができることは明らかである。

【0016】

ＤＦＤ型の３次元表示装置では、各表示面における観察者１００から見た輝度を、各表示面毎に変化させて３次元立体像を表示する。

即ち、図１１に示す３次元表示装置では、２Ｄ化像（１０５，１０６）の各々の輝度の配分を、観察者１００から見た総体的な輝度を一定に保ちつつ、３次元物体１０４の奥行き位置に対応して変化させて３次元立体像を表示する。

また、図１７に示す３次元表示装置では、２Ｄ化像（１０７，１０８）の各々の透過度の配分を、観察者１００から見た総体的な輝度を一定に保ちつつ、３次元物体１０４の奥行き位置に対応して変化させて３次元立体像を表示する。

このように、図１１に示す３次元表示装置では、３次元物体１０４に近い方の面に表示される２Ｄ化像の輝度を、３次元物体１０４に遠い方の面に表示される２Ｄ化像の輝度よりも増加させるのに対して、図１７に示す３次元表示装置では、３次元物体１０４に近い方の透過型表示装置に表示される２Ｄ化像の透過度を、３次元物体１０４に遠い方の透過型表示装置に表示される２Ｄ化像の透過度よりも減少させる点で異なっている。

したがって、図１７に示す３次元表示装置において、図１１に示す３次元表示装置と同様の手法を用いて、３次元物体自体が有する奥行きを表現する場合、あるいは、３次元立体像の動画を表現する場合には、図１１に示す３次元表示装置において、各表示面に表示

される２Ｄ化像の輝度を増加させる場合には、各透過型表示装置に表示される２Ｄ化像の透過度を減少させ、また、図１７に示す３次元表示装置において、各表示面に表示される２Ｄ化像の輝度を減少させる場合には、各透過型表示装置に表示される２Ｄ化像の透過度を増加させるようにすればよい。

【0017】

［実施例１］

図１は、本発明の実施例の３次元表示方法を実現するための３次元表示システムの概略構成を示すブロック図である。

本実施例の３次元表示システムでは、画像生成装置１０の画像生成手段２０１により生成された画像２１１が、画像表示装置１１に転送され、表示手段（２０４，２０５）に表示される。

本実施例では、画像表示装置１１において、画像生成装置１０の画像生成手段２０１から転送される画像２１１の種別を、画像判断手段２０２によって判断し、２次元画像と奥行き画像（２次元画像２１２，奥行き画像２１３）である場合には、輝度分配手段２０３によって複数の２次元画像に変換されて、表示手段（２０４，２０５）に表示される。

また、画像表示装置１１において、画像生成装置１０の画像生成手段２０１から伝送される画像２１１の種別を、画像判断手段２０２によって判断し、独立した２次元画像（２次元画像２１４，２次元画像２１５）である場合には、輝度分配手段２０３の処理を行わずにそのまま表示手段（２０４，２０５）に表示される。

Ｒ、Ｇ、Ｂの各々の画像信号を転送する方式（例えば、パーソナルコンピュータに使用されているようなアナログＲＧＢ、ＤＶＩ、ＬＶＤＳなどを含む）において、２系統の画像信号を転送するためには、全部で６種類（Ｒ１、Ｇ１、Ｂ１、Ｒ２、Ｇ２、Ｂ２）の信号を転送することになる。

そのため、独立した２次元画像（ＲＧＢ＋ＲＧＢ）を転送する場合には６種類全ての信号を利用することになるが、２次元画像と奥行き画像（ＲＧＢ＋Ｚ）の画像を伝送する場合には４種類の信号しか用いずに２つの信号が余ることになる。

この余っている信号を利用して、（ＲＧＢ＋ＲＧＢ）の画像なのか、（ＲＧＢ＋Ｚ）の画像なのかを判断させる。

【0018】

奥行き画像２１３とは、３次元物体の奥行き方向の情報（Ｘ，Ｙ，ＺのＺ）を輝度の情報に置き換えて、輝度の濃淡画像として構成したものである。

なお、３次元物体の奥行き方向の情報は、例えば、視線方向から３次元物体をカメラで撮影する際に、カメラ位置から３次元物体までの距離を、距離測定装置で測定し、その距離データに基づき生成することができる。

前述したように、本発明の基本となる３次元表示装置の重要な要点は、２Ｄ化像（１０５，１０６）の各々の輝度、あるいは、２Ｄ化像（１０７，１０８）の各々の透過度を、観察者１００から見た総体的な輝度を一定に保ちつつ、３次元物体１０４の奥行き位置に対応して変えることである。

したがって、画像生成装置１０から画像表示装置１１へ送信する画像として、２次元画像２１２と奥行き画像２１３とを使用することにより、画像表示装置１１において、各表示面に表示する２次元画像を生成することが可能である。

例えば、表示面（１０１，１０２）の奥行き位置の中間に３次元物体１０４がある場合、画像生成装置１０は、３次元物体の奥行き方向の情報を輝度の情報に置き換えた奥行き画像２１３を、画像表示装置１１に対して送信する。

そして、画像表示装置１１は、当該奥行き画像２１３に基づき、転送された輝度情報を一対一に分割し、２個の表示手段（２０４，２０５）にほぼ等輝度の２Ｄ化像（１０５，１０６）を表示することにより、２個の表示手段（２０４，２０５）の奥行き位置の中間付近に３次元物体があるように、３次元立体像を表示することが可能となる。

【0019】

本実施例では、画像判断手段２０２における、画像の種類の判断方法として、奥行き画

像の転送に使用する信号系統の余った２信号を用いて識別画像を埋め込む。
　埋め込む画像は、図２に示すように、（ＲＧＢ＋Ｚ）の始まりのフレームに始点、（ＲＧＢ＋Ｚ）の終わりのフレームに終点の識別画像を埋め込む。
　識別画像は、例えば、図３に示すように、通常の２次元画像にはあまり出現しないパターン（１つの信号に最高輝度（１１１１１１１１／８ｂｉｔなど）、最低輝度（００００００００／８ｂｉｔなど）を交互に全ての画素に配置し、もう１つの信号には逆の最低輝度、最高輝度というように逆のパターンにするなど）として、始点と終点を判断するための識別とさせる。このパターンは、ここに例示したものに限らず、なるべく通常の２次元画像に出現しないものを選択する。
　また、（ＲＧＢ＋Ｚ）の始まりのフレームに始点の識別画像を埋め込み、そこに継続させるフレームの枚数を埋め込み、そのフレーム数分だけ切り替えを行う方法もある。
　また、埋め込む識別画像は、図４に示すように、（ＲＧＢ＋Ｚ）の場合には、常に識別画像を埋め込み、識別する方法もある。例えば、図５に示すように、通常の２次元画像にはあまり出現しないパターンとして、（ＲＧＢ＋Ｚ）であることを判断するための識別とさせる。
　あるいは、図６に示すように、奥行き画像を反転させた画像を埋め込むなどの方法もある。この方法では、識別画像を１フレーム分読み込んでから判断されるために、１フレーム分のフレームバッファが必要となり、表示にも１フレームの遅れが生じる。
　遅れを最小限にするためには、識別画像をフレーム全体とせずに、例えば、最初の１ラインのみ、最初の数画素のみなどに限定することで、フレームバッファを最小（最初の１ラインのみ、最初の数画素のみなど）とすることができ、表示までの遅れを小さくすることができる。
【0020】
　［実施例２］
　本実施例では、フレーム内で、領域毎に、あるいは画素毎に、（ＲＧＢ＋ＲＧＢ）、あるいは（ＲＧＢ＋Ｚ）を切り替えるために、１フレームを用いて奥行き画像である領域を指定するマップ画像を挿入し、そのマップ画像を元にして次のフレーム以降の領域の判断を行う。
　マップ画像であることを示す識別画像を、余っている２つの信号に埋め込み、例えば、図７に示すように、通常の２次元画像にはあまり出現しないパターンとして、マップ画像であることを判断するための識別とさせる。
　図７の例では、マップ画像の「白」で表した領域が奥行き画像である領域を、「黒」で表した領域が２次元画像である領域をそれぞれ表している。識別画像はマップ画像の反転画像などを利用する方法もある。
　画像は、すぐには表示せずに、画像判断手段２０２に１フレーム分のフレームメモリを介して表示する方法とすることで、このフレームがマップ画像であると判断した場合には、マップ画像が直接表示されるのを避けるために、このフレームは表示せず、前のフレームの画像を保持して表示する。
　次のフレームからはマップ画像に従い、画像判断手段２０２にて、領域あるいは画素毎に輝度分配手段２０３を通る画像（ＲＧＢ＋Ｚ）か、輝度分配手段２０３を通らない画像（ＲＧＢ＋ＲＧＢ）かを切り替える。これを次のマップ画像が出現するまで繰り返す。
　全面を、（ＲＧＢ＋ＲＧＢ）にする場合には、図７に示すように、識別画像として全面が同一なマップ画像とすることで実現できる。逆に、全面（ＲＧＢ＋Ｚ）も同様である。これにより、フレーム内で領域あるいは画素単位での切り替えが可能となる。
【0021】
　［実施例３］
　本実施例では、画素毎に（ＲＧＢ＋ＲＧＢ）が、あるいは（ＲＧＢ＋Ｚ）を切り替えるために、１画素内に識別信号を埋め込むことで識別し判断する。
　埋め込む信号は、図８に示すように（ＲＧＢ＋Ｚ）の始まりの画素に始点、（ＲＧＢ＋Ｚ）の終わりの画素に終点の識別信号を埋め込む。

識別信号は、例えば、図８に示すように、通常の２次元画像の画素にはあまり出現しないパターン（１つの信号に、０１０１０１０１／８ｂｉｔ、もう１つの信号には、１０１０１０１０／８ｂｉｔというように逆のパターンにするなど）として、始点と終点を判断するための識別とさせる。

識別信号は、２次元画像のビットを反転したものを利用することもできる。このパターンは、ここに例示したものに限らず、なるべく通常の２次元画像の画素に出現しないものを選択する。

また、埋め込む識別信号は、図９に示すように、（ＲＧＢ＋Ｚ）の場合には、常に識別信号を埋め込み、識別する方法もある。

例えば、図９に示すように、通常の２次元画像の画素にはあまり出現しないパターン（１つの信号に、０１０１０１０１／８ｂｉｔ、もう１つの信号には、１０１０１０１０／８ｂｉｔというように逆のパターンにする、あるいはそれを画素毎に交互に繰り返すなど）として、（ＲＧＢ＋Ｚ）であることを判断するための識別とさせる。または、奥行き画像の画素を反転させた画素を埋め込むなどの方法もある。

【0022】

さらに、伝送路は８ビットであるが、画像のビット数が少ない場合（例えば、６ビットなど）には、埋め込む識別信号は、図１０に示すように、（ＲＧＢ＋Ｚ）の場合には常に識別信号を埋め込み、さらに画像の表示に必要のない全ての画素の下位２ビットに識別信号（例えば１０＊＊＊＊＊＊と、０１＊＊＊＊＊＊を交互にする：＊は任意）を埋め込むことで、識別する方法もある。

この方法では、識別画像を１画素分読み込んでから判断されるために、１画素分のバッファが必要となる。この方法は、奥行き画像の画素のみに埋め込む場合に比べて、通常の２次元画像で同様なパターンが出現する確立は低くなり、誤った判断を防止することができる。

画像のビット数が少なくない（例えば、８ｂｉｔ）場合にも、目立ちにくい下位のビットに同様に埋め込むことで、識別の精度を向上することも可能である。

また、画素が、（ＲＧＢ＋ＲＧＢ）から（ＲＧＢ＋Ｚ）に切り替わる画素の識別信号に、その画素から何画素分が（ＲＧＢ＋Ｚ）を維持するかの情報を埋め込むことで、常に識別信号を埋め込むことなく判断することもできる。

また、ライン毎の左端の画素（ライン走査する最初の画素）に識別信号として、そのライン中の奥行き画像の存在位置を示すために、例えば、信号２に始点信号（左端からの画素数など）、信号３に終点信号（左端からの画素数、あるいは右端からの画素数など）を埋め込んで、ライン中のどの範囲が奥行き画像であるかを判断する方法もある。

【0023】

また、前述までの説明では、ＲＧＢの画像の内部に識別信号を埋め込むことを説明したが、画像の同期信号やブランク期間の部分に同様な方法にて識別信号を埋め込むことも可能である。

以上説明したように、本実施例によれば、画像生成側から画像表示側に対して、２次元画像と奥行き画像を転送し、画像表示側において輝度分配してＤＦＤ方式の３次元表示する場合と、画像生成側から画像表示側に対して、独立した２次元画像を転送し、画像表示側においてそのまま表示してＤＦＤ方式の３次元表示する場合との切り替えを、画像に埋め込んだ識別画像により自動的に行うことが可能となる。

以上、本発明者によってなされた発明を、前記実施例に基づき具体的に説明したが本発明は、前記実施例に限定されるものではなく、その要旨を逸脱しない範囲において種々変更可能であることは勿論である。

【図面の簡単な説明】

【0024】

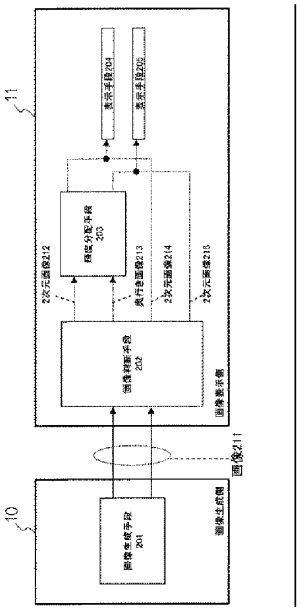
【図1】本発明の実施例の３次元表示方法を実現するための３次元表示システムの概略構成を示すブロック図である。

【図2】本発明の実施例１の３次元表示方法において、画像生成装置から画像表示装置に

転送される画像に埋め込まれる識別画像の一例を説明するための図である。
【図3】本発明の実施例１の３次元表示方法において、画像生成装置から画像表示装置に転送される画像に埋め込まれる識別画像の他の例を説明するための図である。
【図4】本発明の実施例１の３次元表示方法において、画像生成装置から画像表示装置に転送される画像に埋め込まれる識別画像の他の例を説明するための図である。
【図5】本発明の実施例１の３次元表示方法において、画像生成装置から画像表示装置に転送される画像に埋め込まれる識別画像の他の例を説明するための図である。
【図6】本発明の実施例１の３次元表示方法において、画像生成装置から画像表示装置に転送される画像に埋め込まれる識別画像の他の例を説明するための図である。
【図7】本発明の実施例２の３次元表示方法において、画像生成装置から画像表示装置に転送される画像に埋め込まれる識別画像の他の例を説明するための図である。
【図8】本発明の実施例３の３次元表示方法において、画像生成装置から画像表示装置に転送される画像に埋め込まれる識別画像の他の例を説明するための図である。
【図9】本発明の実施例３の３次元表示方法において、画像生成装置から画像表示装置に転送される画像に埋め込まれる識別画像の他の例を説明するための図である。
【図10】本発明の実施例３の３次元表示方法において、画像生成装置から画像表示装置に転送される画像に埋め込まれる識別画像の他の例を説明するための図である。
【図11】本発明の基本となる３次元表示装置の概略構成を示す図である。
【図12】本発明の基本となる３次元表示装置において、各表示面に表示する２Ｄ化像の生成方法を説明するための図である。
【図13】本発明の基本となる３次元表示装置の表示原理を説明するための図である。
【図14】本発明の基本となる３次元表示装置の表示原理を説明するための図である。
【図15】本発明の基本となる３次元表示装置の表示原理を説明するための図である。
【図16】本発明の基本となる３次元表示装置の表示原理を説明するための図である。
【図17】本発明の前提となるＤＦＤ型の３次元表示装置の他の例を説明するための図である。
【符号の説明】
【0025】
１０　画像生成装置
１１　画像表示装置
１００　観察者
１０１，１０２　表示面
１０３　光学系
１０４　３次元物体
１０５，１０６，１０７，１０８　２Ｄ化像
１１１，１１２　透過型表示装置
１１０　バックライト
２０１　画像生成手段
２０２　画像判断手段
２０３　輝度分配手段
２０４，２０５　表示手段
２１１　画像
２１２，２１４，２１５　2次元画像
２１３　奥行き画像

【図1】

図１



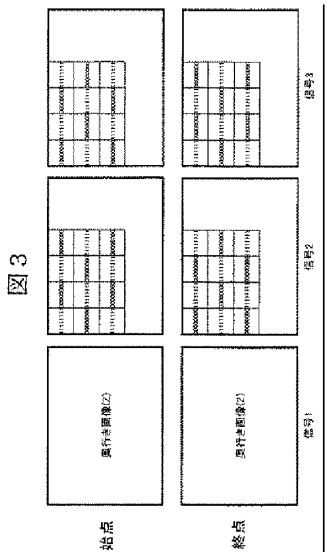
【図2】

図２



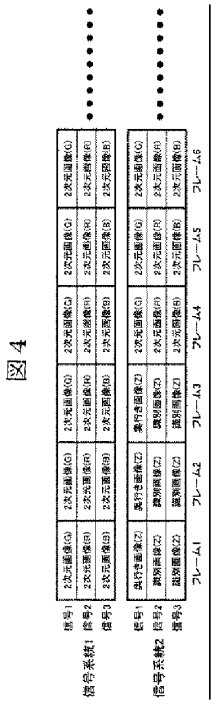
【図3】

図３

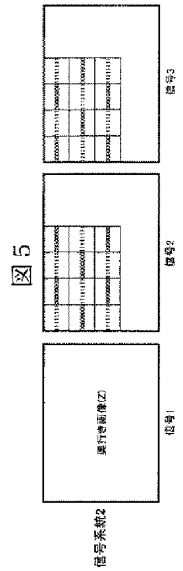


【図4】

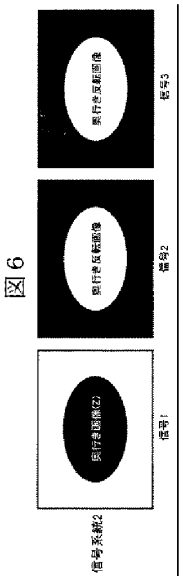
図４



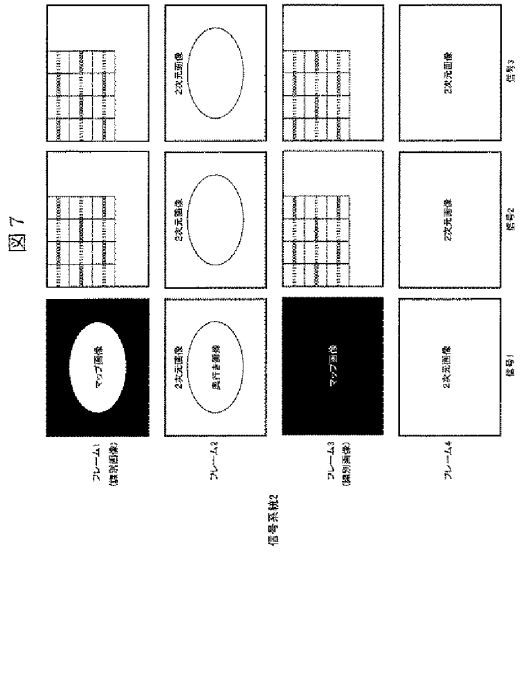
【図5】


図５
信号系統2
信号1
信号2
信号3

【図6】


図６
信号系統2
信号1
信号2
信号3

【図7】

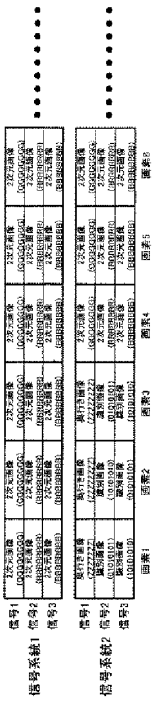

図７
信号系統2
フレームA1
フレームA2
フレームA3
フレームA4
信号1
信号2
信号3

【図8】


図８
信号系統1
信号系統2
信号1
信号2
信号3

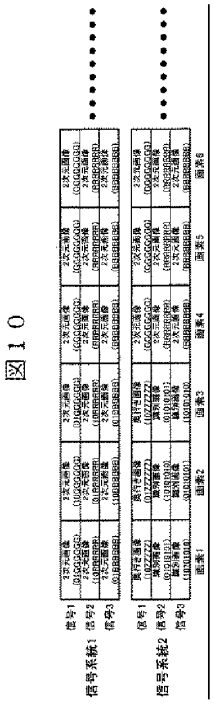
【図9】

図９



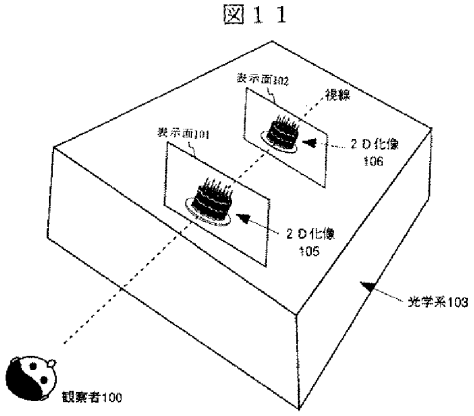
【図10】

図１０



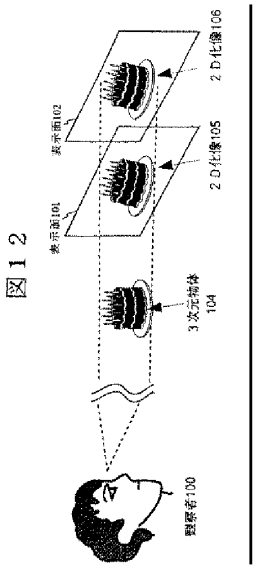
【図11】

図１１



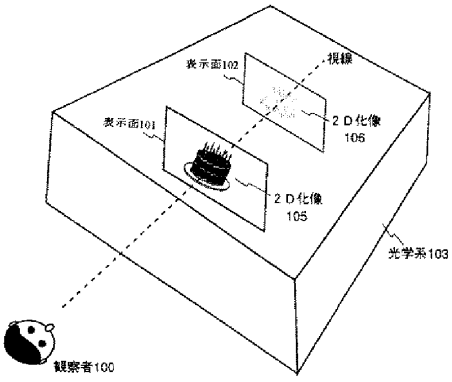
【図12】

図１２



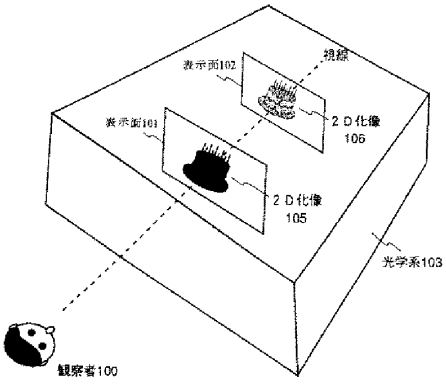
【図13】

図１３



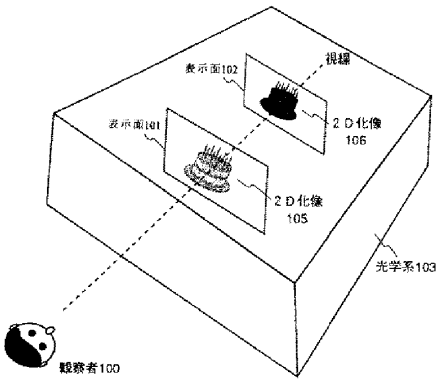
【図14】

図１４



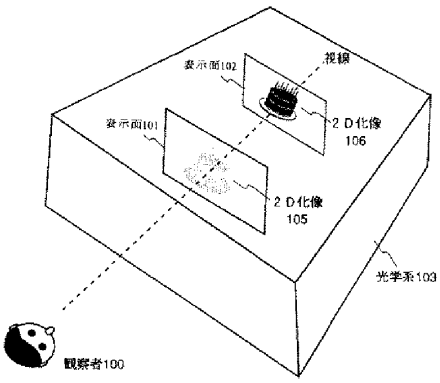
【図15】

図１５



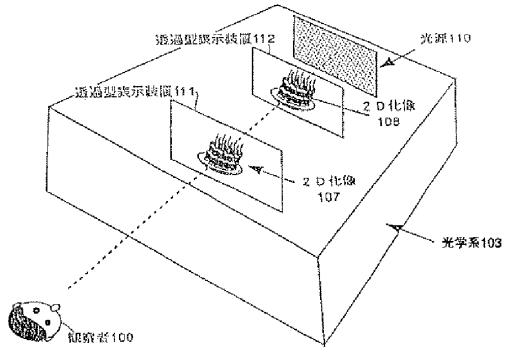
【図16】

図１６



【図17】

図１７


透過型表示装置112
光源110
透過型表示装置111
２Ｄ化像
108
２Ｄ化像
107
光学系103
観察者100

(51)Int.Cl.			FI			テーマコード（参考）
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			Ｇ０９Ｇ	5/10	Ｂ	
			Ｇ０９Ｇ	5/36	５１０Ｖ	
			Ｇ０９Ｇ	5/00	５５５Ｄ	

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DA73 DA89 MM09

Espacenet

Bibliographic data: JP2007325101 (A) — 2007-12-13

COMMUNICATION SYSTEM, TRANSMISSION DEVICE AND RECEPTION DEVICE, COMMUNICATION METHOD, AND PROGRAM

No documents available for this priority number.

Inventor(s): MATSUURA KATSUJI ± (MATSUURA KATSUJI)

Applicant(s): SONY CORP ± (SONY CORP)

Classification: **- international:** ***H04J3/00***
- cooperative:

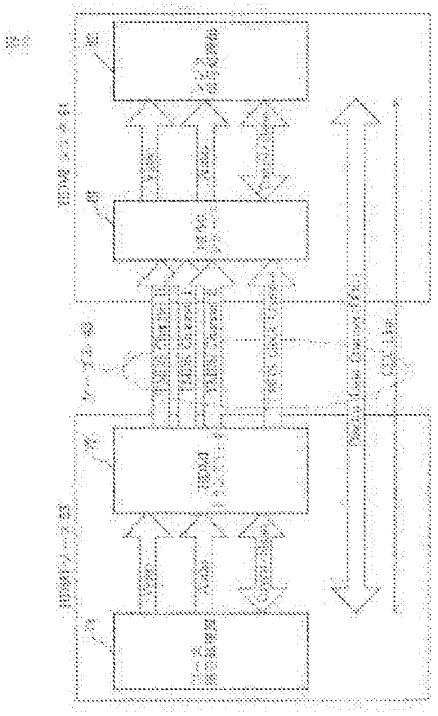
Application number: JP20060154864 20060602

Priority number(s): JP20060154864 20060602

Also published as: JP4957083 (B2)

Abstract of JP2007325101 (A)

PROBLEM TO BE SOLVED: To perform efficient data transmission through an HDMI (R) etc. ; SOLUTION: An HDMI(R) source 53 decides whether an HDMI(R) sink 61 can receive a sub-signal based upon a VSDB of E-EDID and adds the sub-signal to pixel data of a main image comprising the pixel data less in number of bits than transmission pixel data transmitted by a transmitter 72 when the HDMI(R) sink 61 can receive the sub-signal to constitute transmission pixel data, and a transmitter 72 transmits the data over TMDS channels #0 to #2. Further, the HDMI(R) source 53 transmits a general control packet containing sub-signal information showing whether the sub-signal is included in the transmission pixel data in a control section of a vertical blanking period. The present invention is applicable to, for example, the HDMI(R). ; COPYRIGHT: (C) 2008,JPO&INPIT



Last updated: 11.12.2013 Worldwide Database 5.8.15.10; 92p

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DESCRIPTION JP2007325101

[0001]

Receiving device communication system, and a transmission device, a communication method, and a program, in particular, it is possible to high-speed transmission in one direction, the pixel data of an uncompressed image, for example, the present invention, HDMI (High Definition Multimedia Interface) a communication system that enables a communication interface such as (R), to perform efficient data transmission, the transmitter and receiver, a communication method, and a program.

[0002]

Recently, for example, AV source and DVD (Digital Versatile Disc) recorder, set-top boxes, and other from the (source), to the display television receiver, projector, or other digital television signals, i.e., uncompressed (As a communication interface for transmitting at high speed pixel data (video) images of the baseband), and audio data accompanying the image, HDMI (R) is becoming widespread.

[0003]

HDMI For (R), at high speed, the audio data and pixel data, (HDMI (R) Sink) in, HDMI (R) sink TMDS transmitting unidirectionally HDMI (R) source (HDMI (R) Source) from specification of HDMI CEC line for performing bidirectional communication between or (Transition Minimized Differential Signaling) channels, HDMI HDMI and (R) source (R) sink (Consumer Electronics Control Line)

and the like, the (current it is prescribed "High-Definition Multimedia Interface Specification Version 1.2a" specification of the latest, in 14, 2005) December.

[0004]

Also, HDMI is (R), it is possible to implement the HDCP (High-Bandwidth Digital Content Protection) for the copy protection of the content.

[0005]

Others, HDMI for (R), (for example, see Patent Document 1) a method to prevent the transmission performed unwanted signals in the horizontal blanking interval and vertical blanking interval has been proposed.

[0006]

Japanese Patent Publication No. 2005-102161

[0007]

Incidentally, HDMI current in (R), for example, an image respectively (Red, Green, Blue) of RGB consists 8-bit pixel data (hereinafter, appropriately, referred to 24-bit (also = 8 bits × 3) image) It can be transmitted, but in recent years, an image having a high gray level higher, that is, each of RGB, the image consisting of pixel data of multiple bits of 12-bit or 10-bit larger than 8 bits (hereinafter referred to as high gray request to transmit) also referred to as the image is increasing.

[0008]

Therefore, a method in HDMI (R), transmits the high tone image have been studied.

[0009]

However, the request can be transmitted high gray scale image is is growing, but it still, 24-bit images are treated in many cases.

[0010]

Therefore, when it is extended to allow the HDMI (R) is to transmit a high tone image, when transmitting 24-bit image, one pixel per a number of bits of pixel data of the high tone image, 24-bit the difference between 24 bit is the number of bits of pixel data of the image only, so that will be transmitting useless data, the data transmission inefficient performed.

[0011]

The present invention, which has been made in view of such a situation may be high-speed transmission in one direction, the pixel data of an uncompressed image, for example, the communication interface HDMI, such as (R), effective It is to be able to exchange data such.

[0012]

After receiving the performance information representative of the performance of the receiver, from the section to the next vertical synchronization signal, the communication system of the first aspect of the present invention, the vertical blanking interval and the horizontal blanking period of the vertical synchronizing signal of the 1 In an effective image interval is an interval obtained by removing, in a plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, a differential signal, pixel data of the image of one uncompressed screen, a transmission device for transmitting in one direction to the receiving apparatus, after transmitting the performance information, from the transmitting device, in the plurality of channels, and a said receiving apparatus for receiving pixel data transmitted by the differential signal A communication system, by adjusting the frequency of the pixel clock, and the plurality of channels, the transmission apparatus, a differential signal, pixel data assigned number of bits than the number of bits of the fixed, determining the sub-signal reception determination means for determining whether or not can be a transmission unit for transmitting in one direction to the receiving device,

that is under the performance information, the receiving apparatus receives the sub-signal, wherein the receiving device If it is possible to receive a sub-signal, the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmission unit,By adding the sub-signal, the sub-signal addition means for constituting the transmission pixel data in the vertical blanking interval, the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval, and a data transmission control means for transmitting the sub-signal information representative of the sub-signal whether included in the plurality of channels, the receiving apparatus, receiving for receiving the transmission pixel data transmitted by the differential signal the transmission pixel data on the basis of the means and the sub-signal information transmitted in the vertical blanking interval, and transmitted to the effective image period immediately after the vertical blanking interval, the sub-signal is be included If determining sub-signal presence determining means, the transmission pixel data, including the said sub-signal whether, from the transmitting pixel data, I and a separating means for separating the sub-signal.

[0013]

In the communication system of the first aspect of the above, in the transmitting device, the pixels by the transmission means, for adjusting the frequency of the pixel clock, the number of bits than the number of bits of the fixed assigned In the plurality of channels, a differential signal, I send in one direction to the receiving device, the data.

Further, if it is possible is judged whether or not may be based on the performance information, the receiving apparatus receives the sub-signal, the receiving apparatus receives the sub-signal, pixels to be transmitted by said transmitting unit By the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is data, and adding the sub-signal, the transmission pixel data is constructed, in the vertical blanking interval, and as a vertical retrace sub-signal information indicating the transmission pixel data transmitted in the valid image period immediately after the line section, wherein the secondary signal whether included is transmitted.

Meanwhile, in the receiving device, in the plurality of channels, the reception unit receives the transmission pixel data transmitted by the differential signal.

Further, the transmission pixel data on the basis of the sub-signal information transmitted in the vertical blanking interval, and transmitted to the effective image period immediately after the vertical blanking interval, the sub-signal whether included If is is determined, the transmission pixel data, the sub-signal is included, from the transmission pixel data, the sub-signals are separated.

[0014]

After receiving the performance information representative of the performance of the receiver, from the section to the next vertical synchronization signal, the transmission device according to a second aspect of the present invention, the vertical blanking interval and the horizontal blanking period of the vertical synchronizing signal of the 1 In an effective image interval is an interval obtained by removing, in a plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, a differential signal, pixel data of the image of one uncompressed screen, a transmission device for transmitting in one direction to the receiving device, by adjusting the frequency of the pixel clock, in the plurality of channels, differential pixel data assigned number of bits than the number of bits of the fixed The signal, determining the sub-signal reception determination means for determining whether or not can be a transmission unit for transmitting in one direction to the receiving device, that is under the performance information, the receiving apparatus receives the sub-signal, and the If it is possible that the receiving apparatus receives the sub-signal, the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmission unit, and to add the sub signal by a sub-signal addition means for constituting the transmission pixel data in the vertical blanking interval, the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval, the sub-signal is included

[0015]

Communication method according to the second aspect of the present invention, or after receiving the performance information representative of the performance of the receiver, from the section to the next vertical synchronization signal, the program, the vertical and horizontal blanking period of the vertical synchronizing signal of the 1 In an effective image interval is an interval obtained by removing the blanking interval, in the plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, and the differential, the pixel data of the image for one screen of uncompressed The signal, a communication method of a transmission apparatus for transmitting in one direction to the receiving device, or a program to be executed by a computer that controls the transmission device, by adjusting the frequency of the pixel clock, the transmission apparatus of the fixed In the plurality of channels, a differential signal, a transmitting means for transmitting in one direction to the receiving device, based on the performance information, and the receiving device, the pixel data assigned number of bits than the number of bits but if it can be determined whether may receive the sub-signal, the receiving apparatus receives the sub-signals, the number of bits is less than the transmission pixel data is the pixel data transmitted by said transmitting unit By the pixel data of the main image composed of pixel data and adding the sub-signal, constitute the transmission pixel data in the vertical blanking

interval,I comprises the step of transmitting the sub-signal information indicating the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval, the sub-signal whether the like.

[0016]

In a second aspect of the above, if it is possible is judged whether or not may be based on the performance information, the receiving apparatus receives the sub-signal, the receiving apparatus receives the sub signal , by the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmission unit, and to add the auxiliary signal, the transmission pixel data is constructed, and the In the vertical blanking period, sub-signal information indicating the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval, the sub-signal whether included is transmitted.

[0017]

After receiving the performance information representative of the performance of the receiver, from the section to the next vertical synchronization signal, the receiving apparatus according to a third embodiment of the present invention, the vertical blanking interval and the horizontal blanking period of the vertical synchronizing signal of the 1 In an effective image interval is an interval obtained by removing, in a plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, a differential signal, pixel data of the image of one uncompressed screen, a transmission device for transmitting in one direction to the receiving device, by adjusting the frequency of the pixel clock, in the plurality of channels, differential pixel data assigned number of bits than the number of bits of the fixed The signal, determining the sub-signal reception determination means for determining whether or not can be a transmission unit for transmitting in one direction to the receiving device, that is under the performance information, the receiving apparatus receives the sub-signal, and the If it is possible that the receiving apparatus receives the sub-signal, the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmission unit, and to add the sub signal by a sub-signal addition means for constituting the transmission pixel data in the vertical blanking interval, the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval,After the transmitting device and a data transmission control means for transmitting the sub-signal information representative of the sub-signal whether included or submit the performance information, from the transmitting device, with the plurality of channels, differential It is the receiving apparatus for receiving pixel data transmitted by the signal at the plurality of channels, a receiving unit for receiving the transmission pixel data transmitted by

the differential signal, it is sent to the vertical blanking interval determining the sub-signal presence determining means to the transmission pixel data on the basis of the information signal sub the coming, transmitted to the effective image period immediately after the vertical blanking interval, the sub-signal whether contained, the If the transmission pixel data, the sub-signal is included, from the transmitting pixel data, I and a separating means for separating the sub-signal.

[0018]

Communication method of the third aspect of the present invention, or after receiving the performance information representative of the performance of the receiver, from the section to the next vertical synchronization signal, the program, the vertical and horizontal blanking period of the vertical synchronizing signal of the 1 In an effective image interval is an interval obtained by removing the blanking interval, in the plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, and the differential, the pixel data of the image for one screen of uncompressed The signal is a transmission apparatus for transmitting in one direction to the receiving device, by adjusting the frequency of the pixel clock, and the plurality of channels, the pixel data assigned number of bits than the number of bits of the fixed , the differential signal, determines the sub-signal reception determination means for determining whether or not can be a transmission unit for transmitting in one direction to the receiving device, that is under the performance information, the receiving apparatus receives the sub signal and, if it is possible that the receiving apparatus receives the sub-signal, the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmission unit, and the sub signal By adding a sub-signal addition means for constituting the transmission pixel data in the vertical blanking interval, the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval,After the transmitting device and a data transmission control means for transmitting the sub-signal information representative of the sub-signal whether included or submit the performance information, from the transmitting device, with the plurality of channels, differential communication method of the receiving apparatus for receiving pixel data transmitted by the signal, or a program to be executed by a computer for controlling the receiving device, in the plurality of channels, the receiving device is transmitted using differential signals The transmission pixel to a receiving unit for receiving the transmission pixel data coming, based on the sub-signal information transmitted in the vertical blanking interval, and transmitted to the effective image period immediately after the vertical blanking interval the data, it is determined that the sub-signal whether included, when the transmission pixel data, the sub-signal is included, from the transmission pixel data, and a step of separating the sub-signal.

[0019]

In the third aspect described above, the transmission pixel data on the basis of the sub-signal information transmitted in the vertical blanking interval, and transmitted to the effective image period immediately after the vertical blanking interval , if is determined that the sub-signal is whether included, in the transmission pixel data, the sub-signal is included, from the transmission pixel data, the sub-signals are separated.

[0020]

According to the first aspect of the first to third of the present invention may be high-speed transmission in one direction, the pixel data of an uncompressed image, for example, the communication interface HDMI, such as (R), and efficient data transmission It can be performed.

[0021]

In describing the embodiments of the present invention to, the requirements of the present invention, examples of correspondence with the embodiments described in the specification or the drawings is as follows.

This description is intended to assure that embodiments supporting the present invention are described in the specification or the drawings.

Therefore, it is described in the drawings or the specification, but as an embodiment corresponding to a constitutional requirement of the present invention, even if the embodiments not described herein, that matter, its implementation It does not necessarily mean that it does not form corresponds to that feature.

Conversely, even if it is described herein as an embodiment corresponding to a constitutional requirement, that the mean, it is preferable that the embodiment does not correspond to other features of the that does not necessarily.

[0022]

After receiving the performance information representative of the performance of the receiver, from the section to the next vertical synchronization signal, the communication system of the first

aspect of the present invention, the vertical blanking interval and the horizontal blanking period of the vertical synchronizing signal of the 1 In an effective image interval is an interval obtained by removing, in a plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, a differential signal, pixel data of the image of one uncompressed screen, (e.g., HDMI in FIG 2 (R) source 53) and, after transmitting the performance data, from the transmitting device, in the plurality of channels, and is transmitted by the differential signal transmitting apparatus for transmitting in one direction to the receiving device (e.g., HDMI in FIG 2 (R) sink 61) is a communication system comprising from said receiving apparatus for receiving pixel data coming, by adjusting the frequency of the pixel clock, the transmission apparatus of the fixed In the channel of the plurality of differential signals (e.g., transmitter 72 of FIG 2), and the performance transmitting means for transmitting in one direction to the receiving device, the pixel data assigned number of bits than the number of bits determines the sub-signal reception determination unit (for example, sub-signal reception determination unit 105 in FIG 20) and whether it can be based on the information, the receiving apparatus receives the sub-signals,If it is possible that the receiving apparatus receives the sub-signal, the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmission unit, and adds the sub signal By the (e.g., the sub-signal addition section 102 in FIG 20) and the sub-signal addition means for constituting the transmission pixel data in the vertical blanking interval, it is sent to the valid image period immediately after the vertical blanking interval an information transmission control means for transmitting the sub-signal information indicating the transmission pixel data Ru, the sub signal whether contains (eg, sub-signal frame information transmission controller 107 of FIG 20) and, the receiving device , at the plurality of channels, and based on (for example, receiver 81 of FIG 2), the sub-signal information transmitted in the vertical blanking interval receiving means for receiving the transmission pixel data transmitted by the differential signal Te, determines the sub-signal presence determination unit (for example, sub-signal presence determination in FIG 23 to the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval, the sub-signal whether included and section 122), if the transmission pixel data, the auxiliary signal is included, from the transmitting pixel data, I include separating means for separating the sub-signal (for example, a separation section 123) of Figure 23.

[0023]

After receiving the performance information representative of the performance of the receiver, from the section to the next vertical synchronization signal, the transmission device according to a second aspect of the present invention, the vertical blanking interval and the horizontal blanking period of the vertical synchronizing signal of the 1 In an effective image interval is an interval obtained by removing, in a plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, a differential signal, pixel data of the image of one uncompressed

screen, (e.g., HDMI in FIG 2 (R) source 53), and by adjusting the frequency of the pixel clock, the number of bits than the number of bits of the fixed assigned transmitting apparatus for transmitting in one direction to the receiving device In the channel of the plurality of differential signals (e.g., transmitter 72 of FIG 2) and, on the basis of the performance information, the receiving apparatus secondary transmission means for transmitting in one direction to the receiving device, the pixel data are When determining the sub-signal reception determination unit (for example, sub-signal reception determination unit 105 in FIG 20), it is possible that the receiving apparatus receives the sub-signal and whether it can receive a signal, the By the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmitting unit, and to add the sub signal,(For example, the sub-signal addition section 102 in FIG 20) and the sub-signal addition means for constituting the transmission pixel data in the vertical blanking interval, the transmission pixel that is sent to the effective image period immediately after the vertical blanking interval I is an information transmission control means for transmitting the sub-signal information indicating the data, the secondary signal whether contains (eg, sub-signal frame information transmission controller 107 of FIG 20) and a.

[0024]

Communication method according to the second aspect of the present invention, or after receiving the performance information representative of the performance of the receiver, from the section to the next vertical synchronization signal, the program, the vertical and horizontal blanking period of the vertical synchronizing signal of the 1 In an effective image interval is an interval obtained by removing the blanking interval, in the plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, and the differential, the pixel data of the image for one screen of uncompressed The signal, a communication method of a transmission apparatus for transmitting in one direction to the receiving device, or a program to be executed by a computer that controls the transmission device, by adjusting the frequency of the pixel clock, the transmission apparatus of the fixed In the plurality of channels, a differential signal, provided (for example, the transmitter 72 of FIG 2) transmitting means for transmitting in one direction to the receiving device, and wherein the pixel data assigned number of bits than the number of bits (for example, step S104 in FIG 22), if it is possible that the receiving apparatus receives the sub-signal, the transmission and determines whether or not may be based on the performance information, the receiving apparatus receives the sub signal By the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the unit, adding the sub-signal,(For example, step S112 in FIG 22), in the vertical blanking interval, the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval, the sub-signal is included to configure the transmission pixel data including (for example, S116 or step S111 in FIG 22) the step of transmitting the sub-signal information indicating whether the.

[0025]

After receiving the performance information representative of the performance of the receiver, from the section to the next vertical synchronization signal, the receiving apparatus according to a third embodiment of the present invention, the vertical blanking interval and the horizontal blanking period of the vertical synchronizing signal of the 1 In an effective image interval is an interval obtained by removing, in a plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, a differential signal, pixel data of the image of one uncompressed screen, (e.g., HDMI in FIG 2 (R) source 53), and by adjusting the frequency of the pixel clock, the number of bits than the number of bits of the fixed assigned transmitting apparatus for transmitting in one direction to the receiving device In the channel of the plurality of differential signals (e.g., transmitter 72 of FIG 2) and, on the basis of the performance information, the receiving apparatus secondary transmission means for transmitting in one direction to the receiving device, the pixel data are When determining the sub-signal reception determination unit (for example, sub-signal reception determination unit 105 in FIG 20), it is possible that the receiving apparatus receives the sub-signal and whether it can receive a signal, the By the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmitting unit, and to add the sub signal,(For example, the sub-signal addition section 102 in FIG 20) and the sub-signal addition means for constituting the transmission pixel data in the vertical blanking interval, the transmission pixel that is sent to the effective image period immediately after the vertical blanking interval the transmission device including information transmission control means for transmitting the sub-signal information indicating the data, the secondary signal whether contains (eg, sub-signal frame information transmission controller 107 of FIG 20) and to the performance information After transmitting, from the transmitting device in the plurality of channels, (e.g., HDMI in FIG 2 (R) sink 61), and said plurality of said receiving apparatus for receiving pixel data transmitted by the differential signal In the channel, on the basis (e.g., receiver 81 of FIG 2), the sub-signal information transmitted in the vertical blanking interval receiving means for receiving the transmission pixel data transmitted by the differential signal, the determines the sub-signal presence determining means (for example, sub-signal presence determination unit 122 in FIG 23) to the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval, the sub-signal whether included and the case where the transmission pixel data, the auxiliary signal is included, from the transmitting pixel data, I include separating means for separating the sub-signal (for example, separation unit 123 of Figure 23) and.

[0026]

Communication method of the third aspect of the present invention, or after receiving the performance information representative of the performance of the receiver, from the section to the next vertical synchronization signal, the program, the vertical and horizontal blanking period of the vertical synchronizing signal of the 1 In an effective image interval is an interval obtained by removing the blanking interval, in the plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, and the differential, the pixel data of the image for one screen of uncompressed The signal (e.g., HDMI in FIG 2 (R) source 53), and by adjusting the frequency of the pixel clock, the number of bits more than the number of the fixed transmission apparatus for transmitting in one direction to the receiving device In the channel of the plurality of differential signals (e.g., transmitter 72 of FIG 2) and, on the basis of the performance information, the receiving transmission means for transmitting in one direction to the receiving device, the pixel data assigned determines the sub-signal reception determination unit (for example, sub-signal reception determination unit 105 in FIG 20), it is possible that the receiving apparatus receives the sub-signal to determine whether or not the device can receive a sub-signal If, by the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmission unit, and to add the sub signal,(For example, the sub-signal addition section 102 in FIG 20) and the sub-signal addition means for constituting the transmission pixel data in the vertical blanking interval, the transmission pixel that is sent to the effective image period immediately after the vertical blanking interval the transmission device including information transmission control means for transmitting the sub-signal information indicating the data, the secondary signal whether contains (eg, sub-signal frame information transmission controller 107 of FIG 20) and to the performance information After transmitting, from the transmitting device in the plurality of channels, and a communication method of the receiving apparatus for receiving pixel data transmitted by the differential signal at the plurality of channels, the receiving apparatus, the difference provided (for example, receiver 81 of FIG 2) receiving means for receiving the transmission pixel data transmitted by the motion signal, on the basis of the sub-signal information transmitted in the vertical blanking interval, the vertical blanking interval the transmission pixel data transmitted in the valid image period immediately after (for example, step S133 in FIG 24), the transmission pixel data, the sub-signal is contained and determines the sub-signal whether included case, I (eg, step S138 in FIG. 24) the steps from the transmitting pixel data, separating the sub-signal.

[0027]

Hereinafter, with reference to the drawings will be described embodiments of the present invention.

[0028]

Figure 1 shows a configuration example of an embodiment AV according to the present invention (Audio Visual) system.

[0029]

In Figure 1, consists of a display 42 and a (Hard Disk) recorder 41 HD, and the display 42 and the HD recorder 41, AV system, are connected via a cable of 43 HDMI (R) for.

[0030]

Consists HD54 recording and reproducing unit 51, codec 52, HDMI (R) and source 53,, HD recorder 41, recording and reproducing data to HD54.

[0031]

That is, the recording and reproducing unit 51 records the HD54, the encoded data obtained by encoding MPEG with (Moving Picture Experts Group) system or the like data of the baseband of the voice supplied from the codec 52, and the associated image .

Further, the recording reproducing unit 51 supplies (read), the codec 52 reproduces the encoded data from the HD54.

[0032]

Decodes the MPEG system or the like to the baseband video and audio data, the encoded data supplied from the recording and reproducing unit 51, HDMI codec 52, Ya (R) source 53, the video and audio data of the base band is supplied to an external apparatus (not shown).

[0033]

Further, for example, encodes the encoded data, and the baseband video and audio data supplied from an external apparatus (not shown), the codec 52, and supplies the recording reproducing unit 51, the encoded data.

[0034]

The compliant communication (R) HDMI, via the cable 43, HDMI (R) source 53 transmits to the one direction on the display 42, and the baseband video and audio data supplied from the codec 52.

[0035]

Is composed of the display unit 63 (R) sink 61, and a display control unit 62, HDMI, the display 42 performs the display of an image.

[0036]

That is, HDMI (R) sink 61, the baseband transmitted unidirectionally HDMI, HD recorder 41 by communication based on the (R) HDMI, is connected via a cable 43 from (R) source 53 receives the image data and audio data, and supplies it to the display unit 62, the data of the image of them.

For example, the data of audio HDMI (R) sink 61 is received is output is supplied to a speaker (not shown) display 42 is built.

[0037]

Based on the data of the image of the baseband supplied from the HDMI (R) sink 61, controls the display unit 63 (driven), whereby, on the display unit 63, the display control unit 62 displays an image corresponding.

[0038]

For example, is composed of a CRT (Cathode Ray Tube), LCD (Liquid Crystal Display), an organic EL in (Electro Luminescence) and the like, under the control of the display control unit 62, display unit 63 displays an image.

[0039]

In the AV system 1 comprises diagrams, for example, the user, to play HD54, and operates the HD recorder 41, and reproduces the encoded data from the HD54, the recording and reproducing unit 51, the codec 52 as described above supply.

[0040]

Decoded into baseband video and audio data, the encoded data supplied from the recording and reproducing unit 51, the codec 52 and provides the (R) source 53 HDMI, the video and audio data of the base band.

[0041]

The compliant communication (R) HDMI, via the cable 43, HDMI (R) source 53 transmits to the one direction on the display 42, and the baseband video and audio data supplied from the codec 52.

[0042]

In the display 42, HDMI (R) sink 61, the base to be transmitted in one direction HDMI, HD recorder 41 by communication conforming to HDMI (R), is connected via a cable 43 from (R) source 53 receives the video and audio data of the band, and supplies the display control unit 62, the data of the image of which is supplied to the speaker which is not shown, the audio data.

[0043]

The display control unit 62, based on data of the image supplied from the HDMI (R) sink 61, and the display unit 63, whereby the display unit 63, the corresponding image is displayed.

[0044]

Figure 2 shows an exemplary configuration of FIG HDMI 1 HDMI and (R) source 53 (R) sink 61.

[0045]

Section to the next vertical synchronization signal (hereinafter referred to as a video field) from a, HDMI (R) source 53, the effective image is an interval other than the vertical blanking interval and the horizontal blanking period of the vertical synchronizing signal of the 1 section (hereinafter occasionally referred to as an active video period), the plurality of channels, I unidirectionally transmits the HDMI (R) sink 61, a differential signal corresponding to pixel data of the image for one screen of uncompressed together with, in the horizontal blanking period or the vertical blanking period, in a plurality of channels, HDMI (R) of the sink, a differential signal corresponding to the auxiliary data, etc. (Control Packet) and other audio data and control packets associated with the image I send in one direction.

[0046]

In other words, HDMI (R) source 53 includes a transmitter 72 and the source signal processing unit 71.

[0047]

The source signal processor 71, the codec 52 (Fig. 1), etc., and audio data (Video) of (Audio) image uncompressed baseband is supplied.

Performs necessary processing for video and audio data supplied thereto, the source signal processing section 71 supplies the transmitter 72.

Further, with the transmitter 72, the source signal processing section 71 exchanges information if necessary, tell the status information and control (Control / Status) or the like.

[0048]

Converted into a corresponding differential signal, pixel data of the image supplied from the source signal processing section 71, TMDS channel # 3 is a plurality of channels 0, # 1, and # 2, the transmitter 72, the cable 43 HDMI, which is connected via the (R) sink 61, the serial transmission in one direction.

[0049]

In addition, auxiliary data of the control packet voice and other data accompanying supplied from the source signal processing unit 71, in a non-compressed image with (auxiliary data), vertical sync signal horizontal sync signal and (VSYNC) transmitter 72, (HSYNC HDMI, which is converted into a corresponding differential signal, control data) such as a (control data), TMDS channel # 3 0, # 1 and # 2 are connected via a cable 43 (R) sink 61 to, I want to serial transmission in one direction.

[0050]

Further, the transmitter 72, HDMI to the TMDS clock channel, which is connected by a cable 43, a pixel clock synchronized with pixel data transmitted TMDS channel # 3 0, # 1, and # 2 (R) sink 61 I want to send to.

[0051]

In the active video period, in a plurality of channels, along with receiving unidirectionally transmitted from (R) source 53 HDMI, the differential signal corresponding to pixel data, HDMI (R) sink 61, the horizontal blanking period and in the vertical blanking interval, in the plurality of

channels, receiving unidirectionally transmitted from the HDMI (R) source, a differential signal corresponding to the control data and the auxiliary data.

[0052]

That is, HDMI (R) sink 61 has a sync signal processing unit 82 and the receiver 81.

[0053]

Unidirectionally transmitted from (R) source 53 HDMI to TMDS channels # 0, # 1, and # 2, are connected by a cable 43, a receiver 81, a differential signal corresponding to pixel data, is received in synchronization with the pixel clock transmitted on a TMDS clock channel from the HDMI (R) source 53 also, the differential signal corresponding to the control data and the auxiliary data.

[0054]

In addition, and pixel data corresponding to the differential signal, converts the auxiliary data and the control data, if necessary, the receiver 81 supplies the sync signal processor 82.

[0055]

Performs necessary processing on data supplied from the receiver 81, the sync signal processing unit 82 supplies the display control unit 62 or the like.

In addition, with the receiver 81, the sync signal processing unit 82, to exchange information as needed, notifying the status information and control (Control / Status) or the like.

[0056]

The transmission channels of the HDMI (R), HDMI to the (R) sink 61, in synchronization with the

pixel clock and control data pixel data, and ancillary data, serial transmission in one direction from the (R) source 53 HDMI In addition to the TMDS clock channel as a transmission channel not 0 TMDS channel # 3 as transmission channels to to the # 2 transmits the pixel clock, there is a transmission channel called the CEC line and (Display Data Channel) DDC .

[0057]

DDC is used HDMI, which is connected via a cable 43 from (R) sink 61, HDMI (R) source 53, to read the (Enhanced Extended Display Identification Data) E-EDID.

[0058]

That is, EDID ROM in addition to the receiver 81 stores the E-EDID is performance information performance about itself (configuration / capability) (Read Only Memory) HDMI (R) sink 61, (not shown) have.

HDMI, which is connected via a cable 43 from (R) sink 61, read via the DDC, the E-EDID of the (R) sink 61 The HDMI, HDMI (R) source 53, based on the E-EDID setting and performance of the HDMI (R) sink 61, i.e., for example, (for example, the format of the image (an electronic device having a) HDMI (R) sink 61 is compatible (profile) RGB (Red, Green, Blue) and recognizes and 2:2): and, YCBCR4: 4:4, YCBCR4.

[0059]

Note, HDMI (R) source 53 can likewise HDMI (R) sink 61, and stores the E-EDID, if necessary, to send to the (R) sink 61 HDMI, the E-EDID .

[0060]

Between the HDMI HDMI (R) source 53 and the (R) link 2, CEC line is used to perform bidirectional communication of control data.

[0061]

Figure 3 shows a configuration example of the receiver 81 and transmitter 72 of FIG 2.

[0062]

No 0 TMDS channels # 3 to the encoder / serializer 72A three corresponding to # 2, 72B, and the transmitter 72 has a 72C.

Then, each of the 72C encoder / serializer 72A, and 72B,, and the pixel data supplied thereto, and auxiliary data, control data, converts parallel data into serial data, and transmits the differential signal.

[0063]

Here, for example, in the case of having three components R, G, and B, the encoder / serializer 72A, the encoder / serializer 72B, pixel data, R G component (G component) B component (B component) the encoder / serializer 72C component (R component), and supplied, respectively.

[0064]

Further, as auxiliary data, for example, there are audio data and control packets and control packets, for example, the encoder / serializer 72A, for example, 72C and the encoder / serializer 72B, audio data, are supplied.

[0065]

Further, the control data includes a horizontal synchronizing signal the vertical synchronizing signal of one bit (VSYNC), a 1-bit (HSYNC), and has a CTL0, CTL1, CTL2, CTL3 control bits 1 bit, a horizontal and vertical synchronization signals the encoder / serializer 72A, the encoder / serializer 72B, CTL3 and the control bits CTL2 to the encoder / serializer 72C, the synchronization signals are respectively supplied and CTL1 control bits CTL0.

[0066]

B component of the pixel data supplied thereto, the vertical synchronizing signal and horizontal synchronizing signal, and the encoder / serializer 72A transmits in a time division, the auxiliary data.

[0067]

That is, the encoder / serializer 72A, and the 8-bit parallel data that is the fixed number of bits, the B component of the pixel data supplied thereto.

Further encodes the parallel data, converts it into serial data, the encoder / serializer 72A transmits through the TMDS channel # 0.

[0068]

Further, encodes 2-bit parallel data of the vertical synchronizing signal and horizontal synchronizing signal supplied thereto, converts into serial data, the encoder / serializer 72A transmits through the TMDS channel # 0.

[0069]

The encoder / serializer 72A, and the 4-bit parallel data units and auxiliary data supplied thereto.

Then, encodes the parallel data, converts it into serial data, the encoder / serializer 72A transmits through the TMDS channel # 0.

[0070]

The encoder / serializer 72B transmits in a time division, G component of the pixel data supplied

thereto, the auxiliary data and CTL1, and the control bits CTL0.

[0071]

That is, the encoder / serializer 72B, and an 8-bit parallel data that is the fixed number of bits, the G component of the pixel data supplied thereto.

Further encodes the parallel data, converts it into serial data, the encoder / serializer 72B transmits through the TMDS channel # 1.

[0072]

Further, encodes 2-bit parallel data of control bits CTL1 and CTL0 supplied thereto, converts into serial data, the encoder / serializer 72B transmits through the TMDS channel # 1.

[0073]

The encoder / serializer 72B, and the parallel data of the 4-bit auxiliary data supplied thereto.

Then, encodes the parallel data, converts it into serial data, the encoder / serializer 72B transmits through the TMDS channel # 1.

[0074]

The encoder / serializer 72C transmits in a time division, R component of the pixel data supplied thereto, the auxiliary data and CTL3, and the control bits CTL2.

[0075]

That is, the encoder / serializer 72C is an 8-bit parallel data that is the fixed number of bits, the R component of the pixel data supplied thereto.

Further encodes the parallel data, converts it into serial data, the encoder / serializer 72C transmits the TMDS channel # 2.

[0076]

Further, encodes 2-bit parallel data of control bits CTL2 and CTL3 supplied thereto, converts into serial data, the encoder / serializer 72C transmits the TMDS channel # 2.

[0077]

The encoder / serializer 72C is a 4-bit parallel data units and auxiliary data supplied thereto.

Then, encodes the parallel data, converts it into serial data, the encoder / serializer 72C transmits the TMDS channel # 2.

[0078]

No 0 TMDS channels # 3 to the recovery / decoders 81A three corresponding to # 2, 81B, and the receiver 81 has an 81C.

Then, each of the 81C recovery / decoders 81A, and 81B,, and the pixel data not 0 TMDS channel # to transmitted using differential signals with the # 2, to receive the auxiliary data and control data.

Further, each of the 81C recovery / decoders 81A, and 81B,, and from serial data to parallel data, and pixel data, auxiliary data, control data, and outputs the decoded further.

[0079]

That is, the recovery / decoder 81A receives the B component and the pixel data transmitted using differential signals with the TMDS channel # 0, the vertical synchronizing signal and horizontal synchronizing signal, and auxiliary data.

Then, from serial data to parallel data, and B components of the pixel data, the vertical synchronizing signal and horizontal synchronizing signal, and auxiliary data, the recovery / decoder 81A, and outputs the decoded.

[0080]

And G components of the pixel data transmitted using differential signals with the TMDS channel # 1, CTL1, the recovery / decoder 81B receives the auxiliary data and control bits CTL0.

Then, from serial data to parallel data, and G components of the pixel data, CTL1, and auxiliary data and control bits CTL0, the recovery / decoder 81B, and outputs the decoded.

[0081]

And R component of the pixel data transmitted using differential signals with the TMDS channel # 2, CTL3, the recovery / decoder 81C receives the auxiliary data and the control bits CTL2.

Then, from serial data to parallel data, and the R component of the pixel data, CTL3, and auxiliary data and control bits CTL2, the recovery / decoder 81C, and outputs the decoded.

[0082]

No 0 TMDS channels # one of the 3 HDMI (R) to FIG 4 shows an example of a transmission period in which various transmission data is transmitted in # 2 (period).

[0083]

Needless 0 TMDS channel # to the # 2, FIG 4 shows a case where horizontal × vertical is transmitted progressive image of 720 × 480 pixels, the transmission interval of various transmission data.

[0084]

No 0 TMDS channels # three 3 HDMI of (R) to a video field in which transmission data is transmitted in # 2 to (Video Field), depending on the type of the transmission data, the video data section (Video Data period), data island period (Data Island period), and section three control section (Control period) exist.

[0085]

Here is a section between the vertical sync signal to the next (the rising edge of the (active edge)) from the vertical sync signal of 1, horizontal blanking interval (horizontal blanking), vertical blanking interval video field, (vertical blanking) , and, I can be divided into (Active Video) active video interval is an interval excluding the vertical blanking interval and horizontal blanking interval of the video field.

[0086]

The video data period (in FIG 4 portions are hatched Hidariueri (right edge)) is assigned to the active video period, the video data period, the pixels of the image of one uncompressed screen (effective pixel (active pixel)) the data is transmitted.

[0087]

(Portions are hatched right up (left edge) in Figure 4), and (parts are denoted by the vertical lines in Figure 4) the control period, the horizontal and vertical retrace blanking interval data island period assigned to the line period, the data island period and the control period, auxiliary data (auxiliary data) are transmitted.

[0088]

That is, the data island period is assigned to a portion of the vertical blanking interval and the horizontal blanking period, the data island period, of the auxiliary data is data that is not related to

control, for example, packet or the like of the audio data transmission be.

[0089]

Assigned to other parts of the vertical blanking interval and the horizontal blanking interval, the control section, of the auxiliary data is data that is related to control, for example, control period, and the vertical synchronizing signal and horizontal synchronizing signal, control packet, is transmitted.

[0090]

Here, HDMI current (R), that is, the specifications of the latest HDMI (R) in 14, 2005 "High-Definition Multimedia Interface Specification Version 1.2a", December, transmission TDMS clock channel (Figure 2) For example, the frequency of the pixel clock difference is 165MHz, in this case, the transmission rate of the data island period is about 500Mbps nm.

[0091]

As mentioned above, in the data island period and the control period, both the auxiliary data is transmitted, but the distinction is made by the control bits CTL0, CTL1.

[0092]

That is, the control bits CTL0, CTL1, Figure 5 shows the relationship between the data island period and the control period.

[0093]

For example, CTL0, CTL1 control bits, may be as shown in the first of FIG 5 above, and represents the state of the two devices and enable (device enable) state, the device disables the (device disable) state.

In the first of Fig 5 on the Yes expressed by H (High) level the device enable state is represented by L (Low) level and the device disable state.

[0094]

The control bits CTL0, CTL1, a data island period, consists of a device disable state, the control period, it consists of a device enable state, Thus, the control section and the data island period is distinguished.

[0095]

Then, the data island period in which the control bits CTL0, CTL1 are at the L level as the device disable state, as shown in the second from FIG 5 on the part of the auxiliary data, data not related to control, for example, such as voice data are transmitted.

[0096]

On the other hand, in the control period in which the control bits CTL0, CTL1 are at the H level as the device enable state, as shown in the third Figure 5 above, among the auxiliary data, which is data related to control, for example, control packet preamble, and the like are transmitted.

[0097]

In addition, in the control period, as shown in the fourth from the top Figure 5, the horizontal synchronizing signal and a vertical synchronizing signal is also transmitted.

[0098]

Next, referring to FIG 6, HDMI current (R), namely, it is defined is the latest specifications of the HDMI (R) at 14, 2005 "High-Definition Multimedia Interface Specification Version 1.2a", December

I will explain for the transmission of the pixel data are.

[0099]

FIG 6 is a timing chart showing the timing of transmission of pixel data of the image transmitted in the video data period of the (R) HDMI current.

[0100]

The, HDMI current in (R), RGB4: not 0 TMDS channel # to and to be transmitted in # 2, the pixel data of the image in three formats 2:2: 4:4, YCBCR4: YCBCR4 and 4:4, It is possible, but in the following, among the three formats described above, for example, RGB4: is described as an example 4:4.

[0101]

The HDCP is a technique for preventing copying of content, which is adopted in the (R) HDMI, the data scrambling is applied in 8-bit units.

Therefore, in the TMDS channels one and one clock per pixel clock, the number of bits of the fixed units, that is, in 8-bit units to be processed in HDCP, the data is transmitted.

[0102]

As described above, in the TMDS channels one and one clock per pixel clock, 8-bit data since the transmission is not 0 TMDS channels # 3 to According to # 2, one clock per 24-bit it is possible to transmit the data.

[0103]

So, HDMI in the current (R), RGB4: as an image of 4:4, R components of each pixel, G

component, and is 24-bit 8-bit image, not to 0 TMDS channel # of three each of the B component # It is transmitted in 2.

[0104]

That is, HDMI current in (R), as shown in FIG 6, per pixel clock, B component of 8 bits of pixel data of one pixel of the 24-bit image using the TMDS channel # 0, the 8-bit G component is the TMDS channel # 1, R component of the 8 bits in the TMDS channel # 2, and transmitted, respectively.

[0105]

However, as described above, in recent years, the image of high gradation more words, R component, G component, and each of the B component, consisting of the pixel data of multiple bits of 12-bit or 10-bit larger than 8 bits request to transmit the high tone image is increasing.

[0106]

The current HDMI in (R), as described above, in the TMDS channel one, the transmission of 24-bit image, from being carried out by one clock per pixel clock, and transmits the data of 8 bits, the high Simply, the TMDS channels one and one clock per pixel clock, and the larger of than 8 bits, for example, the transmission of the tone image, can be performed by transmitting the data of 12 bits or 10 bits.

[0107]

However, as mentioned above, in the HDCP is a technique for preventing copying of content, which is adopted HDMI in (R), since the data scrambling is applied in 8-bit units, in the TMDS channels of one of the pixel clock one clock per, assuming that the number of bits units other than 8 bits, and transmits the data, applying the HDCP is difficult, with the result that it performs data transmission conforming to HDMI (R) is difficult made.

[0108]

Therefore, HDMI current in (R), as described above, the pixel clock frequency of 165MHz has been adopted as the pixel clock, by adopting the pixel clock of the higher frequency, in the TMDS channels one , it is possible to per clock of the pixel clock, by transmitting the data in 8-bit units of the fixed, while allowing the application of HDCP, and the possible transmission of the high tone image.

[0109]

For example, by employing a 5/4 times of 165MHz in the case of transmitting a 24-bit image, the frequency of the pixel clock, R component, G component, and the high tone image of 10 bits (hereinafter, each of the B component, as appropriate , it is possible to transmit a) referred to as 30-bit (= 10 bits × 3) image.

[0110]

That is, FIG 7 is a timing chart showing the timing of transmission of pixel data in the case of transmitting a 30-bit image in the video data period of HDMI (R).

[0111]

B component in the TMDS channels # 0, G component in the TMDS channel # 1, R component is the TMDS channel # 2, the point to be transmitted, respectively, and per pixel clock, the transmission of 30-bit image, 8-bit in that the data is transmitted, it is common with the transmission of a 24-bit image.

[0112]

However, the transmission of 24-bit image, (R component, G component, or B component) in order is 8 bits, the components of the 8 bits are transmitted in one clock of the pixel clock one component of one pixel whereas, in the transmission of 30-bit image, and in that for one

component of one pixel is 10 bits, the components of the 10 bits are transmitted over a plurality of pixel clock, the 30-bit image transmission is different from the transmission of the 24-bit image.

[0113]

That is, now, it is assumed that there is no b0 to be represented by b9, LSB of the components of the 10 bits (Least Significant Bit) MSB up (Most Significant Bit).

Also, the pixels forming an image, a raster scan order, respectively, and B # i-R # i-1 component, or G # i-1 component, R component of the pixel of the i-th, G component, or a B component as well represented by 1, based on the (pulse) clock of the pixel clock, and that clock # j-1, the j-th clock.

[0114]

In this case, the B component, as shown in FIG 7, but not the lower 8 bits b0 of the 0 component B # 10-bit to b7 may be transmitted in clock # 0, the 0 of the component B # 10-bit and b9 and b8 upper two bits of the remaining not lower 6 bits b0 of the component B # 1 of 10 bits of the next pixel to a total of 8 bits and b5 are transmitted in clock # 1.

[0115]

Furthermore, no significant 4 bits b6 the remainder of the one component B # 10-bit to and b9, but not the lower 4 bits b0 of the two components B # 10-bit pixel next to a total of 8 bits and b3 is the clock # is transmitted in 2, a total of no upper 6 bits b4 the rest of the two component B # 10-bit to the b9, and b1 and lower 2 bits b0 of the three component B # 10-bit of the next pixel 8 bits are transmitted in clock # 3.

[0116]

Then, there is no upper 8 bits b2 the remainder of the three components B # 10-bit to b9 are transmitted in clock # 4.

[0117]

As described above, no 0 B # is the B component of the four pixels to 0 clock # to be transmitted in 5 clocks 4 #, hereinafter, in the same way, three components B # is 5 clock B components of 4 pixels is transmitted.

[0118]

For 24-bit images, as described in FIG 6, B component of the 8 bits are transmitted in one clock, but for 30-bit image, four pixels of the B component of 10 bits, transmitted in 5 clocks be.

Therefore, the 30-bit image, by transmitting with the pixel clock frequency of 5/4 times the 24-bit image, the B component, the same elements as in the first frame of the 24-bit image, one frame of the 30-bit image It can be transmitted in time.

[0119]

It should be noted that the components of the B component other than a 30-bit image, that is, R component and G component are also transmitted in the same way as the B component.

[0120]

Further, the transmission of 30-bit image, the transmission unit, so to speak, is repeated in its transmission unit, and to transmit the pixel data for four pixels in 5 clocks, and the fact the phase of (Phase), a clock in the transmission unit Then, the transmission unit of the 30-bit image is composed of five phases.

[0121]

Then, by the higher, the frequency of the pixel clock, the high tone image gradation greater than 30-bit image, ie, R component, G component, and each of the B component, for example, the high

tone of the 12-bit image (hereinafter, appropriately referred to 36-bit (also = 12 bits × 3) image) or, R component, G component, and for example, the high tone image of 16 bits (hereinafter appropriately, each of the B component is 48 bits (= it is possible to transmit the like) also referred to as 16 bits × 3) image.

[0122]

Specifically, for example, by a 3/2 times the 165MHz when transmitting a 24-bit image, the frequency of the pixel clock, R component, G component, and each of the B component is 36 bits of 12-bit it is possible to transmit an image.

[0123]

That is, FIG 8 is a timing chart showing the timing of transmission of pixel data in the case of transmitting a 36-bit image in the video data period of HDMI (R).

[0124]

B component in the TMDS channels # 0, G component in the TMDS channel # 1, R component is the TMDS channel # 2, the point to be transmitted, respectively, and per pixel clock, the transmission of 36-bit image, 8-bit in that the data is transmitted, it is common with the transmission of a 24-bit image.

[0125]

However, the transmission of 24-bit image, for one component of one pixel is 8 bits, the components of the 8-bit, whereas is transmitted in one clock of the pixel clock, and the transmission of 36-bit image is , and in that for one component of one pixel is 12 bits, the components of the 12 bits are transmitted over a plurality of pixel clock, the transmission of 36-bit image differs from the transmission of the 24-bit image .

[0126]

That is, now, if we say that there is no b0 to be represented by b11, and from the LSB to the MSB of the components of the 12-bit, for the B component, as shown in FIG 8, the lower 8 bits b0 of the 0 component B # 12-bit not to b7 is, is transmitted by the clock # 0, there is no upper 4 bits b8 of the rest of the 0 of component B # 12-bit to a b11, and to not lower 4 bits b0 of the one-component B # 12-bit of the next pixel total of 8 bits and b3 are transmitted by the clock # 1.

[0127]

Then, there is no upper 8 bits b4 the rest of the components B # 1 of the 12-bit to b11 are transmitted in clock # 2.

[0128]

As described above, 0 clock # to be transmitted in 3 clocks 2 #, or less, in the same way, one component B # and B # 0 is a B components of two pixels, three clock B components of two pixels is transmitted.

[0129]

For 24-bit images, as described in FIG 6, B component of the 8 bits are transmitted in one clock, but for 36-bit image, two pixels of the B component of 12 bits, transmitted in 3 clocks be.

Therefore, the 36-bit image, by transmitting with the pixel clock frequency of 3/2 times the 24-bit image, the B component, the same elements as in the first frame of the 24-bit image, one frame of the 36-bit image It can be transmitted in time.

[0130]

It should be noted that the components of the B component other than the 36-bit image, that is, R component and G component are also transmitted in the same way as the B component.

[0131]

Further, the transmission of 36-bit image, the transmission unit is repeated in its transmission unit, and to transmit the pixel data of two pixels at the 3 clocks.

Accordingly, the transmission unit of 36-bit image is composed of three phases.

[0132]

Next, R component, G component, and the transmission of 48-bit 16-bit image, each of the B component, it is performed by twice the 165MHz when transmitting a 24-bit image, the frequency of the pixel clock I could.

[0133]

That is, FIG 9 is a timing chart showing the timing of transmission of pixel data in the case of transmitting a 48-bit image in the video data period of HDMI (R).

[0134]

B component in the TMDS channels # 0, G component in the TMDS channel # 1, R component is the TMDS channel # 2, the point to be transmitted, respectively, and per pixel clock, the transmission of 48-bit image, 8-bit in that the data is transmitted, it is common with the transmission of a 24-bit image.

[0135]

However, the transmission of 24-bit image, for one component of one pixel is 8 bits, the components of the 8-bit, whereas is transmitted in one clock of the pixel clock, and the transmission of 48-bit image is , and in that for one component of one pixel is 16 bits, the components of the 16 bits are transmitted over a plurality of pixel clock, the transmission of 48-bit

image differs from the transmission of the 24-bit image .

[0136]

That is, now, if we say that there is no b0 to be represented by b15, and from the LSB to the MSB of the components of the 16-bit, for the B component, as shown in FIG 9, the lower 8 bits b0 of the 0 component B # 16-bit not to b7 may be transmitted in clock # 0, there is no upper 8 bits b8 of the remainder of the component B # 0 of the 16-bit to b15 are transmitted in clock # 1.

[0137]

As described above, the 0 component B # is the B component of one pixel is transmitted in two clocks # 1 and the clock # 0, the following, in the same manner, B component of one pixel is transmitted in two clocks.

[0138]

For 24-bit images, as described in FIG 6, B component of the 8 bits are transmitted in one clock, but for 48-bit image, one pixel of the B component of 16 bits, transmitted in 2 clock be.

Therefore, the 48-bit image, by transmitting with the pixel clock frequency twice that of the 24-bit image, the B component, and the same time the first frame and a 24-bit image, one frame of the 48-bit image In it can be transmitted.

[0139]

It should be noted that the components of the B component other than the 48-bit image, that is, R component and G component are also transmitted in the same way as the B component.

[0140]

Further, the transmission of 48-bit image, the transmission unit is repeated in its transmission unit, and to transmit the pixel data of 1 pixel in 2 clocks.

Accordingly, the transmission unit of 48-bit image is composed of two phases.

[0141]

As described above, for example, by adjusting the frequency and 5/4 times in the case of transmitting a 24-bit image, 3/2 times and 2 times, HDMI current (R), the frequency of the pixel clock transmission of the pixel data is assigned to each component and 10-bit more than 8 bits which is a fixed number of bits to be transmitted per clock of the pixel clock TMDS channel, 12-bit, 16-bit, i.e., 30-bit image it can be carried out directly using HDMI TMDS channels of current (R), and the transmission of the high tone image 36-bit image, and 48-bit image.

[0142]

Therefore, HDMI current in (R), it is considered that the transmission of the 24-bit image is performed, by adjusting the frequency of the pixel clock, TMDS channels of HDMI current (R) is one clock per pixel clock transmission of the pixel data that is assigned to each component bits of 8 bits or more is a fixed number of bits to be transmitted, that is, for example, addition of 24-bit image, or 30-bit image, 36-bit image, and 48-bit image it can be carried out directly using HDMI TMDS channels of current (R), the transmission of the high tone image.

[0143]

Now, in particular, deep color (deep color) HDMI and (R), a communication interface that can be performed in addition to the 24-bit image, by using as the TMDS channels of HDMI current (R) the transmission of the high tone image Assuming that it is called, for example, in the case of the HDMI compliant deep color HDMI in (R) (R) source, to transmit the high tone image, first, HDMI as a communication partner (R) sink deep color HDMI (there is a need to recognize R) corresponding to whether they are (compliant).

[0144]

Here, HDMI (R) sink whether corresponding deep color HDMI in (R), for example, it should be described in the E-EDID is performance information about its performance the HDMI (R) sink should include (I can be).

[0145]

That is, FIG 10 shows VSDB in E-EDID to (Vender Specific Definition Bit).

[0146]

In the current HDMI (R), bit # 5,6,7 bit 4, # 5, and # 6 has a (Reserved) unused LSB of Byte # 6 of VSDB, but in Figure 10, that bit # 4, # 5, and # 6, respectively, the bit Suport_30bit, Suport_36bit, Suport_48bit is assigned.

[0147]

HDMI is (R) sink, bit Suport_36bit that are assigned bit Suport_30bit that is assigned to bit # 4 of Byte # 6 of VSDB, the bit # 5, bit Suport_48bit and is assigned to the bit # 6, the high tone If it does not correspond to the image, that is, if it corresponds to only 24-bit image, for example, are all 0.

[0148]

When the HDMI (R) sink, corresponds to only 30-bit image of the high tone image, it is only the bit Suport_30bit is 1.

Further, if the HDMI (R) sink, corresponds to the 36-bit image and the 30-bit image of the high tone image, it is only the bit Suport_36bit is 1.

Further, if the 30-bit image in the high tone image, 36-bit image, and HDMI (R) sink, corresponds to all of the 48-bit image, it is only the bit Suport_48bit is 1.

[0149]

As described above, by previously described in VSDB of E-EDID, HDMI (R) sink to see if it supports deep color HDMI in (R), HDMI (R) source, HDMI (R) sink By the, reads the E-EDID, it refers to the VSDB of the E-EDID, (R) sink or whether it corresponds to the high tone image HDMI, and further, (R) sink corresponding to the high tone image HDMI If you have, it is possible to recognize 30-bit image, 36-bit image, or whether corresponds to one of the 48-bit image.

[0150]

Also in VSDB of E-EDID HDMI of (R) source, it is possible to keep written bits Suport_30bit, Suport_36bit, a Suport_48bit shown in FIG 10.

[0151]

Next, and when the HDMI HDMI and (R) and source (R) sink are connected, HDMI exchange of E-EDID between HDMI HDMI and (R) source and the (R) sink, or (R) source It is not intended to be performed at a specific timing, such as when the power supply of the HDMI (R) sink is turned on, is performed periodically.

[0152]

On the other hand, in the case where the HDMI HDMI (R) source and (R) sink, corresponds to the high tone image, HDMI for (R) sink, 24-bit image is transmitted from the HDMI (R) source There are can, and a the high tone image is transmitted, further, in the case of high tone image is transmitted, it is for 30-bit image, 36-bit image, or the transmitted 48-bit image.

[0153]

As described in FIG 4, the transmission of the image, since is performed in the video data section is assigned the active video period of the video field (Active Video), HDMI in (R) sink, and is

transmitted in the video data period 24-bit image, 30-bit image, 36-bit image, the image or the upcoming action, or is any of the 48-bit image, it is possible to recognize the video fields each containing video data period is desirable.

[0154]

In this case, HDMI for (R) sink, the video field every 24-bit image, 30-bit image, the image that is transmitted in the video data period contained in the video field, 36 bits from the HDMI (R) source information representing the image, or whether the one of 48-bit image (hereinafter referred to as the deep color mode) it is necessary to transmit.

[0155]

Here, the general control packet transmitted in the control period of HDMI to the (R) sink, as the information to be transmitted to the video each field, as described in one of the vertical blanking interval, Figure 4 HDMI from (R) source there is a (General Control Packet).

[0156]

Therefore, deep color mode may be included in the general control packet, whereby video each field, so as to transmit the HDMI (R) sink from the HDMI (R) source.

[0157]

That is, FIG 11 shows the format of a general control packet.

[0158]

General control packet has a packet header (General Contorol Packet Header), sub-packet and a (General Control Subpacket), 11 the upper side of Fig, 11 the lower figure, respectively, the sub-packet, a packet header have.

[0159]

In the current HDMI (R), bit # 1, 2, and 3 bit 0, # 1, # 2 from the LSB Byte # SB1 (Fig. 11 bottom) sub-packets of the general control packet, 0 unused It is supposed to be and is, in FIG 11, the bit # 0, # 1, and # 2, respectively, CD0, CD1, CD2 bits representing the deep color mode is assigned.

[0160]

And CD0, CD1, CD2 bits of Byte # SB1 of the sub-packet, the video data period contained in the video field and a (FIG. 4) the control period of the general control packet with the sub-packet is transmitted 12 (FIG. 4 I shows the relationship between the image to be sent to).

[0161]

The CD0, CD1, CD2 bit representing (Color Depth not indicated), the deep color mode, in the same manner as (R) HDMI current, are both set to 0 if the (R) sink does not support high tone image HDMI Ru.

[0162]

Further, when the HDMI (R) sink is compatible with the high tone image, when the image transmitted in the video data period is a 24-bit image, CD0, CD1, CD2 bits representing the deep color mode, for example, Each is 0,0,1, when the image transmitted in the video data period is a 30-bit image, for example, respectively, CD0, CD1, CD2 bits representing the deep color mode is a 1,0,1 Ru.

[0163]

Furthermore, when images are transmitted in the video data period is a 36-bit image, for example, respectively, is a 0,1,1, CD0, CD1, CD2 bits representing the deep color mode is transmitted in the

video data period When the image is a 48-bit image, the CD0, CD1, CD2 bits representing the deep color mode, for example, are both 1.

[0164]

As described above, HDMI in (R) source, by including in the general control packet CD0, CD1, CD2 bits representing the deep color mode, and transmits the control period of the video field, HDMI in (R) sink, the Video it is possible to recognize 24-bit image, 30-bit image, 36-bit image, or an image that is transmitted to the video data period of the field, whether which one of the 48-bit image.

[0165]

The, HDMI current in (R), bit # 5,6,7 bit 4, # 5, # from the LSB Byte # SB1 (Fig. 11 bottom) sub-packets of the general control packet shown in FIG 11 6 is supposed to be zero in unused, in FIG 11, the bit # 4, # 5, and # 6, respectively, PP0, PP1, PP2 bits representing the phase is assigned.

[0166]

That is, 30-bit image, 36-bit image, or if the 48-bit image is transmitted, respectively, as described in 7 through 9, the phase is present.

The PP0, PP1, PP2 bits of Byte # SB1 of the sub packet, among the pixel data of the image transmitted to the video data period contained in the video field containing the control period in which the general control packet having the subpacket is transmitted value representing the phase of the pixel data to be transmitted at the end of is set.

[0167]

Next, with reference to the flowchart of FIG 14 and FIG 13, when it is supported deep color HDMI in (R), HDMI in FIG 2 HDMI (R) and Source 53 (R) sink 61, the HDMI (I will explain the operation and HDMI R) source of 53 (R) sink 61.

[0168]

First, with reference to the flowchart in FIG 13, the operation of the (R) source 53 HDMI in FIG 2.

[0169]

Wait from the HDMI (R) sink 61 via the DDC as described in FIG 2, E-EDID HDMI of (R) sink 61 is to be transmitted, HDMI (R) source 53, in step S11, I want to receive the E-EDID.

[0170]

Then, in step S12, by referring VSDB of E-EDID HDMI from (R) sink 61 (FIG. 10), HDMI (R) source 53, the image may be (R) sink 61 receives HDMI is the (image corresponds), recognizing 24-bit image, 30-bit image, 36-bit image, or whether the one of 48-bit image, and further, that, HDMI (R) sink 61 is correspondingly from the images are, deep color mode, that is, not 0 TMDS channel # 3 to determine the image to be transmitted in # 2.

[0171]

Here, from the images HDMI in (R) source 53, HDMI (R) sink 61 is compatible, for example, from 0 TMDS channels # 3 to the image to be transmitted in # 2, the image having gradation highest can be determined as.

In this case, for example, when you have 24-bit image, 30-bit image, 36-bit image, and the 48-bit image, 48-bit image high gradation most, HDMI (R) sink 61, TMDS channel # 0 not to is determined as the image to be transmitted and # 2.

[0172]

Thereafter, in step S13, and starts outputting the pixel clock corresponding to the deep color mode, which adjusts the frequency of the pixel clock, which was determined in step S12, HDMI (R)

source 53, the process proceeds to step S14.

[0173]

In step S14, the pixel data of the image indicated by the deep color mode determined in step S12, the no 0 TMDS channel # to HDMI (R) source 53 starts transmission by # 2.

[0174]

The image represented by the deep color mode, not 0 TMDS channel # to transmission by the # 2, is performed in synchronization with the pixel clock output is started in step S13.

[0175]

Further, the image represented by the deep color mode, not 0 TMDS channel # to the transmission over the # 2, as described in FIG 12 and FIG 11, the video field, that is, for each frame, HDMI (R) source 53, the vertical control period of blanking period (Fig. 4), I transmits the general control packet CD0, CD1, CD2 bits representing the deep color mode of the image transmitted to the video data period is described.

[0176]

Next, with reference to the flowchart in FIG 14, the operation of the (R) sink 61 HDMI in FIG 2.

[0177]

At step S31, via the DDC (Fig. 2), HDMI (R) sink 61, and transmits to the (R) source 53 HDMI, the E-EDID thereof.

[0178]

Thereafter, HDMI in (R) source 53, as described in FIG 13, the output of the pixel clock is started and not 0 TMDS channels # the general control packet to it and transmitted thereto via the # 2, HDMI (R) In step S32, by receiving (11, 12) the general control packet from the HDMI (R) source 53, referring to CD0, CD1, CD2 bits of the general control packet, the sink 61, the video data period and recognizes the deep color mode of the image that is transmitted to the.

[0179]

Then, the pixel data of the image of the deep color mode recognized in step S32 is, in synchronization with the pixel clock, not 0 TMDS channel # to via the # 2, HDMI HDMI (R) sink 61, from (R) source 53 The waiting to be transmitted, at step S33, and receives the pixel data.

[0180]

It should be noted that the processing of steps S32 and S33 is performed in the video for each field.

[0181]

Then, as described in FIG 13, to determine the deep color mode, not 0 TMDS channel # to HDMI (R) source 53 is transmitted in # 2 image of the deep color mode, HDMI (R) source for 53, image supplied as a transmission target, i.e., for example, necessarily, the image to be transmitted is supplied to the HDMI (R) source 53 (FIG. 1) codec 52 is determined by the HDMI (R) source 53 It does not necessarily coincide with the image of the deep color mode is.

[0182]

That is, there may be an image to be transmitted is the image gray level is lower than the image of the deep color mode determined by the HDMI (R) source 53.

[0183]

Here, hereinafter referred to as the main image, the image to be transmitted to be transmitted to the (R) sink from 61 HDMI (R) source 53 HDMI.

[0184]

Thus, if the image tone is lower than the image of the deep color mode determined the HDMI (R) source 53, the pixel data of the main image, for example, the main image is transmitted as shown in FIG 15 be.

[0185]

That is, FIG 15 is a 36-bit image the image of the deep color mode, the case of a 30-bit image of the gray scale lower than the image of the deep color mode through the TMDS channels in one transmission main image (Transmission) I shows the transmission pixel data is pixel data.

[0186]

If the image of the deep color mode is a 36-bit image, since the 12-bit components R of the pixel data of the 36-bit image, G, and B, the transmission pixel data transmitted on the TMDS channels One As shown in Figure 15, is a 12-bit data.

[0187]

On the other hand, if the main image is a 30-bit image, each component R of the pixel data of the 30-bit image, G, and B, since the 10-bit, upon transmission of a 30-bit image as the main image, the TMDS single pixel data of the main image to be transmitted in the channel is a 10-bit data less than 12 bits is the number of bits of the transmission pixel data.

[0188]

Thus, if it is the image number of bits is less than the transmission pixel data, HDMI in (R) source 53, for example, as shown in FIG 15, the pixel data of the main image, the pixel data of the main image, transmits the upper bits of the pixel data, and transmitted by being allocated in the form of pack, so to speak.

[0189]

Thus, as described above, the pixel data of the main image is 10 bits, when the transmission pixel data is 12 bits, the transmitter 72 HDMI of (R) source 53 (FIG. 2), as shown in Figure 15 in, and transmitted by assigning to the 10 most significant bits of the transmission pixel data of 12 bits, the pixel data of the main image of 10 bits.

[0190]

In this case, the receiver of 81 HDMI (R) sink 61 (FIG. 2), the transmission pixel data of 12 bits from the transmitter 72 HDMI of (R) source 53 is received, the transmission of pixel data of the 12-bit only the pixel data of the main image that is assigned, the upper 10 bits are processed, are ignored two low-order bits of the remaining (to be discarded).

[0191]

Here, for example, if as described above, and corresponds to the 36-bit image, that is, HDMI HDMI (R) and Source 53 (R) sink 61, the transmission pixel data of the 12-bit HDMI is (R) source 53 In the case where it is possible to send, HDMI (R) sink 61 receives the transmission pixel data of 12 bits, when it is the pixel data of the 12 bits less than the pixel data of the main image, corresponding to the 36-bit image HDMI you are in (R) source 53, the lower bits are not assigned among the transmission pixel data of 12 bits, the pixel data of the main image is no signal (0).

Further, HDMI, which corresponds to the 36-bit image in the (R) sink 61, the transmission 12-bit pixel data from the HDMI (R) source 53 is processed as it is, the resultant image is displayed.

In view of this image, since no signal (0) and the lower bits not assigned of the transmission 12-bit pixel data, the pixel data of the main image is a display of the image HDMI in (R) sink 61 is

ignored.

As a result, HDMI in (R) sink 61, and the image according to the pixel data assigned to the upper bits of the transmission pixel data of 12 bits, that is, the main image is displayed.

Therefore, HDMI in (R) sink 61, the transmission 12-bit pixel data, the pixel data of 10 bits or 8 bits if assigned, the image according to the pixel data of 10 bits and the 8 bits is displayed .

[0192]

As described above, if the number B1 bits of pixel data of the main image is smaller than the number B2 bits of the transmission pixel data, the number of bits is the pixel data of the main image of B1, the number of bits transmitted pixel data B2 assigned to the upper bits, the transmission pixel data is transmitted to the HDMI (R) sink 61 HDMI from (R) source 53, in this case, it transmits the HDMI (R) sink 61 HDMI from (R) source 53 B2-B1 lower bits of the transmission pixel data, the pixel data of the main image is not assigned, has not been substantially used, which is inefficient.

[0193]

Therefore, HDMI HDMI (R) and the source 53 in the (R) sink 61, the bits not assigned among the transmission pixel data, the pixel data of the main image, another signal (hereinafter referred to as sub-signal and the main image it is possible to assign a) of, thereby to perform simultaneous transmission and auxiliary signal the main image, and efficient data transmission.

[0194]

Here, hereinafter referred to as bit remainder bits not assigned among the transmission pixel data, the pixel data of the main image.

[0195]

Figure 16 illustrates an allocation method of allocating sub-signal to transmission pixel data.

[0196]

For example, as described with reference to FIG 15 (the pixel data transmitted on the TMDS channel one) transmission pixel data is 12 bits, in the case (one component of) the pixel data of the main image is 10 bits , to the 10 most significant bits of the transmission pixel data, pixel data of the main image of 10 bits are allocated, by this, the lower 2 bits of the transmission pixel data is considered to be a bit too much.

[0197]

Now, for example, if it is assumed that the signal (data) organized in a single 8-bit, as shown in FIG 16, the sub-signal of one unit, the sub-signal, 4 two equal bits per bit number and bit remainder is partitioned into data Tsu, data of the four are assigned respectively to the lower 2 bits is a remainder bits of the transmission pixel data of four pixels.

[0198]

In this case, the sub-signal, for example, the components R, G, and B is assumed to be 8-bit image, the image is the sub-signal, for example, a resolution of 1/4 of the main image (the number of pixels it is possible to employ a picture).

[0199]

Here, for example, 10-bit components R, G, and B is an image of 1080 lines of 1920 pixels ×, the transmission pixel data, for example, in the case of a 12-bit main image, the sub-signal, For example, when the 8-bit components R, G, and B is an image of 360 lines 480 pixels ×, sub signal as an image of 360 lines thereof 480 pixels × and 360 lines of the 1080 lines of the main image it is possible to assign two bits to the remainder bits of the transmission pixel data in minutes.

In this case, the transmission pixel data sub-signals of the transmission pixel data for 1080 lines of the main image, as an image of 360 lines × 480 pixels is not allocated in the 720 (= 1080-360) lines are , it is possible to allocate the sub-signals another.

[0200]

Further, for example, the 8-bit components R, G, and B is an image of 1080 lines of 1920 pixels ×, the transmission pixel data, for example, in the case of a 12-bit main image, the transmission pixel data 4 low-order bits is a bit too much.

In this case, the transmission pixel data for 1080 lines of the main image, and I may be components of R, G, and B is assigned as the sub-signal, an 8-bit image of 720 lines approximately 960 pixels ×.

[0201]

In the following, the sub-signal, it is assumed that the signal of 8-bit units.

[0202]

As described above, HDMI current (, HDMI, which may be the remainder bits of the transmission pixel data, assigning a sub-signal, together with the main picture, not 0 TMDS channel # to in # 2, and transmits the transmission pixel data (R) In order to distinguish R), if we say that called (R) extended HDMI, HDMI corresponding to (R) extended HDMI (R) source, when transmitting by allocating the remainder bits of the transmission pixel data sub-signals , first, it is necessary to recognize (R) sink to see if it corresponds to the expanded HDMI (R) HDMI as a communication partner.

[0203]

(R) sink Whether corresponds expanded HDMI to (R) HDMI, for example, as described above, HDMI (R) sink and whether the corresponding deep color HDMI in (R), HDMI (R) it is possible to keep described E-EDID is performance information regarding the performance of the sync.

[0204]

That is, FIG 17 shows the VSDB in E-EDID.

[0205]

In the current HDMI (R), as shown in FIG 10, the bit # 5,6,7,8 bit 4, # 5, # 6, # 7, unused LSB of Byte # 7 of VSDB it is the (Reserved), and in FIG 17, the bit # 4, # 5, # 6, and # 7, respectively, the bit Sub_2bit, Sub_4bit, Sub_8bit, Sub_Data_Support is assigned.

[0206]

HDMI is (R) sink, bit Sub_4bit the assigned bit Sub_2bit that is assigned to bit # 4 of Byte # 7 of VSDB, the bit # 5 bit Sub_8bit and it is assigned to bit # 6, the sub signal If it is not possible to receive, i.e., if it can not handle a sub-signal, for example, are all 0.

[0207]

Then, if it is possible as a bit too low-order 2 bits of the transmission pixel data, HDMI (R) sink can handle the sub-signal assigned to the remainder bits of the 2 bits, and is the bit Sub_2bit and 1.

Further, if it is possible as a bit too low-order 4 bits of the transmission pixel data, HDMI (R) sink can handle the sub-signal assigned to the remainder bits of the 4 bits, and is the bit Sub_4bit and 1.

Further, if it is possible as a bit too lower 8 bits of the transmission pixel data, HDMI (R) sink, handle sub-signal assigned to the remainder bits of the 8 bits, and is the bit Sub_8bit and 1.

[0208]

It is set to 1 if it is possible HDMI (R) sink, handle sub-signal, if it can not handle a sub-signal, that is, bit Sub_Data_Support is a 0 if it does not support extended HDMI (R) of Ru.

[0209]

It should be noted that if Sub_Data_Support bit is 0, Sub_2bit, Sub_4bit, Sub_8bit becomes all 0

[0210]

As described above, by previously described in VSDB of E-EDID, HDMI (R) sink to see if it corresponds expanded HDMI to (R), HDMI HDMI (R) source, from (R) sink , by reading the E-EDID, referring to VSDB of the E-EDID, whether may be HDMI (R) sink can handle the sub-signal, and further, that the HDMI (R) sink can handle the sub-signal If possible, it is possible to recognize to what can be a bit, the number of bits of lower transmission pixel data, is allocated to sub-signals too.

[0211]

Also in VSDB of E-EDID HDMI of (R) source, it is possible to keep written bits Sub_2bit, Sub_4bit, Sub_8bit, a Sub_Data_Support shown in Figure 17.

[0212]

Further, it was decided in FIG 17, the sub-signal assigned to transmission pixel data is any of the 8-bit 2 bits, or 4 bits, but the bit number of the sub-signal to be assigned to the transmission pixel data, these It is not intended to be limiting.

[0213]

In addition, there is no 5 from the LSB of Byte # 7 of VSDB to it is not a 4-bit # 4 of 8 bit to the # 7, Sub_2bit, Sub_4bit, Sub_8bit, rather than Sub_Data_Support, the value corresponding to the number of bits of the sub-signal to be assigned to the transmission pixel data It is possible to set.

In this case, a 4-bit # 4 to According to # 7, it is possible to represent the bit number of sixteen.

[0214]

Then, as described above, and when the HDMI HDMI and (R) and source (R) sink are connected, replacement of E-EDID between HDMI HDMI and (R) source and the (R) sink, HDMI It is not intended to be performed at a specific timing, such as when the power supply of the HDMI (R) sink is turned on, is performed periodically or (R) source.

[0215]

On the other hand, when the HDMI HDMI and (R) and source (R) sink, corresponds extended HDMI (R), and transmit the pixel data transmitted HDMI to the (R) sink from the HDMI (R) source may be the case that the sub-signals are allocated, and a when the sub-signal is not assigned.

Further, when the sub-signal is assigned to the transmission pixel data, may be sub-signals allocated is the 8-bit 2-bit or 4 bits.

[0216]

Here, for simplicity of explanation, hereinafter, also expressed as a 0 bit number of the sub-signal as appropriate, is assigned to the transmission pixel data, that the sub-signal is not assigned to the transmission pixel data.

[0217]

As described in FIG 4, the transmission of the transmission pixel data from being performed in the video data section is assigned the active video period of the video field (Active Video), HDMI in (R) sink, and transmitted in the video data period sub-signal assigned to transmission pixel data to come is the action, or which one of the eight bit 0 bit, 2 bits, or 4 bits, and that it can be recognized in the video fields each containing video data period It is desirable.

[0218]

In this case, HDMI for (R) sink, a video field by field, the sub-signal assigned to transmission pixel data transmitted in the video data period contained in the video field, 0 HDMI from (R) source information indicating whether which one of the 8-bit or 2 bits, or 4 bits (hereinafter referred to as sub-signal information) is necessary to transmit.

[0219]

Like the deep color mode described above, are included in the general control packet transmitted control period in the vertical blanking interval (Fig. 4), the video field by field, HDMI from (R) source the sub-signal information, HDMI (R It may be adapted to transmit in) sink.

[0220]

That is, FIG 18 shows a general control packet containing sub-signal information.

[0221]

As described in FIG 11 includes a packet header and (General Contorol Packet Header), sub-packet and a (General Control Subpacket), general control packet 18 upper figure 18 the lower figure, a packet header is, I'm respectively, the sub-packet.

[0222]

In the current HDMI (R), bit # 1, 2, and 3 bit 0, # 1, # 2 from the LSB Byte # SB2 subpacket general control packet, are taken to be 0 unused Are However, in FIG 18, the bit # 0, # 1, and # 2, respectively, SD0, SD1, SD2 bit as sub-signal information are allocated.

[0223]

And SD0, SD1, SD2 bits of Byte # SB2 of the sub-packet, the video data period contained in the video field and a (FIG. 4) the control period of the general control packet with the sub-packet is transmitted 19 (FIG. 4 I shows the relation between the number of bits of the sub-signal assigned to transmission pixel data transmitted).

[0224]

If the number of bits of the sub-signal assigned to transmission pixel data is 0 bits, that is, bits (Sub Data not Inserted), serving as sub-signal information SD0, SD1 when the sub-signal is not assigned to the transmission pixel data and SD2, in the same manner as (R) HDMI current are both zero.

[0225]

Further, if the number of bits assigned to transmission pixel data is 2 bits, for example, respectively, SD0, SD1, SD2 bits as the sub-signal information is 1,0,0.

Further, if the number of bits assigned to transmission pixel data is 4 bits, for example, respectively, is a 0,1,0, SD0, SD1, SD2 bits as the sub-signal information, assigned to the transmission pixel data If the number of bits which are 8 bits, for example, respectively, SD0, SD1, SD2 bits as the sub-signal information is a 1,1,0.

[0226]

As described above, HDMI in (R) source, by including in the general control packet SD0, SD1, SD2 bit as sub-signal information, and transmits the control period of the video field, HDMI in (R) sink, the Video it is possible to recognize the sub-signal assigned to transmission pixel data transmitted thereto in the video data period of the field, whether which one of the eight bit 0 bit, 2 bits, or 4 bits.

[0227]

Then, when the (R) source 53 corresponds to the expanded HDMI HDMI in FIG 2, FIG 20 shows a

configuration example of a source signal processing unit 71 having the (R) source 53 thereof HDMI.

[0228]

In Figure 20, the main image processing unit 101, the sub-signal addition section 102, sub-signal processing unit 103, the sub-signal-related information insertion section 104, sub-signal reception determination unit 105, the source signal processing section 71, sub-signal assignment bits and a deep color mode determination unit 108 determining unit 106, and the sub-signal frame information transmission controller 107.

[0229]

The main image processing unit 101, for example, the main image with the components R, G, and B are supplied.

Performs necessary processing on the main image supplied thereto, the main image processing unit 101 supplies the sub-signal addition section 102, the pixel data of the main image.

[0230]

Further, it detects the P (pixel number of the effective pixels) pixels of video data period (Fig. 4) video field of the main image supplied thereto, the main image processor 101 supplies the sub-signal processing unit 103 .

[0231]

It also detects the number B1 bits of each component of the pixel data of the main image supplied thereto, the main image processor 101 supplies the sub-signal assignment bits determination section 106.

[0232]

The sub-signal addition section 102, the main image processing unit 101, another pixel data of the main image of B1 is supplied to the bit number, the sub-signal is supplied from the sub-signal-related information insertion section 104.

Further, the sub-signal addition section 102, the deep color mode determination unit 108, the deep color mode is supplied from the sub-signal assignment bits determination section 106, the number B3 bits of the sub-signal assigned to transmission pixel data sub-signal assignment number of bits represented by the supplied.

[0233]

Based on the deep color mode from the deep color mode determination unit 108, the sub-signal addition section 102 recognizes the number B2 bits of the transmission pixel data.

That is, for example, in the case of the deep color mode, 24-bit image, 30-bit image, 36-bit image, or represents a 48-bit image, each sub-signal addition unit 102, 8-bit, 10-bit, 12-bit , or is recognized as the number B2 bits of the transmission pixel data, 16 bits.

[0234]

The sub-signal addition section 102, sub-signals are divided into sub-signal assignment bits number B3 each of the sub-signal assignment bits determination section 106, the sub-signal supplied from the sub-signal-related information insertion section 104, and divided the By the number of bits supplied from the main image processor 101, the division sub-signal is be added as the lower bits of the pixel data B1, the number of bits B2 it is recognized from the deep color mode from the deep color mode determination unit 108 transmitting the pixel data, that is, the pixel data of the main image of B1 is assigned to the upper bits number of bits, number of bits allocated to the lower bits divided sub-signal B3, the number of bits of B2 (= B1 + B3) I make up the transmission pixel data.

[0235]

Note that the sub-signal addition section 102, for each of the components R, G, and B, the number

of bits constituting the transmission pixel data in B2.

The transmission pixel data B2, the components R, G, and B, are provided the transmitter 72 (FIG. 2) is not 0 TMDS channel # to at # 2, the number of bits obtained by the sub-signal addition section 102, for example, is transmitted at a timing corresponding one of the timing described in Figure 9, the number of bits B2 transmission pixel data to FIG.

[0236]

The sub-signal processor 103, as described above, from the main image processor 101, other pixels P of the video data period of the main image is supplied, the secondary signal is supplied.

Further, the sub-signal processor 103, the sub-signal assignment bits determination section 103, sub-signal assignment bits is supplied.

[0237]

Supplied from the main image processor 101, a pixel number P of video data period of the main image, the sub-signal processor 103, the number B3 Prefecture sub-signal assignment bits supplied from the sub-signal assignment bits determination section 103, The determined amount of data P × B3 of the maximum of the sub-signals can be transmitted in the video data period of the video field 1, within a data amount P × B3 of the maximum video fields 1 video (1 frame) amount of data of the sub-signal to be transmitted in the data section (hereinafter referred to as sub-signal additional unit amount of data) to determine the D.

[0238]

Further, the sub-signal addition unit data amount D for each sub-signal processor 103 supplies the sub-signal-related information insertion section 104, the sub-signal supplied thereto.

[0239]

Further, the sub-signal processor 103 supplies the sub-signal frame information transmission

controller 107, a sub-signal information indicating sub-signal whether contained in the transmission pixel data.

[0240]

That is, when supplying to the sub-signal-related information insertion section 104, the sub-signal of the sub-signal addition unit data amount D, that is, if there is a sub-signal to be assigned to the transmission pixel data, the sub-signal processor 103, the transmission pixel data and supplies the sub-signal frame information transmission controller 107, a sub-signal information indicating that the sub-signal.

When it is not supplied to the sub-signal-related information insertion section 104, the sub-signal of the sub-signal addition unit data amount D, i.e., the sub-signal processor 103, if there is no supply auxiliary signal to the sub-signal-related information insertion section 104 , and supplies the sub-signal frame information transmission controller 107, a sub-signal information indicating that the sub-signal is not contained in the transmission pixel data.

[0241]

In sub-signal of the sub-signal additional unit amount of data D from the sub-signal processing unit 103, including the sub-signal related information related to the sub-signal and (insert), sub-signal related information insertion section 104, sub-signal addition section 102 is supplied to.

[0242]

The sub-signal reception determination unit 105, VSDB of E-EDID read out HDMI communication partner HDMI of (R) source 53 (R) sink (FIG. 17) is supplied.

[0243]

The sub-signal reception determination unit 105, by referring bits Sub_Data_Support of VSDB supplied thereto (FIG. 17), HDMI communication partner HDMI of (R) source 53 (R) sink receives the sub signal Whether can, that is, a determination is made as to whether it can handle the sub-

signal, and supplies the required block, the determination result.

[0244]

Further, if it is determined that it may be HDMI communication partner HDMI of (R) source 53 (R) sink can handle the sub-signal, further, the sub-signal reception determination unit 105, the bit Sub_2bit the VSDB, Sub_4bit, Sub_8bit Recognizing the number of bits of the sub-signal which makes it possible to see (Figure 17), HDMI communication partner HDMI of (R) source 53 (R) sink can handle (hereinafter referred to available number of bits) the , is supplied to the sub-signal assignment bit number determining section 106.

[0245]

The sub-signal assignment bits determination section 106, as described above, from the main image processor 101, the number B1 bits of pixel data of the main image is supplied from the sub-signal reception determination unit 105, available bits number is supplied.

Further, the sub-signal assignment bits determination section 106, the deep color mode determination unit 108, the deep color mode is supplied.

[0246]

Based on the deep color mode supplied from the deep color mode determining unit 108 recognizes the number B2 bits of the transmission pixel data, the sub-signal assignment bits determination section 106, the pixel data of the main image from the main image processor 101 B2-B1 difference between the number of bits B1, that is, I find the bit number B2-B1 of the remainder of the transmission bit pixel data.

[0247]

And, sub-signal assignment bit number determining section 106, if in the corresponding number of bits from the sub-signal reception determining section 105, there is a number of bits to match the bit number B2-B1 of the remainder bits of the transmission pixel data is, I determine the number

B3 sub-signal bit allocation, the number of bits.

[0248]

Here, for example, in the case of the three 2-bit, 4 bits, and 8 bits, the number B3 sub-signal assignment bits, corresponding number of bits from the sub-signal reception determination unit 105, the following values is determined.

[0249]

That is, for example, the number B2 bits of the transmission pixel data is 10 bits, the number B1 bits of the pixel data in the main pixel, for example, when it is 8 bits, the number B3 sub-signal assignment bits is determined to be 2 bits Ru.

[0250]

Further, for example, the number B2 bits of the transmission pixel data is 12 bits, for example, when it is 10 bits or 8 bits, the number B3 sub-signal assignment bits, the number B1 bits of the pixel data in the main pixel, respectively, is determined to 2-bit or 4-bit.

[0251]

Further, for example, the number B2 bits of the transmission pixel data is 16 bits, for example, when it is 12 bits or 8 bits, the number B3 sub-signal assignment bits, the number B1 bits of the pixel data in the main pixel, respectively, is determined in 4-bit or 8-bit.

[0252]

In addition, sub-signal assignment bit number determining section 106, in the case in the corresponding number of bits from the sub-signal reception determining section 105, there is no number of bits to match the bit number B2-B1 of the remainder bits of the transmission pixel data

is, for example, in a corresponding number of bits from the sub-signal reception determination unit 105, among the available number of bits matching the number of bits having B2-B1 less than the remainder bits of the transmission pixel data, for example, it is possible to determine the number B3 sub-signal assignment bits, the maximum value.

However, in this case, in order to simplify the explanation, the case in a corresponding number of bits from the sub-signal reception determination unit 105, there is no number of bits matching the number of bits B2-B1 of the remainder bits of the transmission pixel data is, it is assumed that the process, as if it is impossible HDMI in (R) source 53, and does not transmit the sub-signals, HDMI communication partner (R) sink can handle the sub-signal.

[0253]

When you determine the number B3 sub-signal assignment bit, sub-signal assignment bit number determining section 106, sub-signal frame information transmission control section 107 sub-signal addition section 102, and sub-signal processing unit 103, and the number B3 the sub-signal assignment bit is supplied to.

[0254]

The sub-signal frame information transmission controller 107, sub-signal information indicating, as described above, the sub-signal processing unit 103, sub-signal whether contained in the transmission pixel data is supplied, the sub-signal assignment bits from the decision unit 106, another number B3 sub-signal assignment bits is supplied from the deep color mode determining section 108, the deep color mode is supplied.

[0255]

Further, if necessary, the sub-signal frame information transmission controller 107, a sub-signal information from the sub-signal processor 103, the deep color mode from the deep color mode determining section 108, sub-signal assignment bits determination section 106 I to transmit (Figure 2) and a transmitter 72, general control packet that contains the number B3 sub-signal assignment bits supplied from (Figure 18).

[0256]

That is, when the sub-signal information from the sub-signal processor 103, represents the fact that the sub-signal is not contained in the transmission pixel data, the sub-signal frame information transmission controller 107, the bit of FIG 18 SD0, SD1 , SD2 is set to 0 Any further and CD0, CD1, CD2 bits, general control packet is set to a value indicating a deep color mode from the deep color mode determination unit 108 (hereinafter, as appropriate, no secondary signal I control transmissions to be sent to the transmitter 72, a) of the general control packet.

[0257]

Further, when the sub-signal information from the sub-signal processor 103, represents the fact that the sub-signal is contained in the transmission pixel data, the sub-signal frame information transmission controller 107, the bit of FIG 18 SD0, SD1, It is set to the value representing the number B3 sub-signal assignment bits from the sub-signal assignment bits determination section 106, and further, the CD0, CD1, CD2 bit, SD2, and the value indicating the deep color mode from the deep color mode determination unit 108 I control transmissions to be sent to the transmitter 72, the general control packet is set to (hereinafter referred to as the general control packet has the secondary signal).

[0258]

The deep color mode determination unit 108, VSDB of E-EDID read out HDMI communication partner HDMI of (R) source 53 (R) sink (FIG. 17) is supplied.

[0259]

By reference bit Suport_30bit of VSDB supplied thereto, Suport_36bit, Suport_48bit (FIG. 17), HDMI communication partner HDMI of (R) source 53 (R) sink, deep color mode determination unit 108, the high tone If it is determined to determine whether it corresponds to an image, it is not compatible with deep color mode, that is, not 0 TMDS channels # 3 to determine the 24-bit image, the image to be transmitted in # 2.

[0260]

Further, if it is determined that the HDMI communication partner HDMI of (R) source 53 (R) sink, and corresponds to the high tone image, and further, the deep color mode determining section 108, bit Suport_30bit the VSDB, Suport_36bit, Suport_48bit by reference to (Figure 17), high tone recognizes the high tone image to the HDMI communication partner HDMI of (R) source 53 is (R) sink supports, the, HDMI (R) sink corresponds from the image, the deep color mode, that is, not 0 TMDS channels # 3 to determine the image to be transmitted in # 2.

[0261]

That is, for example, from the images HDMI (R) sink is compatible, for example, from 0 TMDS channel # (three deep color mode to the deep color mode determination unit 108, # 2, an image having gradation highest in is determined as the image) to be transmitted.

[0262]

The deep color mode determination unit 108 supplies the sub-signal frame information transmission controller 107 sub-signal addition section 102, and sub-signal assignment bits determination section 106, and a deep color mode.

[0263]

Next, referring to FIG 21, will be described the sub-signal-related information contained in the sub-signal sub-signal-related information insertion unit 104 of FIG 20.

[0264]

Expanded HDMI in (R), pixel data of the video data period video field (Fig. 4), that is, sub-signal, together with the main image assigned to the lower bits of the transmission pixel data, assigned to the upper bits of the transmission pixel data is transmitted, but not necessarily limited to the transmission pixel data of all the sub-signal to be assigned.

[0265]

That is, depending on the amount of data of the sub-signal, only the transmission pixel data of a portion of the video data period, the sub-signal is assigned to the transmission pixel data of the remaining, sometimes sub-signal is not assigned.

[0266]

Thus, the transmission pixel data of a portion of the video data period, the sub-signal is assigned, in the case where the transmission pixel data of the remaining sub-signal is not assigned, HDMI receiving the transmission pixel data (such In R) sink, only for the transmission pixel data to distinguish the transmission pixel data assigned to the sub-signal, and the transmission pixel data that has not been assigned, is assigned the sub-signal, the sub-signal, the low-order bits it is necessary to extract.

[0267]

Therefore, in the sub-signal-related information insertion section 104, sub-signals of the sub-signal addition unit data amount D, that is, the sub-signal assigned to transmission pixel data in the video data period (Fig. 4) video field one, at least sub will be included sub-signal-related information including information used to distinguish the transmission pixel data that is assigned a signal.

[0268]

That is, for example, as shown in 21 right figure, consists of a sub-signal end information and the sub-signal start information, the sub-signal start information, the sub-signal-related information, the beginning of the sub-signal of the sub-signal addition unit data amount D are arranged, the sub-signal end information is placed at the end of the sub-signal of the sub-signal addition unit data amount.

[0269]

Then, for example, are assigned as shown in 21 left figure, the transmission pixel data of the pixels constituting the (horizontal lines of the first from the top) the first line of the video data period of the video field, the sub-signal start information and the sub-signal addition the transmission pixel data of pixels constituting the lines of the second and subsequent lines, the sub-signal of the unit data amount is allocated sequentially.

[0270]

Assuming that all of the sub-signal of the sub-signal additional unit amount of data D, and assigned to the transmission pixel data of pixels constituting the +1 th line M through the second line, sub-signal end information, the M-th of the immediately following I assigned to the transmission pixel data of pixels constituting the +2 line.

[0271]

As described above, the sub-signal start information is placed at the beginning of the sub-signal of the sub-signal addition unit data amount D, for example, the fact that the transmission pixel data of the second and subsequent lines, the sub-signal is assigned and, information indicating the type of sub-signals, such as a text data the image data, or audio data (attributes), and further, may include information relating to the sub-signal format, and other sub-signal is the sub signal .

[0272]

Further, the sub-signal end information is placed at the end of the sub-signal of the sub-signal addition unit data amount, a unique code indicating that this is the final sub signal, further, transmitted pixels are assigned the last sub-signal If the data is the transmission pixel data of the pixels in the middle of the pixels constituting the +1 th line M, it is possible to include such information representative of the location of the pixels in the transmission pixel data.

[0273]

Note, for example, in a composed of 1920 pixels, the transmission pixel data, for example, the lower two bits, when assigning a sub-signal, one line of the video data period of the video field, the transmission of the pixels forming one line It is 2 bits × 1920 pixels = 3840 bits = 480 bytes, as the sub-signal end information and the sub-signal start information, the data amount of the sub-signal that can be assigned to the pixel data, adopting the information of 480 bytes each I could.

[0274]

Further, in the sub-signal processing unit 103 in FIG 20, the sub-signal addition unit data amount D, it the amount of data plus the data amount of the sub-signal end information and the sub-signal start information to be included in the sub-signal, the video data period is determined so as not to exceed the amount of data P × B3 of the maximum of the sub-signals can be transmitted.

[0275]

Next, with reference to the flowchart in FIG 22, HDMI in FIG 2 (R) source 53, corresponds expanded HDMI to (R), the HDMI source signal processing section 71 of the (R) source 53 Figure 20 will be described in the composed, the operation of the HDMI (R) source 53, as shown in.

[0276]

HDMI In (R) source 53, the pixel data of the main image is supplied to the main image processing unit 101 the source signal processor 71 (FIG. 20), and further, if necessary, the sub-signal, the sub-signal processing unit and is supplied to the 103.

[0277]

The main image processing unit 101, processing necessary for the main image supplied thereto is performed, the pixel data of the main image after the processing is supplied to the sub-signal addition section 102.

[0278]

It also detects the P (number of pixels of the effective pixels) pixels of the video data period (Fig. 4) video field of the main image supplied thereto, the main image processor 101 supplies the sub-signal processing unit 103 .

[0279]

Further, it detects the number B1 bits of each component of the pixel data of the main image, the main image processor 101 supplies the sub-signal assignment bits determination section 106.

[0280]

In addition, wait from the HDMI (R) sink 61 via the DDC as described in FIG 2, E-EDID HDMI of (R) sink 61 is to be transmitted, HDMI (R) source 53, the step S101 in, I receive the E-EDID.

[0281]

In (R) source 53, the sub-signal reception determination unit 105 source signal processor 71 (FIG. 20), E-EDID HDMI from (R) sink 61 is supplied to the deep color mode determination unit 108 HDMI .

[0282]

In step S102, by referring VSDB of E-EDID HDMI from (R) sink 61 (FIG. 17), the image that corresponding (R) sink 61 HDMI, deep color mode determination unit 108, 24 recognize bit image, 30-bit image, 36-bit image, or whether which one of the 48-bit image.

Furthermore, the deep color mode determining section 108, the deep color mode from the images (R) sink 61 is compatible DMI, not 0 TMDS channels # 3 to determine the image to be transmitted in # 2, representing the image is supplied to the sub-frame signal information transmission control section 107 sub-signal addition section 102, and sub-signal assignment bit number determining unit 106, and.

[0283]

When it is only a 24-bit image, that is, when the HDMI (R) sink 61 does not correspond to the high tone image, the image of HDMI (R) sink 61 are corresponding, HDMI (R) source 53 is, processing is performed without performing the processing of step S104 and thereafter to be described later, conforming to the current HDMI (R).

Therefore, in this case, the transmission of the sub-signal is not performed.

[0284]

Thereafter, in step S103, the adjusted to a frequency corresponding to the deep color mode determined in step S102, the frequency of the pixel clock, starting the output of the pixel clock, HDMI (R) source 53, the process proceeds to step S104 .

[0285]

In step S104, by reference to (Figure 17) is supplied thereto, bit Sub_Data_Support of VSDB in E-EDID HDMI from (R) sink 61, the sub-signal reception determination unit 105, HDMI (R) sink 61, whether it can receive a sub-signal, that is, determines whether it can handle the sub-signal.

[0286]

In step S104, if it is determined that it is difficult to HDMI (R) sink 61 can handle the sub-signal, i.e., bit Sub_Data_Support the VSDB (Fig. 17) is 0 is a value indicating that it can not handle a sub-signal If it is in, the process proceeds to step S105, hereinafter, HDMI (R) source 53, TMDS channel # 0, the pixel data of the image indicated by the deep color mode without transmitting the sub-signals, determined in step S102 I do not to be transmitted and # 2.

[0287]

That is, that, SD0, SD1, SD2 bit of FIG 18, is set to 0 both, further, in step S105, the sub-signal frame information transmission controller 107, the general control packet with no sub-signal, bits CD0, CD1 The control section of the vertical blanking interval of the video field (Fig. 4), CD2 is, the transmitter 72, a general control packet is set to a value indicating a deep color mode supplied from the deep color mode determining section 108 in step S102 It is transmitted (Fig. 2), the process proceeds to step S106.

[0288]

In step S106, the only from the pixel data of the main image supplied from the main image processor 101, the sub-signal addition section 102, the transmission pixel data of the number of bits B2 corresponding to the image of the deep color mode determined in step S102 Configure, is supplied to the transmitter 72.

Thus, the video data period of the video field, and transmits the transmission pixel data, the transmitter 72, the process proceeds to step S107.

[0289]

The transmission of the transmission pixel data is performed in synchronization with the pixel clock output is started in step S103.

[0290]

In step S107, the transmission pixel data to video fields which has transmitted the transmission pixel data in step S106 immediately before (hereinafter referred to as the target video field) in the active video period of the sub-signal addition section 102 is not transmitted yet is present a determination is made as to whether or not to.

[0291]

If, in step S107, it is determined that the transmission pixel data in the active video period of the

target video field has not yet been transmitted, the process returns to step S106, the active video period of the target video field, transmission pixel which has not been transmitted yet data is transmitted.

[0292]

Further, if in step S107, it is determined that there is no transmission pixel data in the active video period of the target video field has not yet been transmitted, i.e., transmission of all the transmission pixel data in the active video period of the target video field ends If you, the process proceeds to step S108, the sub-signal addition section 102 determines video field next to the target video field (frame) exists.

[0293]

In step S108, if it is determined that a video field next to the target video field is present, a new, the video field following, is a target video field, the process returns to step S105, the above-mentioned processing is repeated be.

[0294]

In step S108, if it is determined that video field next to the video field of interest does not exist, the process ends.

[0295]

On the other hand, in step S104, if it is determined that it may be HDMI (R) sink 61 handles sub signal, i.e., bit Sub_Data_Support in VSDB (FIG. 17), a value indicating that it can handle the sub-signal If it is there is one, by referring to the bit Sub_2bit the VSDB, Sub_4bit, Sub_8bit (Figure 17), sub-signal reception determination unit 105, the bit of the sub-signals may be HDMI (R) sink 61 is handled Recognizing the available number of bits is a number, and supplies to the sub-signal assignment bits determination section 106, the process proceeds to step S109.

[0296]

In step S109, the available number of bits bits of pixel data of the main image from the main image processing unit 101 number B1, from the sub-signal reception determining section 105, and sub-signal assignment bit number determining unit 106, deep color mode decision Based on the number B2 bits of the transmission pixel data to be recognized from the deep color mode from the section 108, in the manner described above, to determine the number B3 sub-signal assignment bits is the number of bits of the sub-signal assigned to transmission pixel data, and supplies the sub-signal frame information transmission controller 107 sub-signal addition section 102, and the sub-signal processor 103, the process proceeds to step S110.

[0297]

Here, the main image processing unit 101, the number of pixels P in the video data period of the main image is supplied from the sub-signal assignment bits determination section 103, sub-signal processor 103 is supplied with the number B3 sub-signal assignment bits and Ru, the number B3 Prefecture sub-signal assignment bits and pixels P of the video data period of the main image, in the manner described above, the sub-signal is a data amount of the sub-signal to be transmitted in the video data period of the video field of 1 I will determine the additional amount of data unit D.

[0298]

Then, in step S110, the sub-signal processor 103 determines whether there is a sub-signal to be added to the pixel data in the video data period of the video field.

[0299]

If, in step S110, it is determined that there is a sub-signal to be added to the pixel data in the video data period of the video field, that is, for example, when the sub-signal is supplied to the sub-signal processor 103, the sub-signal processing unit 103, indicating that it is supplied to the sub-signal-related information insertion section 104, of the sub-signal supplied thereto, the sub-signal by the sub-signal addition unit data amount D, the sub-signal is contained in the transmission pixel data and supplies the sub-signal frame information transmission controller 107, a sub-signal information, the process proceeds to step S111, hereinafter, HDMI (R) is the source 53, the main

representative of the deep color mode and the sub-signal, which is determined in step S102 no 0 TMDS channel # to me to transmit and # 2, and the pixel data of the image.

[0300]

That is, according to the sub-signal information from the sub-signal processor 103, the general control packet has the sub-signal, that is, in step S111, the sub-signal frame information transmission controller 107, the SD0, SD1, SD2 bits 18 , and is set to a value corresponding to the number B3 sub-signal assignment bits is the number of bits supplied from the sub-signal assignment bits determination section 106 in step S109, the sub-signal assigned to transmission pixel data, and further, the bit CD0, CD1 The control section of the vertical blanking interval of the video field (Fig. 4), CD2 is, the transmitter 72, a general control packet is set to a value indicating a deep color mode supplied from the deep color mode determining section 108 in step S102 It is transmitted (Fig. 2), the process proceeds to Step S112.

[0301]

Here, if it is determined in step S110, that there is a sub-signal to be added to the pixel data of the video data period of the video field, as described above, the sub-signal is the sub-signal processor 103 is supplied thereto is supplied to the sub-signal related information insertion section 104, of the, the sub-signal of only sub-signal additional unit amount of data D.

[0302]

Sub-signal of the sub-signal addition unit data amount D from the sub-signal processing unit 103 is supplied, the sub-signal-related information insertion section 104, as described with reference to FIG 21, the sub-signal-related information related to the sub signal including the, and supplies the sub-signal addition section 102.

[0303]

In step S112, the configuration of the transmission image data, that is, sub-signal adding unit 102 starts to the pixel data of the main image from the main image processing unit 101, the addition of

a sub-signal from the sub-signal related information insert 104 .

[0304]

In other words, sub-signal addition section 102, divided into categories sub-signal of the sub-signal assignment bit number B3 each, which is supplied from the sub-signal assignment bit number determining unit 106 in step S109, the sub signal from the sub-signal related information insert 104 By then, it is added as the lower bits of the pixel data from the main image processor 101, that is, the transmission pixel data of the bit number B2 that is recognized from the deep color mode supplied from the deep color mode determining section 108 in step S102, the bit pixel data of the main image of B1 is assigned to the upper bit number, the number of bits is allocated to the lower bits divided sub-signal B3, the number of bits constituting the transmission pixel data in B2.

[0305]

Then, the process proceeds to step S113 from step S112, the pixel data of the main image assigned to the high-order bits, the sub-signal addition section 102 supplies the transmitter 72, the transmission pixel data that is assigned to the lower bits are divided sub-signal, Thus, the video data period of the video field, and transmits the transmission pixel data, the transmitter 72, the process proceeds to step S114.

[0306]

The transmission of the transmission pixel data is performed in synchronization with the pixel clock output is started in step S103.

[0307]

In step S114, the transmission pixel data in the active video period of the target video field is a video field sub-signal addition section 102, and transmits the pixel data as the transmission pixel data in step S113 immediately before and has not yet been transmitted exists a determination is made as to whether.

[0308]

If, in step S114, it is determined that there is a transmission pixel data in the active video period of the target video field has not been transmitted yet, returns to step S113, the active video period of the target video field, pixel data that has not been transmitted yet But it is transmitted as transmission pixel data.

[0309]

Further, if in step S114, it is determined that there is no transmission pixel data in the active video period of the target video field has not yet been transmitted, i.e., transmission of all the transmission pixel data in the active video period of the target video field ends If you, the process proceeds to step S115, the sub-signal addition section 102 determines video field next to the video field of interest exists.

[0310]

In step S115, if it is determined that a video field next to the target video field is present, a new, the video field following, is a target video field, the process returns to step S110, the above-mentioned processing is repeated be.

[0311]

In step S115, if it is determined that video field next to the video field of interest does not exist, the process ends.

[0312]

On the other hand, if in step S110, it is determined that there is no sub-signal to be added to the pixel data in the video data period of the video field, that is, for example, when the sub-signal is not supplied to the sub-signal processor 103, the sub signal and supplies the sub-signal frame

information transmission controller 107, a sub-signal information indicating that the sub-signal is not contained in the transmission pixel data, the process proceeds to step S116, the processing unit 103, sub-signal frame information transmission controller 107, In response to the sub-signal information from the sub-signal processor 103, as in step S105, the general control packet with no sub-signal, that is, SD0, SD1, SD2 bit of FIG 18, is set to 0 Any further the control period of the vertical blanking interval of the video field CD0, CD1, CD2 bits (FIG. 4), a general control packet is set to a value indicating a deep color mode supplied from the deep color mode determining section 108 in step S102 in, I to transmit (Figure 2) and a transmitter 72.

[0313]

Then, the following Steps S113 to the S115, HDMI (R) is the source 53, TMDS channel # # to 0, the pixel data of the main image indicated by the deep color mode without transmitting a sub-signal, which is determined in step S102 I transmitted in 2.

[0314]

That is, if the general control packet no secondary signal is transmitted in step S116, only from the pixel data of the main image supplied from the main image processor 101, in step S113, the sub-signal addition section 102 determines in step S102 Configure the transmission pixel data of B2 bit number corresponding to the image of deep color mode that has been, is supplied to the transmitter 72.

Thus, the video data period of the video field, and transmits the transmission pixel data, the transmitter 72, the process proceeds to step S114.

[0315]

The transmission of the transmission pixel data is performed in synchronization with the pixel clock output is started in step S103.

[0316]

In step S114, the transmission pixel data in the active video period of the target video field is a video field sub-signal addition section 102, and transmits the pixel data as the transmission pixel data in step S113 immediately before and has not yet been transmitted exists a determination is made as to whether.

[0317]

If, in step S114, it is determined that there is a transmission pixel data in the active video period of the target video field has not yet been transmitted, the process returns to step S113, the active video period of the target video field, transmission pixel which has not been transmitted yet data is transmitted.

[0318]

Further, if in step S114, it is determined that there is no transmission pixel data in the active video period of the target video field has not yet been transmitted, i.e., transmission of all the transmission pixel data in the active video period of the target video field ends If you, the process proceeds to step S115, the sub-signal addition section 102 determines video field next to the video field of interest exists.

[0319]

In step S115, if it is determined that a video field next to the target video field is present, a new, the video field following, is a target video field, the process returns to step S110, the above-mentioned processing is repeated be.

[0320]

In step S115, if it is determined that video field next to the video field of interest does not exist, the process ends.

[0321]

Then, when the (R) sink 61 corresponds to the expanded HDMI HDMI in FIG 2, FIG 23 shows a configuration example of the sync signal processing unit 82 having the (R) sink 61 The HDMI.

[0322]

In Figure 23, (First In First Out) memory 121, the sub-signal presence determination unit 122, separation unit 123, the main image processing unit 124, the main image memory 125, the sync signal processing unit 82, and sub-signal processing unit 126, FIFO and a sub-signal memory 127.

[0323]

The FIFO memory 121 (FIG. 2) receives the transmission pixel data in the video data period of the video field (Fig. 4) is supplied to the receiver 81.

[0324]

The sequentially stores the transmission pixel data from the receiver 81, FIFO memory 121 supplies to the separation unit 123.

[0325]

The sub-signal presence determination unit 122, the receiver 81 is received, the general control packet in the control period of the vertical blanking interval video field (Fig. 4) is supplied.

[0326]

Sub-signal presence determination unit 122, the video data period immediately after the vertical blanking interval on the basis of the SD0, SD1, SD2 general control packet from the receiver 81 bits (FIG. 18), the general control packet has been transmitted the transmission pixel data

transmitted, it is determined sub-signal whether contained, is supplied to the separation unit 123, the determination result.

[0327]

Further, if it is determined that the sub-signal is contained in the transmission pixel data, on the basis of the SD0, SD1, SD2 general control packet from the receiver 81 bits (FIG. 18), the sub-signal presence determination unit 122, the general recognizes the number B3 sub-signal assignment bits of the sub-signal contained in the transmission pixel data transmitted in the video data period immediately after the vertical blanking interval of the control packet has been transmitted, is supplied to the separating portion 123.

[0328]

If the sub-signal presence determination unit 122, the determination result indicating that the sub-signal is not contained in the transmission pixel data is supplied, receives the transmission pixel data from the FIFO memory 121, the separation unit 123, to the transmission pixel data is supplied to the main image processing unit 124, the pixel data of the main image are now assigned.

[0329]

Further, if the sub-signal presence determination unit 122, the determination result indicating that the sub-signal is contained in the transmission pixel data is supplied, receives the transmission pixel data from the FIFO memory 121, the separation unit 123, sub-signal presence determining Based on the number B3 sub-signal assignment bits supplied from the unit 122, the transmission pixel data, and separates the pixel data of the main image and the sub signal indicator.

[0330]

That is, extracted as sub-divided signal among the transmission pixel data from the FIFO memory 121, the lower bits of the number B3 sub-signal assignment bits from the sub-signal presence determination unit 122, separation unit 123, sub-signal processing unit and supplies to 126.

In addition, extracted as pixel data of the main image, of the transmission pixel data from the FIFO memory 121, the high-order bit of rest, separation unit 123 supplies the main image processing unit 124.

[0331]

And performs necessary processing on the pixel data of the main image supplied from the separation unit 123, and reconstructing the main image of the video field corresponding to 1, the main image processing unit 124 supplies the main image memory 125.

[0332]

The main image memory 125 temporarily stores the main image supplied from the main image processing unit 124.

The appropriately read, the main image stored in the main image memory 125 is supplied (Fig. 1) the display control unit 62.

[0333]

The section sub-signal supplied from demultiplexer 123, reconfigure the sub-signal source, the sub-signal processor 126 supplies the sub-signal memory 127.

As already described in FIG 21, the sub-signal, the sub-signal-related information is included, with reference as necessary to the sub-signal-related information, the sub-signal processing unit 126, re-sub signal to configure.

[0334]

Sub-signal memory 127 temporarily stores the sub-signal supplied from the sub-signal processor 126.

[0335]

Next, with reference to the flowchart in FIG 24, HDMI in FIG 2 (R) sink 61, corresponds expanded HDMI to (R), the HDMI sink signal processing section 82 (R) sink 61 Figure 23 will be described in the composed, the operation of the HDMI (R) sink 61, as shown in.

[0336]

In step S131, via the DDC (Fig. 2), HDMI (R) sink 61, and transmits to the (R) sink 61 HDMI, the E-EDID thereof.

[0337]

Thereafter, HDMI in (R) sink 61, as described in FIG 22, the output of the pixel clock is started and not 0 TMDS channels # the general control packet to it and transmitted thereto via the # 2, HDMI (R) receiver 81 of the sink 61 (FIG. 2), in step S132, receives the general control packet from the HDMI (R) sink 61 (FIG. 18), the sub-signal presence determination unit 122 of the sync signal processing unit 82 (FIG. 23) by supplying to, the process proceeds to step S133.

[0338]

In step S133, the sub-signal presence determination unit 122, immediately after the vertical blanking interval on the basis of the SD0, SD1, SD2 general control packet from the receiver 81 bits (FIG. 18), the general control packet has been transmitted and determines the transmission pixel data transmitted in the video data period, sub-signal whether the like.

[0339]

In step S133, if it is determined that the sub-signal is not contained in the transmission pixel data, and supplies to the separation unit 123, the judgment result to that effect, the sub-signal presence determination unit 122 proceeds to step S134.

[0340]

In step S134, the receiver 81 HDMI of (R) sink 61 (FIG. 2), the transmission pixel data of the image of the deep color mode CD0, CD1, CD2 bit of general control packet from the HDMI (R) source 53 is represented, Wait in synchronization with the pixel clock, not 0 TMDS channel # to via the # 2, and to be transmitted from the (R) sink 61 HDMI, receives the transmission pixel data, FIFO memories of the sync signal processing unit 82 through 121, and are supplied to the separation unit 123, the process proceeds to the step S135.

[0341]

In step S135, the separation unit 123, assigned to the transmission pixel data in accordance with the determination result indicating that the secondary signal is not included in the sub-signal presence determination unit 122, the transmission pixel data, and is supplied via the FIFO memory 121 is supplied to the main image processing unit 124, the pixel data of the main image is.

[0342]

In step S135, in order to reconstruct a main image of the video field corresponding to 1, the main image processing unit 124, and stored in to the main image memory 125 the pixel data of the main image from the separator 123, I the process proceeds to the step S136.

[0343]

In step S136, the main image processing unit 124, processing of the pixel data of the main image of the video field portion of one or ended, that is, in the main image memory 125, the main image of the video-field period of 1 whether stored it is judged.

[0344]

If, in step S136, it is determined that the processing of the pixel data of the main image of the

video field corresponding 1 is not completed, the process returns to step S134, and the same processing is repeated.

[0345]

Further, if it is determined in step S136, the processing of the pixel data of the main image of the video field corresponding 1 has been completed, waiting general control packet is to be transmitted in the video fields, and returns to step S132 Thereafter, the same process is repeated.

[0346]

On the other hand, if it is determined in step S133, the sub-signal is contained in the transmission pixel data, the sub-signal presence determination unit 122, based on the SD0, SD1, SD2 general control packet from the receiver 81 bit (Fig. 18) , recognizes the number B3 sub-signal assignment bits of the sub-signal contained in the transmission pixel data, together with the determination result indicating that the sub-signal is contained in the transmission pixel data, and supplies to the separation unit 123, the process proceeds to step S137.

[0347]

In step S137, the receiver 81 HDMI of (R) sink 61 (FIG. 2), the transmission pixel data of the image of the deep color mode CD0, CD1, CD2 bit of general control packet from the HDMI (R) source 53 is represented, Wait in synchronization with the pixel clock, not 0 TMDS channel # to via the # 2, and to be transmitted from the (R) sink 61 HDMI, receives the transmission pixel data, FIFO memories of the sync signal processing unit 82 through 121, and are supplied to the separation unit 123, the process proceeds to step S138.

[0348]

In step S138, the transmission pixel data in accordance with the determination result indicating that the sub-signal is included in the sub-signal presence determination unit 122, the transmission pixel data supplied via the FIFO memory 121, the separation unit 123, sub- Separate the lower bits of the number B3 sub-signal assignment bits from the signal presence determination unit 122,

a sub-divided signal, and supplies the sub-signal processor 126.

[0349]

In step S138, the separation unit 123, the transmission pixel data supplied via the FIFO memory 121, to separate the remaining upper bits, as the pixel data of the main image, and supplies to the main image processing unit 124, I, the process proceeds to step S139.

[0350]

In step S139, in order to reconstruct a main image of the video field corresponding to 1, the main image processing unit 124 stores and supplies to the main image memory 125 the pixel data of the main image from the separator unit 123.

In step S139, in order to reconstruct the sub signal, the sub-signal processing unit 126 to be stored therein are supplied to the sub-signal memory 127, the division sub-signal from the separation unit 123.

[0351]

In step S140, the the main image processing unit 124, processing of the pixel data of the main image of the video field portion of one or ended, that is, in the main image memory 125, the main image of the video-field period of 1 whether stored it is judged.

[0352]

If, in step S140, it is determined that the processing of the pixel data of the main image of the video field corresponding 1 is not completed, the process returns to step S137, and the same processing is repeated.

[0353]

Further, if it is determined in step S140, the processing of the pixel data of the main image of the video field corresponding 1 has been completed, waiting general control packet is to be transmitted in the video fields, and returns to step S132 Thereafter, the same process is repeated.

[0354]

As described above, receives the E-EDID as performance information indicating performance HDMI (R) sink 61 (FIG. 2), then (section between the next vertical synchronization signal from the vertical synchronization signal 1) video field In the video data period assigned to the (valid image period) the active video period from, except for the vertical blanking interval and the horizontal blanking interval, per clock of the pixel clock, the pixel data of the image for one screen of uncompressed no 0 TMDS channel # 3 for transmitting the data of the number of bits of fixed to and # 2, the differential signals, HDMI to be transmitted in one direction (R) sink 61 HDMI in (R) source 53, the transmitter 72, By adjusting the frequency of the pixel clock is not 0 TMDS channels # 3 to the # 2, the differential signals, HDMI (, the transmission pixel data that is assigned the number of bits of 8 bits or more is a fixed bit number I send in one direction R) sink 61.

[0355]

In this case, it is determined HDMI in (R) source 53, whether or not may be based VSDB of E-EDID (Figure 17), (R) sink 61 receives the sub-signal HDMI, HDMI (R If it is possible) sink 61 receives the sub-signal, by the pixel data of a main image composed of pixel data bits is less than the transmission pixel data transmitted by the transmitter 72, to add a sub-signal, the transmission pixel data is constituted by the transmitter 72, no 0 TMDS channels # 3 to to be transmitted in # 2.

[0356]

Further, HDMI in (R) source 53, the control period of the vertical blanking interval (Fig. 4), the transmission pixel data transmitted in the video data period immediately after the vertical blanking period, sub-signal whether included general control packet including SD0, SD1, SD2 bit as sub-signal information indicating (FIG. 18) is transmitted.

[0357]

On the other hand, transmits the E-EDID, followed, HDMI receiving the pixel data from the HDMI (R) source 53, not 0 TMDS channels # 3 to the # 2, transmitted by the differential signal, the (R) sink 61 The receiver 81 receives the transmission pixel data not 0 TMDS channels # 3 to # 2 in, transmitted by differential signals.

[0358]

Further, HDMI in (R) sink 61, based on the SD0, SD1, SD2 bits contained in (Figure 18) the general control packet transmitted control period of the vertical blanking interval (Fig. 4), the vertical blanking If it is determined in the transmission pixel data transmitted in the video data period immediately following the interval, the sub-signal whether included, in the transmission pixel data, the sub-signal is included, the transmission pixel data, the sub-signal is separated Ru.

[0359]

Therefore, when the number of bits of pixel data of the main image is smaller than the number of bits of the transmission pixel data determined by the deep color mode, the bits that are not assigned bits of the transmission pixel data, the pixel data of the main image, the sub- it is possible to perform efficient data transmission assignment signals, together with the main image, and transmits the sub-signals.

[0360]

It should be noted that, as is the large difference between the number of bits of the transmission pixel data, and the number of bits of the pixel data of the main image, I can be in the transmission pixel data, the amount of data is assigned sub-signal of large a (Category sub-signal).

[0361]

Further, in this embodiment, for the purpose of the sub signal, it is not particularly mentioned, the

secondary signal can be used in various applications.

[0362]

Specifically, the sub-signal, for example, may be employed or low resolution image that is synchronized with the main image, an image of the image, other program different from the main image.

In this case, it is possible to display 42 (FIG. 1), the split display, or displayed on the child screen of PinP (Picture in Picture) for the image as the sub signal.

[0363]

Further, as the sub-signal, for example, it is possible to employ a control signal for controlling the display of the main image.

In this case, it is possible in the display 42 is controlled in response to the control signal as a sub signal, the display of the main image.

[0364]

As the sub-signal, in the case of using the (video) images, when the sound associated with the image, it can also be transmitted by assigning the transmission pixel data, and the voice is similar to the audio accompanying the main image in, it is possible to transmit the data island period (Fig. 4).

That is, HDMI in (R), the data island period (Fig. 4), the speech which could be the transmission of voice data of multiple audio channels, and associated with the image as the sub-signal, the audio data accompanying the main image It can be performed by using a voice channel that is not used to send.

[0365]

Next, a series of processing of the sync signal processing unit 82 and the source signal control unit 71 described above can also be can also be performed by dedicated hardware, or performed by software.

When the series of processes is executed by software, for example, a program constituting the software is installed into a computer such as a microcomputer for controlling HDMI HDMI (R) and Source 53 (R) sink 61.

[0366]

Therefore, Figure 25 shows a configuration example of an embodiment of a computer program for executing the series of processes described above is installed.

[0367]

The program may be recorded in advance in the ROM203 and (Electrically Erasable Programmable Read-only Memory) 205 EEPROM as a recording medium mounted in the computer.

[0368]

Alternatively, the removable recording medium a flexible disk, CD-ROM (Compact Disc Read Only Memory), MO (Magneto Optical) disk, DVD (Digital Versatile Disc), magnetic disk, or a semiconductor memory, the program is permanent or temporary it is possible to specifically stored (recorded).

Such a removable recording medium can be provided as package software.

[0369]

The may be installed on the computer from the removable recording medium as described above, from a download site via a satellite for digital satellite broadcasting, or transferred wirelessly to a computer program, LAN (Local Area Network), Internet It is possible via the network and is

transferred by wire to a computer, the computer, and install the EEPROM205 that is received on the output interface 206, and built, the programs which are transferred in this way.

[0370]

The computer has a built-in (Central Processing Unit) 202 CPU.

The CPU202, via a bus 201, input-output interface 206 is connected, CPU202 is loaded into (Random Access Memory) 204 RAM, the program stored in the EEPROM205 and (Read Only Memory) 203 ROM I executes the program from.

Thus, CPU202 performs the processing performed by the configuration of the block diagram described above, or processing according to the flowchart described above.

[0371]

In this specification, need not be processed in time series in the order described in the flowchart necessarily, process steps describing the program for causing a computer to execute various processes are in parallel or individually (For example, parallel processing or processing by object) but includes processing to be executed.

[0372]

Also, the program may be one which is processed by a single computer, or may be subjected to distributed processing by a plurality of computers.

[0373]

Incidentally, the present invention is not limited to the embodiments described above, embodiments of the present invention, various modifications are possible without departing from the scope of the present invention.

[0374]

That is, for example, any number B3 sub-signal assignment bits bits of the pixel data of the main image having B1, and the number B2, bits of the transmission pixel data is not limited to the values described above.

In addition, for example, it is not intended to be limited to the region described above, space that can be allocated to the SD0, SD1, SD2, etc. bit bit Suport_30bit, Suport_36bit, and Suport_48bit, bit Sub_2bit, Sub_4bit, Sub_8bit, Sub_Data_Support, as a sub-signal information is also current In the HDMI (R), it can be assigned to any region that is a (Reserved) unused.

[0375]

In addition to the HDMI (R), after receiving the performance information representative of the performance of the receiver, from the section to the next vertical synchronization signal, the present invention, the vertical blanking and horizontal blanking period of the vertical synchronizing signal of the 1 In an effective image interval is an interval excluding a section, in a plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, a differential signal, pixel data of the image for one screen of uncompressed a transmission device for transmitting in one direction to the receiving apparatus, after transmitting performance information, from the transmitting device, in a plurality of channels, the communication interface consisting of a receiving apparatus for receiving pixel data transmitted by the differential signal is applicable.

[0376]

Is a block diagram showing a configuration example of an embodiment of the AV system according to the present invention.

Is a block diagram showing a configuration example of an HDMI HDMI (R) source 53 (R) sink 61.

Is a block diagram showing a configuration example of the receiver 81 and transmitter 72.

No 0 TMDS channels # 3 to is a diagram showing a transmission section of the transmission via the # 2.

And control bits CTL0, CTL1, is a timing chart showing the relationship between the data island

period and the control period.

Is a timing chart showing the timing of transmission of pixel data of the image transmitted in the video data period of the (R) HDMI current.

Is a timing chart showing the timing of transmission of pixel data in the case of transmitting a 30-bit image in the video data period of HDMI (R).

Is a timing chart showing the timing of transmission of pixel data in the case of transmitting a 36-bit image in the video data period of HDMI (R).

Is a timing chart showing the timing of transmission of pixel data in the case of transmitting a 48-bit image in the video data period of HDMI (R).

Is a diagram showing a format of VSDB in E-EDID.

Is a diagram showing a format of a general control packet.

The diagrams and CD0, CD1, CD2 bits of Byte # SB1 of the sub packet, showing the relationship between an image transmitted to the video data period.

Is a flowchart for explaining the operation of the (R) source 53 HDMI correspond deep color HDMI in (R).

Is a flowchart for explaining the operation of the (R) sink 61 HDMI correspond deep color HDMI in (R).

Is a diagram illustrating the transmission of pixel data of the main image gradation is lower than the image of the deep color mode determined by the (R) source 53 HDMI.

Is a diagram illustrating an allocation method of allocating a sub-signal to transmission pixel data.

Is a diagram showing a format of VSDB in E-EDID.

Is a diagram showing a format of a general control packet.

The diagrams and SD0, SD1, SD2 bits Byte # SB2 of the sub-packet, showing the relationship between the number of bits of the sub-signal.

Is a block diagram showing a configuration example of a source signal processor 71.

It is a view for explaining the sub-signal-related information to be included in the sub-signal.

Is a flowchart for explaining the operation of the (R) source 53 HDMI that supports extended to HDMI (R).

Is a block diagram showing a configuration example of the sync signal processor 82.

Is a flowchart for explaining the operation of the (R) sink 61 HDMI that supports extended to HDMI (R).

Is a block diagram showing a configuration example of an embodiment of a computer according to the present invention.

[0377]

41 HD recorder, the display 42, 43 cables, recording and reproducing unit 51, 52 codec, 53 HDMI (R) source, 54 HD, 61 HDMI (R) sink, the display control unit 62, a display unit 63, 71 source signal processing unit, 72 transmitter, no 72A to 72C encoder / serializer, 81 receiver, not 81A to 81C recovery / decoder, 82 sync signal processor, 101 main image processing unit, 102 sub-signal applying section 103 sub-signal processing unit, 104 sub-signal related information inserted section, 105 sub-signal reception determining unit, 106 sub-signal assignment bit number determining unit, 107 sub-signal frame information transmission control unit, 108 deep color mode determination unit, 121 FIFO memory, 122 sub-signal presence determination unit, separating unit 123, 124 main image processing unit, main image memory 125, 126 sub-signal processing unit, 127 sub-signal memory, bus 201, 202 CPU, 203 ROM, 204 RAM, 205 EEPROM, 206 input and output interface

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[0001]

After receiving the performance information representative of the performance of the receiver, the effective image section is a section from the section to the next vertical synchronization signal, except for the vertical blanking interval and the horizontal blanking period of the vertical synchronization signal 1, the non- In the plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, a differential signal, a transmission apparatus for transmitting in one direction to the receiving device, the pixel data of the image for one screen of the compression, After transmitting the performance data, from the transmitting device, in the plurality of channels, a communication system consisting of said receiving apparatus for receiving pixel data transmitted by the differential signal, the transmitting device, the pixel By adjusting the frequency of the clock in the plurality of channels, a differential signal, and transmitting means for transmitting in one direction to the receiving device, the pixel data assigned number of bits than the number of bits of the fixed , if it is possible and determines the sub-signal reception determination means for determining whether or not may be based on the performance information, the receiving apparatus receives the sub-signal, the receiving apparatus receives the sub-signal, the transmission By the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the unit, adding the sub-signal,A sub-signal addition means for constituting the transmission pixel data in the vertical blanking interval, the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval, the sub-signal whether included an information transmission control means for transmitting an information signal sub-represented in the plurality of channels, a receiving unit for receiving the transmission pixel data transmitted by the differential signal, the receiving apparatus, the vertical blanking interval determines the sub-signal presence determining means to the transmission pixel data on the basis of the sub-signal information transmitted, is transmitted to the effective image period immediately after the vertical blanking interval, the sub-signal whether included and the case where the transmission pixel data, the sub-signal is

included, the communication system from the transmission pixel data, and a separating means for separating the sub-signal.

[0002]

After receiving the performance information representative of the performance of the receiver, the effective image section is a section from the section to the next vertical synchronization signal, except for the vertical blanking interval and the horizontal blanking period of the vertical synchronization signal 1, the non- In the plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, a differential signal, it is a transmission device that transmits to the one direction to the receiving device, the pixel data of the image for one screen of the compressed , by adjusting the frequency of the pixel clock, and the plurality of channels, a differential signal, and transmits in one direction to the receiving device, the pixel data assigned number of bits than the number of bits of the fixed If it is possible for determining the sub-signal reception determination means for determining whether or not can be a transmission unit, that is under the performance information, the receiving apparatus receives the sub-signal, the receiving apparatus receives the sub signal , by the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmission unit, and to add the auxiliary signal, the auxiliary signal constituting the transmission pixel data and adding means, in the vertical blanking interval, and transmit the sub-signal information indicating the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval, the sub-signal whether included

[0003]

The transmission unit, the transmission apparatus according to claim 2, based on the performance information, determines the number of bits of the transmission pixel data, on the basis of the number of bits of the transmission pixel data, and adjusts the frequency of the pixel clock .

[0004]

After receiving the performance information representative of the performance of the receiver, the effective image section is a section from the section to the next vertical synchronization signal, except for the vertical blanking interval and the horizontal blanking period of the vertical synchronization signal 1, the non- In the plurality of channels for transmitting data of a fixed

number of bits in one clock per pixel clock, a differential signal, the communication of the transmission apparatus for transmitting in one direction to the receiving device, the pixel data of the image for one screen of the compressed A method, by adjusting the frequency of the pixel clock, and the plurality of channels, a differential signal, the transmitting apparatus, wherein the pixel data assigned number of bits than the number of bits of the fixed be determined whether there can be a transmitting means for transmitting in one direction to the receiving device, based on the performance information, the receiving apparatus receives the sub-signal, the receiving apparatus receives the sub signal If so, by the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmission unit, and to add the auxiliary signal, configure the transmission pixel data , in the vertical blanking interval, the step of transmitting the sub-signal information indicating the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval, the sub-signal whether included

[0005]

After receiving the performance information representative of the performance of the receiver, the effective image section is a section from the section to the next vertical synchronization signal, except for the vertical blanking interval and the horizontal blanking period of the vertical synchronization signal 1, the non- In the plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, a differential signal, controlling the transmission apparatus for transmitting in one direction to the receiving device, the pixel data of the image for one screen of the compressed This is a program to be executed by a computer that, by adjusting the frequency of the pixel clock, and the plurality of channels, wherein the transmitting device is the difference, pixel data assigned number of bits than the number of bits of the fixed The motion signal, a determination is made as to whether or not it is possible to a transmission means for transmitting in one direction to the receiving device, based on the performance information, the receiving apparatus receives the sub-signal, wherein the receiving device is the sub signal If it is possible to receive, by the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmission unit, and to add the auxiliary signal, and the transmission constitute the pixel data in the vertical blanking interval, the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval,Program for causing a computer to execute a communication process including a step of transmitting the sub-signal information representative of the sub-signal whether the like.

[0006]

After receiving the performance information representative of the performance of the receiver, the effective image section is a section from the section to the next vertical synchronization signal, except for the vertical blanking interval and the horizontal blanking period of the vertical synchronization signal 1, the non- In the plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, a differential signal, it is a transmission device that transmits to the one direction to the receiving device, the pixel data of the image for one screen of the compressed , by adjusting the frequency of the pixel clock, and the plurality of channels, a differential signal, and transmits in one direction to the receiving device, the pixel data assigned number of bits than the number of bits of the fixed If it is possible for determining the sub-signal reception determination means for determining whether or not can be a transmission unit, that is under the performance information, the receiving apparatus receives the sub-signal, the receiving apparatus receives the sub signal , by the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmission unit, and to add the auxiliary signal, the auxiliary signal constituting the transmission pixel data and adding means, in the vertical blanking interval, the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval,After the transmitting device and a data transmission control means for transmitting the sub-signal information representative of the sub-signal whether included or submit the performance information, from the transmitting device, with the plurality of channels, differential It is the receiving apparatus for receiving pixel data transmitted by the signal at the plurality of channels, a receiving unit for receiving the transmission pixel data transmitted by the differential signal, it is sent to the vertical blanking interval determining the sub-signal presence determining means to the transmission pixel data on the basis of the information signal sub the coming, transmitted to the effective image period immediately after the vertical blanking interval, the sub-signal whether contained, the If the transmission pixel data, the sub-signal is included, from the transmission pixel data, the receiving device comprising separating means for separating the sub-signal.

[0007]

After receiving the performance information representative of the performance of the receiver, the effective image section is a section from the section to the next vertical synchronization signal, except for the vertical blanking interval and the horizontal blanking period of the vertical synchronization signal 1, the non- In the plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, a differential signal, it is a transmission device that transmits to the one direction to the receiving device, the pixel data of the image for one screen of the compressed , by adjusting the frequency of the pixel clock, and the plurality of channels, a differential signal, and transmits in one direction to the receiving device, the pixel data assigned number of bits than the number of bits of the fixed If it is possible for determining the sub-signal reception determination means for determining whether or not can be a transmission unit, that is

under the performance information, the receiving apparatus receives the sub-signal, the receiving apparatus receives the sub signal , by the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmission unit, and to add the auxiliary signal, the auxiliary signal constituting the transmission pixel data and adding means, in the vertical blanking interval, the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval,After the transmitting device and a data transmission control means for transmitting the sub-signal information representative of the sub-signal whether included or submit the performance information, from the transmitting device, with the plurality of channels, differential This is a communication method of the receiving apparatus for receiving pixel data transmitted by the signal at the plurality of channels, the receiving device includes a receiving means for receiving the transmission pixel data transmitted by the differential signal, In determining the transmission pixel data on the basis of the sub-signal information transmitted in the vertical blanking interval, is transmitted to the effective image period immediately after the vertical blanking interval, the sub-signal whether included The, when the transmission pixel data, the sub-signal is included, from the transmission pixel data, the communication method comprising the step of separating the sub-signal.

[0008]

After receiving the performance information representative of the performance of the receiver, the effective image section is a section from the section to the next vertical synchronization signal, except for the vertical blanking interval and the horizontal blanking period of the vertical synchronization signal 1, the non- In the plurality of channels for transmitting data of a fixed number of bits in one clock per pixel clock, a differential signal, it is a transmission device that transmits to the one direction to the receiving device, the pixel data of the image for one screen of the compressed , by adjusting the frequency of the pixel clock, and the plurality of channels, a differential signal, and transmits in one direction to the receiving device, the pixel data assigned number of bits than the number of bits of the fixed If it is possible for determining the sub-signal reception determination means for determining whether or not can be a transmission unit, that is under the performance information, the receiving apparatus receives the sub-signal, the receiving apparatus receives the sub signal , by the pixel data of a main image composed of pixel data bits is less than the transmission pixel data is the pixel data transmitted by the transmission unit, and to add the auxiliary signal, the auxiliary signal constituting the transmission pixel data and adding means, in the vertical blanking interval, the transmission pixel data transmitted in the valid image period immediately after the vertical blanking interval,After the transmitting device and a data transmission control means for transmitting the sub-signal information representative of the sub-signal whether included or submit the performance information, from the transmitting device, with the plurality of channels, differential This is a program for causing a computer for controlling the receiving apparatus for receiving pixel data transmitted by the signal at the plurality of channels,

the receiving device receives the transmission pixel data transmitted by the differential signal the transmission pixel data to a receiving unit, on the basis of the sub-signal information transmitted in the vertical blanking interval, and transmitted to the effective image period immediately after the vertical blanking interval, the sub-signal is contained determination is made as to whether, when the transmission pixel data, the sub-signal is included, from the transmission pixel data, the program for causing a computer to execute a communication process including a step of separating the sub-signal.

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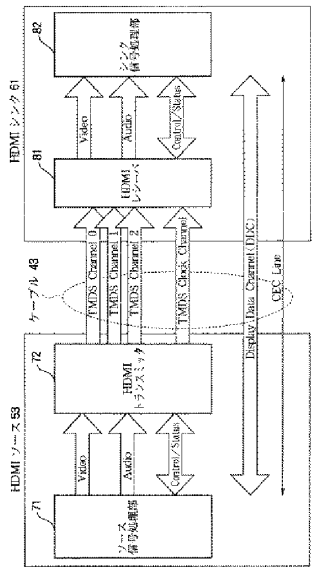
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(54)【発明の名称】通信システム、送信装置及び受信装置、通信方法、並びにプログラム

(57)【要約】
【課題】HDMI(R)等において、効率的なデータ伝送を行う。
【解決手段】HDMI(R)ソース５３は、E-EDIDのVSDBに基づいて、HDMI(R)シンク６１が副信号を受信することができるか否かを判定し、HDMI(R)シンク６１が副信号を受信することができる場合、トランスミッタ７２により送信される送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、副信号を付加することにより、送信画素データを構成し、トランスミッタ７２により、TMDSチャンネル#0ないし#2で送信する。また、HDMI(R)ソース５３は、垂直帰線区間のコントロール区間において、送信画素データに、副信号が含まれるかどうかを表す副信号情報を含むゼネラルコントロールパケットを送信する。本発明は、例えばHDMI(R)に適用できる。
【選択図】図２

図２



【特許請求の範囲】
【請求項1】
受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置と、
前記性能情報を送信した後、前記送信装置から、前記複数のチャンネルで、差動信号により送信されてくる画素データを受信する前記受信装置と
からなる通信システムであり、
前記送信装置は、
前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段と、
前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定する副信号受信可否判定手段と、
前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成する副信号付加手段と、
前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる情報送信制御手段と
を備え、
前記受信装置は、
前記複数のチャンネルで、差動信号により送信されてくる送信画素データを受信する受信手段と、
前記垂直帰線区間に送信されてくる前記副信号情報に基づいて、その垂直帰線区間の直後の有効画像区間に送信されてくる前記送信画素データに、前記副信号が含まれるかどうかを判定する副信号有無判定手段と、
前記送信画素データに、前記副信号が含まれる場合、前記送信画素データから、前記副信号を分離する分離手段と
を備える
通信システム。
【請求項2】
受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置であり、
前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段と、
前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定する副信号受信可否判定手段と、
前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成する副信号付加手段と、

前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる情報送信制御手段と
を備える送信装置。
【請求項3】
前記送信手段は、前記性能情報に基づいて、前記送信画素データのビット数を決定し、その送信画素データのビット数に基づいて、前記ピクセルクロックの周波数を調整する
請求項２に記載の送信装置。
【請求項4】
受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置の通信方法であり、
前記送信装置は、前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段を備え、
前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定し、
前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成し、
前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる
ステップを含む通信方法。
【請求項5】
受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置を制御するコンピュータに実行させるプログラムであり、
前記送信装置は、前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段を備え、
前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定し、
前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成し、
前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる
ステップを含む通信処理を、コンピュータに実行させるプログラム。
【請求項6】
受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置であり、
前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、

前記受信装置に一方向に送信する送信手段と、
　前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定する副信号受信可否判定手段と、
　前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成する副信号付加手段と、
　前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる情報送信制御手段と
　を備える送信装置
に対して、前記性能情報を送信した後、前記送信装置から、前記複数のチャンネルで、差動信号により送信されてくる画素データを受信する前記受信装置であり、
前記複数のチャンネルで、差動信号により送信されてくる送信画素データを受信する受信手段と、
前記垂直帰線区間に送信されてくる前記副信号情報に基づいて、その垂直帰線区間の直後の有効画像区間に送信されてくる前記送信画素データに、前記副信号が含まれるかどうかを判定する副信号有無判定手段と、
前記送信画素データに、前記副信号が含まれる場合、前記送信画素データから、前記副信号を分離する分離手段と
を備える受信装置。
【請求項7】
　受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置であり、
　前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段と、
　前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定する副信号受信可否判定手段と、
　前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成する副信号付加手段と、
　前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる情報送信制御手段と
　を備える送信装置
に対して、前記性能情報を送信した後、前記送信装置から、前記複数のチャンネルで、差動信号により送信されてくる画素データを受信する前記受信装置の通信方法であり、
前記受信装置は、前記複数のチャンネルで、差動信号により送信されてくる送信画素データを受信する受信手段を備え、
前記垂直帰線区間に送信されてくる前記副信号情報に基づいて、その垂直帰線区間の直後の有効画像区間に送信されてくる前記送信画素データに、前記副信号が含まれるかどうかを判定し、
前記送信画素データに、前記副信号が含まれる場合、前記送信画素データから、前記副信号を分離する
ステップを含む通信方法。

【請求項8】
受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置であり、
前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段と、
前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定する副信号受信可否判定手段と、
前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成する副信号付加手段と、
前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる情報送信制御手段と
を備える送信装置
に対して、前記性能情報を送信した後、前記送信装置から、前記複数のチャンネルで、差動信号により送信されてくる画素データを受信する前記受信装置を制御するコンピュータに実行させるプログラムであり、
前記受信装置は、前記複数のチャンネルで、差動信号により送信されてくる送信画素データを受信する受信手段を備え、
前記垂直帰線区間に送信されてくる前記副信号情報に基づいて、その垂直帰線区間の直後の有効画像区間に送信されてくる前記送信画素データに、前記副信号が含まれるかどうかを判定し、
前記送信画素データに、前記副信号が含まれる場合、前記送信画素データから、前記副信号を分離する
ステップを含む通信処理を、コンピュータに実行させるプログラム。
【発明の詳細な説明】
【技術分野】
【0001】
本発明は、通信システム、送信装置及び受信装置、通信方法、並びにプログラムに関し、特に、非圧縮の画像の画素データを、一方向に高速伝送することができる、例えば、HDMI(High Definition Multimedia Interface)(R)などの通信インタフェースにおいて、効率的なデータ伝送を行うことができるようにする通信システム、送信装置及び受信装置、通信方法、並びにプログラムに関する。
【背景技術】
【0002】
近年、例えば、DVD(Digital Versatile Disc)レコーダや、セットトップボックス、その他のAVソース(source)から、テレビジョン受像機、プロジェクタ、その他のディスプレイに対して、ディジタルテレビジョン信号、すなわち、非圧縮（ベースバンド）の画像（動画）の画素データと、その画像に付随する音声データとを、高速に伝送する通信インタフェースとして、HDMI(R)が普及しつつある。
【0003】
HDMI(R)については、画素データと音声データを、高速で、HDMI(R)ソース(HDMI(R) Source)からHDMI(R)シンク(HDMI(R) Sink)に、一方向に伝送するTMDS(Transition Minimized Differential Signaling)チャンネルや、HDMI(R)ソースとHDMI(R)シンクとの間で双方向の通信を行うためのCECライン(Consumer Electronics Control Line)等が、HDMIの仕様書（現在の最新の仕様書は"High-Definition Multimedia Interface Specification Vers

ion 1.2a", December 14, 2005）において規定されている。

【0004】

また、HDMI(R)は、コンテンツのコピー防止のためにHDCP(High-Bandwidth Digital Content Protection) を実装することができる。

【0005】

その他、HDMI(R)については、垂直帰線区間や水平帰線区間での不要な信号の伝送を行わないようにする方法が提案されている（例えば、特許文献１を参照）。

【0006】

【特許文献1】特開2005-102161号公報

【発明の開示】

【発明が解決しようとする課題】

【0007】

ところで、現行のHDMI(R)では、例えば、RGB(Red,Green,Blue)のそれぞれが８ビットの画素データからなる画像（以下、適宜、２４ビット（＝８ビット×３）画像ともいう）を伝送することができるが、近年、より階調の高い画像、つまり、RGBのそれぞれが、８ビットより大の１０ビットや１２ビット等の多ビットの画素データからなる画像（以下、適宜、高階調画像ともいう）を伝送することの要請が高まっている。

【0008】

そこで、HDMI(R)において、高階調画像を伝送する方法が検討されている。

【0009】

しかしながら、高階調画像を伝送することの要請が高まってはいるものの、それでもなお、２４ビット画像が扱われることが多い。

【0010】

したがって、HDMI(R)が、高階調画像を伝送することができるように拡張された場合において、２４ビット画像を伝送するときには、１画素あたり、高階調画像の画素データのビット数と、２４ビット画像の画素データのビット数である２４ビットとの差分だけ、無駄なデータを伝送することなり、非効率的なデータ伝送が行われることになる。

【0011】

本発明は、このような状況に鑑みてなされたものであり、非圧縮の画像の画素データを、一方向に高速伝送することができる、例えば、HDMI(R)などの通信インタフェースにおいて、効率的なデータ伝送を行うことができるようにするものである。

【課題を解決するための手段】

【0012】

本発明の第１の側面の通信システムは、受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置と、前記性能情報を送信した後、前記送信装置から、前記複数のチャンネルで、差動信号により送信されてくる画素データを受信する前記受信装置とからなる通信システムであり、前記送信装置は、前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段と、前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定する副信号受信可否判定手段と、前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成する副信号付加手段と、前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる情報送信制御手段とを備え、前記受信装置は、前記複数のチャンネルで、差動信号により送信されてくる送信画素

データを受信する受信手段と、前記垂直帰線区間に送信されてくる前記副信号情報に基づいて、その垂直帰線区間の直後の有効画像区間に送信されてくる前記送信画素データに、前記副信号が含まれるかどうかを判定する副信号有無判定手段と、前記送信画素データに、前記副信号が含まれる場合、前記送信画素データから、前記副信号を分離する分離手段とを備える。

【0013】

以上のような第１の側面の通信システムにおいては、前記送信装置において、前記送信手段が、前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する。また、前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かが判定され、前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データが構成され、前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報が送信される。一方、前記受信装置では、前記受信手段が、前記複数のチャンネルで、差動信号により送信されてくる送信画素データを受信する。さらに、前記垂直帰線区間に送信されてくる前記副信号情報に基づいて、その垂直帰線区間の直後の有効画像区間に送信されてくる前記送信画素データに、前記副信号が含まれるかどうかが判定され、前記送信画素データに、前記副信号が含まれる場合、前記送信画素データから、前記副信号が分離される。

【0014】

本発明の第２の側面の送信装置は、受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置であり、前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段と、前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定する副信号受信可否判定手段と、前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成する副信号付加手段と、前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる情報送信制御手段とを備える。

【0015】

本発明の第２の側面の通信方法、又はプログラムは、受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置の通信方法、又は送信装置を制御するコンピュータに実行させるプログラムであり、前記送信装置は、前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段を備え、前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定し、前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成し、前記垂直帰線区間において、その垂直帰線区間の直後

の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させるステップを含む。

【0016】

以上のような第２の側面においては、前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かが判定され、前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データが構成され、前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報が送信される。

【0017】

本発明の第３の側面の受信装置は、受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置であり、前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段と、前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定する副信号受信可否判定手段と、前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成する副信号付加手段と、前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる情報送信制御手段と　を備える送信装置に対して、前記性能情報を送信した後、前記送信装置から、前記複数のチャンネルで、差動信号により送信されてくる画素データを受信する前記受信装置であり、前記複数のチャンネルで、差動信号により送信されてくる送信画素データを受信する受信手段と、前記垂直帰線区間に送信されてくる前記副信号情報に基づいて、その垂直帰線区間の直後の有効画像区間に送信されてくる前記送信画素データに、前記副信号が含まれるかどうかを判定する副信号有無判定手段と、前記送信画素データに、前記副信号が含まれる場合、前記送信画素データから、前記副信号を分離する分離手段とを備える。

【0018】

本発明の第３の側面の通信方法、又はプログラムは、受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置であり、前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段と、前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定する副信号受信可否判定手段と、前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成する副信号付加手段と、前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる情報送信制御手段とを備える送信装置に対して、前記性能情報を送信した後、前記送信装置から、前記複数のチャンネルで、差動信号により送信されてくる画素データを受信する前記受信装置の通信方法、又は前記受信装置を制御するコンピュータに実行させるプログラムであり、前記受信

装置は、前記複数のチャンネルで、差動信号により送信されてくる送信画素データを受信する受信手段を備え、前記垂直帰線区間に送信されてくる前記副信号情報に基づいて、その垂直帰線区間の直後の有効画像区間に送信されてくる前記送信画素データに、前記副信号が含まれるかどうかを判定し、前記送信画素データに、前記副信号が含まれる場合、前記送信画素データから、前記副信号を分離するステップを含む。

【0019】

以上のような第３の側面においては、前記垂直帰線区間に送信されてくる前記副信号情報に基づいて、その垂直帰線区間の直後の有効画像区間に送信されてくる前記送信画素データに、前記副信号が含まれるかどうかが判定され、前記送信画素データに、前記副信号が含まれる場合、前記送信画素データから、前記副信号が分離される。

【発明の効果】

【0020】

本発明の第１ないし第３の側面によれば、非圧縮の画像の画素データを、一方向に高速伝送することができる、例えば、HDMI(R)などの通信インタフェースにおいて、効率的なデータ伝送を行うことができる。

【発明を実施するための最良の形態】

【0021】

以下に本発明の実施の形態を説明するが、本発明の構成要件と、明細書又は図面に記載の実施の形態との対応関係を例示すると、次のようになる。この記載は、本発明をサポートする実施の形態が、明細書又は図面に記載されていることを確認するためのものである。従って、明細書又は図面中には記載されているが、本発明の構成要件に対応する実施の形態として、ここには記載されていない実施の形態があったとしても、そのことは、その実施の形態が、その構成要件に対応するものではないことを意味するものではない。逆に、実施の形態が構成要件に対応するものとしてここに記載されていたとしても、そのことは、その実施の形態が、その構成要件以外の構成要件には対応しないものであることを意味するものでもない。

【0022】

本発明の第１の側面の通信システムは、

受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置（例えば、図２のHDMI(R)ソース５３）と、

前記性能情報を送信した後、前記送信装置から、前記複数のチャンネルで、差動信号により送信されてくる画素データを受信する前記受信装置（例えば、図２のHDMI(R)シンク６１）と

からなる通信システムであり、

前記送信装置は、

前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段（例えば、図２のトランスミッタ７２）と、

前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定する副信号受信可否判定手段（例えば、図２０の副信号受信可否判定部１０５）と、

前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成する副信号付加手段（例えば、図２０の副信号付加部１０２）と、

前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる情報送信制御手段（例えば、図２０の副信号フレーム情報送信制御部１０７）と

を備え、
前記受信装置は、
前記複数のチャンネルで、差動信号により送信されてくる送信画素データを受信する受信手段（例えば、図２のレシーバ８１）と、
前記垂直帰線区間に送信されてくる前記副信号情報に基づいて、その垂直帰線区間の直後の有効画像区間に送信されてくる前記送信画素データに、前記副信号が含まれるかどうかを判定する副信号有無判定手段（例えば、図２３の副信号有無判定部１２２）と、
前記送信画素データに、前記副信号が含まれる場合、前記送信画素データから、前記副信号を分離する分離手段（例えば、図２３の分離部１２３）と
を備える。
【0023】
本発明の第２の側面の送信装置は、
受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置（例えば、図２のHDMI(R)ソース５３）であり、
前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段（例えば、図２のトランスミッタ７２）と、
前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定する副信号受信可否判定手段（例えば、図２０の副信号受信可否判定部１０５）と、
前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成する副信号付加手段（例えば、図２０の副信号付加部１０２）と、
前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる情報送信制御手段（例えば、図２０の副信号フレーム情報送信制御部１０７）と
を備える。
【0024】
本発明の第２の側面の通信方法、又はプログラムは、
受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置の通信方法、又は送信装置を制御するコンピュータに実行させるプログラムであり、
前記送信装置は、前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段（例えば、図２のトランスミッタ７２）を備え、
前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定し（例えば、図２２のステップＳ１０４）、
前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成し（例えば、図２２のステップＳ１１２）、
前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる（例え

ば、図２２のステップＳ１１１又はＳ１１６）
ステップを含む。
【0025】
本発明の第３の側面の受信装置は、
受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置（例えば、図２のHDMI(R)ソース５３）であり、
前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段（例えば、図２のトランスミッタ７２）と、
前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定する副信号受信可否判定手段（例えば、図２０の副信号受信可否判定部１０５）と、
前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成する副信号付加手段（例えば、図２０の副信号付加部１０２）と、
前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる情報送信制御手段（例えば、図２０の副信号フレーム情報送信制御部１０７）と
を備える送信装置
に対して、前記性能情報を送信した後、前記送信装置から、前記複数のチャンネルで、差動信号により送信されてくる画素データを受信する前記受信装置（例えば、図２のHDMI(R)シンク６１）であり、
前記複数のチャンネルで、差動信号により送信されてくる送信画素データを受信する受信手段（例えば、図２のレシーバ８１）と、
前記垂直帰線区間に送信されてくる前記副信号情報に基づいて、その垂直帰線区間の直後の有効画像区間に送信されてくる前記送信画素データに、前記副信号が含まれるかどうかを判定する副信号有無判定手段（例えば、図２３の副信号有無判定部１２２）と、
前記送信画素データに、前記副信号が含まれる場合、前記送信画素データから、前記副信号を分離する分離手段（例えば、図２３の分離部１２３）と
を備える。
【0026】
本発明の第３の側面の通信方法、又はプログラムは、
受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置（例えば、図２のHDMI(R)ソース５３）であり、
前記ピクセルクロックの周波数を調整することにより、前記固定のビット数以上のビット数が割り当てられている画素データを、前記複数のチャンネルで、差動信号により、前記受信装置に一方向に送信する送信手段（例えば、図２のトランスミッタ７２）と、
前記性能情報に基づいて、前記受信装置が副信号を受信することができるか否かを判定する副信号受信可否判定手段（例えば、図２０の副信号受信可否判定部１０５）と、
前記受信装置が副信号を受信することができる場合、前記送信手段により送信される画素データである送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、前記副信号を付加することにより、前記送信画素データを構成する副信号付加手段（例えば、図２０の副信号付加部１０２）と、
前記垂直帰線区間において、その垂直帰線区間の直後の有効画像区間に送信される前

記送信画素データに、前記副信号が含まれるかどうかを表す副信号情報を送信させる情報送信制御手段（例えば、図２０の副信号フレーム情報送信制御部１０７）と
　を備える送信装置
　に対して、前記性能情報を送信した後、前記送信装置から、前記複数のチャンネルで、差動信号により送信されてくる画素データを受信する前記受信装置の通信方法であり、
　前記受信装置は、前記複数のチャンネルで、差動信号により送信されてくる送信画素データを受信する受信手段（例えば、図２のレシーバ８１）を備え、
　前記垂直帰線区間に送信されてくる前記副信号情報に基づいて、その垂直帰線区間の直後の有効画像区間に送信されてくる前記送信画素データに、前記副信号が含まれるかどうかを判定し（例えば、図２４のステップＳ１３３）、
　前記送信画素データに、前記副信号が含まれる場合、前記送信画素データから、前記副信号を分離する（例えば、図２４のステップＳ１３８）
　ステップを含む。
【0027】
　以下、図面を参照して、本発明の実施の形態について説明する。
【0028】
　図１は、本発明を適用したAV(Audio Visual)システムの一実施の形態の構成例を示している。
【0029】
　図１において、AVシステムは、HD(Hard Disk)レコーダ４１及びディスプレイ４２から構成され、HDレコーダ４１とディスプレイ４２とは、HDMI(R)用のケーブル４３を介して接続されている。
【0030】
　HDレコーダ４１は、記録再生部５１、コーデック５２、HDMI(R)ソース５３、及びHD５４から構成され、HD５４に対するデータの記録や再生を行う。
【0031】
　すなわち、記録再生部５１は、コーデック５２から供給される、画像とそれに付随する音声のベースバンドのデータをMPEG(Moving Picture Experts Group)方式等でエンコードして得られるエンコードデータを、HD５４に記録する。また、記録再生部５１は、HD５４からエンコードデータを再生し（読み出し）、コーデック５２に供給する。
【0032】
　コーデック５２は、記録再生部５１から供給されるエンコードデータを、ベースバンドの画像と音声のデータにMPEG方式等でデコードし、そのベースバンドの画像と音声のデータを、HDMI(R)ソース５３や図示せぬ外部の装置に供給する。
【0033】
　また、コーデック５２は、例えば、図示せぬ外部の装置から供給されるベースバンドの画像と音声のデータを、エンコードデータにエンコードし、そのエンコードデータを、記録再生部５１に供給する。
【0034】
　HDMI(R)ソース５３は、HDMI(R)に準拠した通信により、コーデック５２から供給されるベースバンドの画像と音声のデータを、ケーブル４３を介して、ディスプレイ４２に一方向に送信する。
【0035】
　ディスプレイ４２は、HDMI(R)シンク６１、表示制御部６２、及び表示部６３から構成され、画像の表示等を行う。
【0036】
　すなわち、HDMI(R)シンク６１は、HDMI(R)に準拠した通信により、ケーブル４３を介して接続されているHDレコーダ４１のHDMI(R)ソース５３から一方向に送信されてくるベースバンドの画像と音声のデータを受信し、そのうちの画像のデータを、表示部６２に供給する。なお、HDMI(R)シンク６１が受信した音声のデータは、例えば、ディスプレイ４２

が内蔵する図示せぬスピーカに供給されて出力される。

【0037】

表示制御部６２は、HDMI(R)シンク６１から供給されるベースバンドの画像のデータに基づき、表示部６３を制御（駆動）し、これにより、表示部６３に、対応する画像を表示させる。

【0038】

表示部６３は、例えば、CRT(Cathode Ray Tube)や、LCD(Liquid Crystal Display)、有機EL（Electro Luminescence）等で構成され、表示制御部６２の制御にしたがって、画像を表示する。

【0039】

以上のように構成される図１のAVシステムでは、例えば、ユーザが、HD５４を再生するように、HDレコーダ４１を操作すると、記録再生部５１が、HD５４からエンコードデータを再生し、コーデック５２に供給する。

【0040】

コーデック５２は、記録再生部５１から供給されるエンコードデータを、ベースバンドの画像と音声のデータにデコードし、そのベースバンドの画像と音声のデータを、HDMI(R)ソース５３に供給する。

【0041】

HDMI(R)ソース５３は、HDMI(R)に準拠した通信により、コーデック５２から供給されるベースバンドの画像と音声のデータを、ケーブル４３を介して、ディスプレイ４２に一方向に送信する。

【0042】

ディスプレイ４２では、HDMI(R)シンク６１が、HDMI(R)に準拠した通信により、ケーブル４３を介して接続されているHDレコーダ４１のHDMI(R)ソース５３から一方向に送信されてくるベースバンドの画像と音声のデータを受信し、そのうちの画像のデータを、表示制御部６２に供給するとともに、音声のデータを、図示せぬスピーカに供給する。

【0043】

表示制御部６２は、HDMI(R)シンク６１から供給される画像のデータに基づき、表示部６３を制御し、これにより、表示部６３では、対応する画像が表示される。

【0044】

図２は、図１のHDMI(R)ソース５３とHDMI(R)シンク６１の構成例を示している。

【0045】

HDMI(R)ソース５３は、１の垂直同期信号から次の垂直同期信号までの区間（以下、適宜、ビデオフィールドという）から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間（以下、適宜、アクティブビデオ区間ともいう）において、非圧縮の１画面分の画像の画素データに対応する差動信号を、複数のチャンネルで、HDMI(R)シンク６１に一方向に送信するとともに、水平帰線区間又は垂直帰線区間において、画像に付随する音声データや制御パケット(Control Packet)その他の補助データ等に対応する差動信号を、複数のチャンネルで、HDMI(R)シンクに一方向に送信する。

【0046】

すなわち、HDMI(R)ソース５３は、ソース信号処理部７１及びトランスミッタ７２を有する。

【0047】

ソース信号処理部７１には、コーデック５２（図１）等から、ベースバンドの非圧縮の画像(Video)や音声(Audio)のデータが供給される。ソース信号処理部７１は、そこに供給される画像や音声のデータに必要な処理を施し、トランスミッタ７２に供給する。また、ソース信号処理部７１は、トランスミッタ７２との間で、必要に応じて、制御用の情報やステータスを知らせる情報(Control/Status)等をやりとりする。

【0048】

トランスミッタ７２は、ソース信号処理部７１から供給される画像の画素データを、対

応する差動信号に変換し、複数のチャンネルである３つのTMDSチャンネル#0,#1,#2で、ケーブル４３を介して接続されているHDMI(R)シンク６１に、一方向にシリアル伝送する。

【0049】

さらに、トランスミッタ７２は、ソース信号処理部７１から供給される、非圧縮の画像に付随する音声データや制御パケットその他の補助データ(auxiliary data)と、垂直同期信号(VSYNC)や水平同期信号(HSYNC)等の制御データ(control data)とを、対応する差動信号に変換し、３つのTMDSチャンネル#0,#1,#2で、ケーブル４３を介して接続されているHDMI(R)シンク６１に、一方向にシリアル伝送する。

【0050】

また、トランスミッタ７２は、３つのTMDSチャンネル#0,#1,#2で送信する画素データに同期したピクセルクロックを、TMDSクロックチャンネルで、ケーブル４３を介して接続されているHDMI(R)シンク６１に送信する。

【0051】

HDMI(R)シンク６１は、アクティブビデオ区間において、複数のチャンネルで、HDMI(R)ソース５３から一方向に送信されてくる、画素データに対応する差動信号を受信するとともに、水平帰線区間及び垂直帰線区間において、複数のチャンネルで、HDMI(R)ソースから一方向に送信されてくる、補助データや制御データに対応する差動信号を受信する。

【0052】

すなわち、HDMI(R)シンク６１は、レシーバ８１及びシンク信号処理部８２を有する。

【0053】

レシーバ８１は、TMDSチャンネル#0,#1,#2で、ケーブル４３を介して接続されているHDMI(R)ソース５３から一方向に送信されてくる、画素データに対応する差動信号と、補助データや制御データに対応する差動信号を、同じくHDMI(R)ソース５３からTMDSクロックチャンネルで送信されてくるピクセルクロックに同期して受信する。

【0054】

さらに、レシーバ８１は、差動信号を、対応する画素データや、補助データ、制御データに変換し、必要に応じて、シンク信号処理部８２に供給する。

【0055】

シンク信号処理部８２は、レシーバ８１から供給されるデータに必要な処理を施し、表示制御部６２等に供給する。その他、シンク信号処理部８２は、レシーバ８１との間で、必要に応じて、制御用の情報やステータスを知らせる情報(Control/Status)等をやりとりする。

【0056】

HDMI(R)の伝送チャンネルには、HDMI(R)ソース５３からHDMI(R)シンク６１に対して、画素データ、補助データ、及び制御データを、ピクセルクロックに同期して、一方向にシリアル伝送するための伝送チャンネルとしての３つのTMDSチャンネル#0ないし#2と、ピクセルクロックを伝送する伝送チャンネルとしてのTMDSクロックチャンネルとの他に、DDC(Display Data Channel)やCECラインと呼ばれる伝送チャンネルがある。

【0057】

DDCは、HDMI(R)ソース５３が、ケーブル４３を介して接続されたHDMI(R)シンク６１から、E-EDID(Enhanced Extended Display Identification Data)を読み出すのに使用される。

【0058】

すなわち、HDMI(R)シンク６１は、レシーバ８１の他に、自身の性能(configuration/capability)に関する性能情報であるE-EDIDを記憶しているEDID ROM(Read Only Memory)（図示せず）を有している。HDMI(R)ソース５３は、ケーブル４３を介して接続されているHDMI(R)シンク６１から、そのHDMI(R)シンク６１のE-EDIDを、DDCを介して読み出し、そのE-EDIDに基づき、HDMI(R)シンク６１の性能や設定、すなわち、例えば、HDMI(R)シンク６１（を有する電子機器）が対応している画像のフォーマット（プロファイル）（例えば、RGB(Red,Green,Blue)や、YC_BC_R4:4:4, YC_BC_R4:2:2）などを認識する。

【0059】
なお、HDMI(R)ソース５３も、HDMI(R)シンク６１と同様に、E-EDIDを記憶し、必要に応じて、そのE-EDIDを、HDMI(R)シンク６１に送信することができる。
【0060】
CECラインは、HDMI(R)ソース５３とHDMI(R)リンク２との間で、制御用のデータの双方向通信を行うのに用いられる。
【0061】
図３は、図２のトランスミッタ７２とレシーバ８１の構成例を示している。
【0062】
トランスミッタ７２は、３つのTMDSチャンネル#0ないし#2にそれぞれ対応する３つのエンコーダ／シリアライザ７２Ａ，７２Ｂ、及び７２Ｃを有する。そして、エンコーダ／シリアライザ７２Ａ，７２Ｂ、及び７２Ｃのそれぞれは、そこに供給される画素データや、補助データ、制御データをエンコードし、パラレルデータからシリアルデータに変換して、差動信号により送信する。
【0063】
ここで、画素データが、例えば、R,G,Bの３成分を有する場合には、B成分(B component)はエンコーダ／シリアライザ７２Ａに、G成分(G component)はエンコーダ／シリアライザ７２Ｂに、R成分(R component)はエンコーダ／シリアライザ７２Ｃに、それぞれ供給される。
【0064】
また、補助データとしては、例えば、音声データや制御パケットがあり、制御パケットは、例えばエンコーダ／シリアライザ７２Ａに、音声データは、例えばエンコーダ／シリアライザ７２Ｂ及び７２Ｃに、それぞれ供給される。
【0065】
さらに、制御データとしては、１ビットの垂直同期信号(VSYNC)、１ビットの水平同期信号(HSYNC)、及び、それぞれ１ビットの制御ビットCTL0,CTL1,CTL2,CTL3があり、垂直同期信号及び水平同期信号はエンコーダ／シリアライザ７２Ａに、制御ビットCTL0及びCTL1はエンコーダ／シリアライザ７２Ｂに、制御ビットCTL2及びCTL3はエンコーダ／シリアライザ７２Ｃに、それぞれ供給される。
【0066】
エンコーダ／シリアライザ７２Ａは、そこに供給される画素データのB成分、垂直同期信号及び水平同期信号、並びに補助データを、時分割で送信する。
【0067】
すなわち、エンコーダ／シリアライザ７２Ａは、そこに供給される画素データのB成分を、固定のビット数である８ビット単位のパラレルデータとする。さらに、エンコーダ／シリアライザ７２Ａは、そのパラレルデータをエンコードし、シリアルデータに変換して、TMDSチャンネル#0で送信する。
【0068】
また、エンコーダ／シリアライザ７２Ａは、そこに供給される垂直同期信号及び水平同期信号の２ビットのパラレルデータをエンコードし、シリアルデータに変換して、TMDSチャンネル#0で送信する。
【0069】
さらに、エンコーダ／シリアライザ７２Ａは、そこに供給される補助データを４ビット単位のパラレルデータとする。そして、エンコーダ／シリアライザ７２Ａは、そのパラレルデータをエンコードし、シリアルデータに変換して、TMDSチャンネル#0で送信する。
【0070】
エンコーダ／シリアライザ７２Ｂは、そこに供給される画素データのG成分、制御ビットCTL0及びCTL1、並びに補助データを、時分割で送信する。
【0071】
すなわち、エンコーダ／シリアライザ７２Ｂは、そこに供給される画素データのG成分

を、固定のビット数である８ビット単位のパラレルデータとする。さらに、エンコーダ／シリアライザ７２Ｂは、そのパラレルデータをエンコードし、シリアルデータに変換して、TMDSチャンネル#1で送信する。

【0072】

また、エンコーダ／シリアライザ７２Ｂは、そこに供給される制御ビットCTL0及びCTL1の２ビットのパラレルデータをエンコードし、シリアルデータに変換して、TMDSチャンネル#1で送信する。

【0073】

さらに、エンコーダ／シリアライザ７２Ｂは、そこに供給される補助データを４ビット単位のパラレルデータとする。そして、エンコーダ／シリアライザ７２Ｂは、そのパラレルデータをエンコードし、シリアルデータに変換して、TMDSチャンネル#1で送信する。

【0074】

エンコーダ／シリアライザ７２Ｃは、そこに供給される画素データのR成分、制御ビットCTL2及びCTL3、並びに補助データを、時分割で送信する。

【0075】

すなわち、エンコーダ／シリアライザ７２Ｃは、そこに供給される画素データのR成分を、固定のビット数である８ビット単位のパラレルデータとする。さらに、エンコーダ／シリアライザ７２Ｃは、そのパラレルデータをエンコードし、シリアルデータに変換して、TMDSチャンネル#2で送信する。

【0076】

また、エンコーダ／シリアライザ７２Ｃは、そこに供給される制御ビットCTL2及びCTL3の２ビットのパラレルデータをエンコードし、シリアルデータに変換して、TMDSチャンネル#2で送信する。

【0077】

さらに、エンコーダ／シリアライザ７２Ｃは、そこに供給される補助データを４ビット単位のパラレルデータとする。そして、エンコーダ／シリアライザ７２Ｃは、そのパラレルデータをエンコードし、シリアルデータに変換して、TMDSチャンネル#2で送信する。

【0078】

レシーバ８１は、３つのTMDSチャンネル#0ないし#2にそれぞれ対応する３つのリカバリ／デコーダ８１Ａ，８１Ｂ、及び８１Ｃを有する。そして、リカバリ／デコーダ８１Ａ，８１Ｂ、及び８１Ｃのそれぞれは、TMDSチャンネル#0ないし#2で差動信号により送信されてくる画素データや、補助データ、制御データを受信する。さらに、リカバリ／デコーダ８１Ａ，８１Ｂ、及び８１Ｃのそれぞれは、画素データや、補助データ、制御データを、シリアルデータからパラレルデータに変換し、さらにデコードして出力する。

【0079】

すなわち、リカバリ／デコーダ８１Ａは、TMDSチャンネル#0で差動信号により送信されてくる画素データのB成分や、垂直同期信号及び水平同期信号、補助データを受信する。そして、リカバリ／デコーダ８１Ａは、その画素データのB成分や、垂直同期信号及び水平同期信号、補助データを、シリアルデータからパラレルデータに変換し、デコードして出力する。

【0080】

リカバリ／デコーダ８１Bは、TMDSチャンネル#1で差動信号により送信されてくる画素データのG成分や、制御ビットCTL0及びCTL1、補助データを受信する。そして、リカバリ／デコーダ８１Bは、その画素データのG成分や、制御ビットCTL0及びCTL1、補助データを、シリアルデータからパラレルデータに変換し、デコードして出力する。

【0081】

リカバリ／デコーダ８１Cは、TMDSチャンネル#2で差動信号により送信されてくる画素データのR成分や、制御ビットCTL2及びCTL3、補助データを受信する。そして、リカバリ／デコーダ８１Cは、その画素データのR成分や、制御ビットCTL2及びCTL3、補助データを、シリアルデータからパラレルデータに変換し、デコードして出力する。

【0082】
図４は、HDMI(R)の３つのTMDSチャンネル#0ないし#2で各種の伝送データが伝送される伝送区間（期間）の例を示している。
【0083】
なお、図４は、TMDSチャンネル#0ないし#2において、横×縦が７２０×４８０画素のプログレッシブの画像が伝送される場合の、各種の伝送データの伝送区間を示している。
【0084】
HDMI(R)の３つのTMDSチャンネル#0ないし#2で伝送データが伝送されるビデオフィールド(Video Field)には、伝送データの種類に応じて、ビデオデータ区間(Video Data period)、データアイランド区間(Data Island period)、及びコントロール区間(Control period)の３種類の区間が存在する。
【0085】
ここで、ビデオフィールドは、１の垂直同期信号（の立ち上がりエッジ(active edge)）から次の垂直同期信号までの区間であり、水平帰線区間(horizontal blanking)、垂直帰線区間(vertical blanking)、並びに、ビデオフィールドから水平帰線区間及び垂直帰線区間を除いた区間であるアクティブビデオ区間(Active Video)に分けられる。
【0086】
ビデオデータ区間（図４において左上り(右下り)の斜線を付してある部分)は、アクティブビデオ区間に割り当てられ、ビデオデータ区間では、非圧縮の１画面分の画像の画素（有効画素(active pixel)）データが伝送される。
【0087】
データアイランド区間（図４において右上り(左下り)の斜線を付してある部分）、及びコントロール区間（図４において縦方向の線を付してある部分）は、水平帰線区間と垂直帰線区間に割り当てられ、データアイランド区間及びコントロール区間では、補助データ(auxiliary data)が伝送される。
【0088】
すなわち、データアイランド区間は、水平帰線区間と垂直帰線区間の一部分に割り当てられ、データアイランド区間では、補助データのうちの、制御に関係しないデータである、例えば、音声データのパケット等が伝送される。
【0089】
コントロール区間は、水平帰線区間と垂直帰線区間の他の部分に割り当てられ、コントロール区間では、補助データのうちの、制御に関係するデータである、例えば、垂直同期信号及び水平同期信号や、制御パケット等が伝送される。
【0090】
ここで、現行のHDMI(R)、すなわち、HDMI(R)の最新の仕様書である"High-Definition Multimedia Interface Specification Version 1.2a", December 14, 2005では、TDMSクロックチャンネル（図２）で伝送されるピクセルクロックの周波数は、例えば、165MHzであり、この場合、データアイランド区間の伝送レートは、約500Mbps程度である。
【0091】
上述したように、データアイランド区間及びコントロール区間では、いずれも、補助データが伝送されるが、その区別は、制御ビットCTL0,CTL1によって行われる。
【0092】
すなわち、図５は、制御ビットCTL0,CTL1と、データアイランド区間及びコントロール区間との関係を示している。
【0093】
制御ビットCTL0,CTL1は、例えば、図５上から1番目に示すように、デバイスイネーブル(device enable)状態と、デバイスディセーブル(device disable)状態との２つの状態を表すことができる。なお、図５上から１番目では、デバイスイネーブル状態をH(High)レベルで表してあり、デバイスディセーブル状態をL(Low)レベルで表してある。
【0094】

制御ビットCTL0,CTL1は、データアイランド区間では、デバイスディセーブル状態となり、コントロール区間では、デバイスイネーブル状態となり、これにより、データアイランド区間とコントロール区間とが区別される。

【0095】

そして、制御ビットCTL0,CTL1がデバイスディセーブル状態としてのLレベルとなるデータアイランド区間では、図５上から２番目に示すように、補助データのうちの、制御に関係しないデータである、例えば、音声データ等が伝送される。

【0096】

一方、制御ビットCTL0,CTL1がデバイスイネーブル状態としてのHレベルとなるコントロール区間では、図５上から３番目に示すように、補助データのうちの、制御に関係するデータである、例えば、制御パケットやプリアンブル等が伝送される。

【0097】

その他、コントロール区間では、図５上から４番目に示すように、垂直同期信号及び水平同期信号も伝送される。

【0098】

次に、図６を参照して、現行のHDMI(R)、すなわち、HDMI(R)の最新の仕様書である"High-Definition Multimedia Interface Specification Version 1.2a", December 14, 2005で規定されている画素データの伝送について説明する。

【0099】

図６は、現行のHDMI(R)のビデオデータ区間において伝送される画像の画素データの伝送のタイミングを表すタイミングチャートである。

【0100】

なお、現行のHDMI(R)では、RGB4:4:4, YC_BC_R4:4:4、及びYC_BC_R4:2:2の３つのフォーマットの画像の画素データを、TMDSチャンネル#0ないし#2で送信することができるが、以下では、上述の３つのフォーマットのうちの、例えば、RGB4:4:4を例に説明をする。

【0101】

HDMI(R)において採用されているコンテンツのコピーを防止する技術であるHDCPでは、データに、８ビット単位でスクランブルがかけられる。このため、１つのTMDSチャンネルでは、ピクセルクロックの１クロックあたりに、固定のビット数単位、つまり、HDCPの処理の対象となる８ビット単位で、データが伝送される。

【0102】

以上のように、１つのTMDSチャンネルでは、ピクセルクロックの１クロックあたりに、８ビットのデータが伝送されるので、３つのTMDSチャンネル#0ないし#2によれば、１クロックあたりに、２４ビットのデータを伝送することができる。

【0103】

そこで、現行のHDMI(R)では、RGB4:4:4の画像としての、各画素のR成分、G成分、及びB成分のそれぞれが８ビットの２４ビット画像が、３つのTMDSチャンネル#0ないし#2で伝送される。

【0104】

すなわち、現行のHDMI(R)では、図６に示すように、ピクセルクロックの１クロックにつき、２４ビット画像の１画素の画素データのうちの８ビットのB成分がTMDSチャンネル#0で、８ビットのG成分がTMDSチャンネル#1で、８ビットのR成分がTMDSチャンネル#2で、それぞれ伝送される。

【0105】

ところで、前述したように、近年、より階調の高い画像、つまり、R成分、G成分、及びB成分のそれぞれが、８ビットより大の１０ビットや１２ビット等の多ビットの画素データからなる高階調画像を伝送することの要請が高まっている。

【0106】

現行のHDMI(R)では、上述したように、２４ビット画像の伝送が、１つのTMDSチャンネルにおいて、ピクセルクロックの１クロックあたりに、８ビットのデータを伝送すること

によって行われているから、高階調画像の伝送は、単純には、１つのTMDSチャンネルにおいて、ピクセルクロックの１クロックあたりに、８ビットより大の、例えば、１０ビットや１２ビットのデータを伝送することによって行うことができる。

【0107】

しかしながら、上述したように、HDMI(R)において採用されているコンテンツのコピーを防止する技術であるHDCPでは、データに、８ビット単位でスクランブルがかけられるため、１つのTMDSチャンネルにおいて、ピクセルクロックの１クロックあたりに、８ビット以外のビット数単位で、データを伝送することとすると、HDCPを適用することが困難になり、その結果、HDMI(R)に準拠したデータ伝送を行うことが困難になる。

【0108】

そこで、現行のHDMI(R)では、上述したように、165MHzの周波数のピクセルクロックが採用されているが、このピクセルクロックとして、より高い周波数のピクセルクロックを採用することにより、１つのTMDSチャンネルにおいて、ピクセルクロックの１クロックあたりに、固定の８ビット単位のデータを伝送して、HDCPの適用を可能としながら、高階調画像の伝送も可能とすることができる。

【0109】

例えば、ピクセルクロックの周波数を、２４ビット画像を伝送する場合の165MHzの5/4倍とすることによって、R成分、G成分、及びB成分のそれぞれが、１０ビットの高階調画像（以下、適宜、３０ビット（＝１０ビット×３）画像ともいう）を伝送することができる。

【0110】

すなわち、図７は、HDMI(R)のビデオデータ区間において３０ビット画像を伝送する場合の画素データの伝送のタイミングを表すタイミングチャートである。

【0111】

３０ビット画像の伝送は、B成分がTMDSチャンネル#0で、G成分がTMDSチャンネル#1で、R成分がTMDSチャンネル#2で、それぞれ伝送される点、及びピクセルクロックの１クロックにつき、８ビットのデータが伝送される点において、２４ビット画像の伝送と共通する。

【0112】

但し、２４ビット画像の伝送では、１画素の１つの成分（R成分、G成分、又はB成分）が８ビットであるために、その８ビットの成分が、ピクセルクロックの１クロックで伝送されるのに対して、３０ビット画像の伝送では、１画素の１つの成分が１０ビットであるために、その１０ビットの成分が、ピクセルクロックの複数クロックに亘って伝送される点で、３０ビット画像の伝送は、２４ビット画像の伝送と異なる。

【0113】

すなわち、いま、１０ビットの成分のLSB(Least Significant Bit)からMSB(Most Significant Bit)までを、b0ないしb9で表すこととする。また、画像を構成する画素の、ラスタスキャン順で、i番目の画素のR成分、G成分、又はB成分を、それぞれ、R#i-1成分、G#i-1成分又はB#i-1と表すとともに、ピクセルクロックのあるクロック（パルス）を基準として、j番目のクロックを、クロック#j-1ということとする。

【0114】

この場合、B成分については、図７に示すように、１０ビットのB#0成分のうちの下位８ビットb0ないしb7が、クロック#0で伝送され、１０ビットのB#0成分のうちの残りの上位２ビットb8及びb9と、次の画素の１０ビットのB#1成分のうちの下位６ビットb0ないしb5との合計８ビットが、クロック#1で伝送される。

【0115】

さらに、１０ビットのB#1成分のうちの残りの上位４ビットb6ないしb9と、次の画素の１０ビットのB#2成分のうちの下位４ビットb0ないしb3との合計８ビットが、クロック#2で伝送され、１０ビットのB#2成分のうちの残りの上位６ビットb4ないしb9と、次の画素の１０ビットのB#3成分のうちの下位２ビットb0及びb1との合計で８ビットが、クロック#

3で伝送される。

【0116】

そして、１０ビットのB#3成分のうちの残りの上位８ビットb2ないしb9が、クロック#4で伝送される。

【0117】

以上のように、４画素のB成分であるB#0ないしB#3成分が、クロック#0ないし#4の５クロックで伝送され、以下、同様にして、４画素のB成分が５クロックで伝送される。

【0118】

２４ビット画像については、図６で説明したように、８ビットのB成分が、１クロックで伝送されるが、３０ビット画像については、１０ビットのB成分の４画素分が、５クロックで伝送される。したがって、３０ビット画像については、B成分を、２４ビット画像の5/4倍の周波数のピクセルクロックを使用して伝送することにより、３０ビット画像の１フレームを、２４ビット画像の１フレームと同一の時間で伝送することができる。

【0119】

なお、３０ビット画像のB成分以外の成分、つまり、G成分及びR成分も、B成分と同様に伝送される。

【0120】

また、３０ビット画像の伝送では、５クロックで４画素の画素データを伝送することを、いわば伝送単位として、その伝送単位が繰り返されるが、この伝送単位におけるクロックを、フェーズ（Phase）ということとすると、３０ビット画像の伝送単位は、５つのフェーズからなる。

【0121】

次に、ピクセルクロックの周波数を、より高くすることによって、３０ビット画像よりも高い階調の高階調画像、すなわち、R成分、G成分、及びB成分のそれぞれが、例えば、１２ビットの高階調画像（以下、適宜、３６ビット（＝１２ビット×３）画像ともいう）や、R成分、G成分、及びB成分のそれぞれが、例えば、１６ビットの高階調画像（以下、適宜、４８ビット（＝１６ビット×３）画像ともいう）等を伝送することが可能となる。

【0122】

具体的には、例えば、ピクセルクロックの周波数を、２４ビット画像を伝送する場合の165MHzの3/2倍とすることによって、R成分、G成分、及びB成分のそれぞれが、１２ビットの３６ビット画像を伝送することができる。

【0123】

すなわち、図８は、HDMI(R)のビデオデータ区間において３６ビット画像を伝送する場合の画素データの伝送のタイミングを表すタイミングチャートである。

【0124】

３６ビット画像の伝送は、B成分がTMDSチャンネル#0で、G成分がTMDSチャンネル#1で、R成分がTMDSチャンネル#2で、それぞれ伝送される点、及びピクセルクロックの１クロックにつき、８ビットのデータが伝送される点において、２４ビット画像の伝送と共通する。

【0125】

但し、２４ビット画像の伝送では、１画素の１つの成分が８ビットであるために、その８ビットの成分が、ピクセルクロックの１クロックで伝送されるのに対して、３６ビット画像の伝送では、１画素の１つの成分が１２ビットであるために、その１２ビットの成分が、ピクセルクロックの複数クロックに亘って伝送される点で、３６ビット画像の伝送は、２４ビット画像の伝送と異なる。

【0126】

すなわち、いま、１２ビットの成分のLSBからMSBまでを、b0ないしb11で表すこととすると、B成分については、図８に示すように、１２ビットのB#0成分のうちの下位８ビットb0ないしb7が、クロック#0で伝送され、１２ビットのB#0成分のうちの残りの上位４ビットb8ないしb11と、次の画素の１２ビットのB#1成分のうちの下位４ビットb0ないしb3との

合計８ビットが、クロック#1で伝送される。

【0127】

そして、１２ビットのB#1成分のうちの残りの上位８ビットb4ないしb11が、クロック#2で伝送される。

【0128】

以上のように、２画素のB成分であるB#0及びB#1成分が、クロック#0ないし#2の３クロックで伝送され、以下、同様にして、２画素のB成分が３クロックで伝送される。

【0129】

２４ビット画像については、図６で説明したように、８ビットのB成分が、１クロックで伝送されるが、３６ビット画像については、１２ビットのB成分の２画素分が、３クロックで伝送される。したがって、３６ビット画像については、B成分を、２４ビット画像の3/2倍の周波数のピクセルクロックを使用して伝送することにより、３６ビット画像の１フレームを、２４ビット画像の１フレームと同一の時間で伝送することができる。

【0130】

なお、３６ビット画像のB成分以外の成分、つまり、G成分及びR成分も、B成分と同様に伝送される。

【0131】

また、３６ビット画像の伝送では、３クロックで２画素の画素データを伝送することを、伝送単位として、その伝送単位が繰り返される。したがって、３６ビット画像の伝送単位は、３つのフェーズからなる。

【0132】

次に、R成分、G成分、及びB成分のそれぞれが、１６ビットの４８ビット画像の伝送は、ピクセルクロックの周波数を、２４ビット画像を伝送する場合の165MHzの2倍とすることによって行うことができる。

【0133】

すなわち、図９は、HDMI(R)のビデオデータ区間において４８ビット画像を伝送する場合の画素データの伝送のタイミングを表すタイミングチャートである。

【0134】

４８ビット画像の伝送は、B成分がTMDSチャンネル#0で、G成分がTMDSチャンネル#1で、R成分がTMDSチャンネル#2で、それぞれ伝送される点、及びピクセルクロックの１クロックにつき、８ビットのデータが伝送される点において、２４ビット画像の伝送と共通する。

【0135】

但し、２４ビット画像の伝送では、１画素の１つの成分が８ビットであるために、その８ビットの成分が、ピクセルクロックの１クロックで伝送されるのに対して、４８ビット画像の伝送では、１画素の１つの成分が１６ビットであるために、その１６ビットの成分が、ピクセルクロックの複数クロックに亘って伝送される点で、４８ビット画像の伝送は、２４ビット画像の伝送と異なる。

【0136】

すなわち、いま、１６ビットの成分のLSBからMSBまでを、b0ないしb15で表すこととすると、B成分については、図９に示すように、１６ビットのB#0成分のうちの下位８ビットb0ないしb7が、クロック#0で伝送され、１６ビットのB#0成分のうちの残りの上位８ビットb8ないしb15が、クロック#1で伝送される。

【0137】

以上のように、１画素のB成分であるB#0成分が、クロック#0及び#1の２クロックで伝送され、以下、同様にして、１画素のB成分が２クロックで伝送される。

【0138】

２４ビット画像については、図６で説明したように、８ビットのB成分が、１クロックで伝送されるが、４８ビット画像については、１６ビットのB成分の１画素分が、２クロックで伝送される。したがって、４８ビット画像については、B成分を、２４ビット画像

の2倍の周波数のピクセルクロックを使用して伝送することにより、４８ビット画像の１フレームを、２４ビット画像の１フレームと同一の時間で伝送することができる。

【0139】

なお、４８ビット画像のB成分以外の成分、つまり、G成分及びR成分も、B成分と同様に伝送される。

【0140】

また、４８ビット画像の伝送では、２クロックで１画素の画素データを伝送することを、伝送単位として、その伝送単位が繰り返される。したがって、４８ビット画像の伝送単位は、2つのフェーズからなる。

【0141】

以上のように、ピクセルクロックの周波数を、例えば、２４ビット画像を伝送する場合の5/4倍や、3/2倍、２倍とする周波数の調整を行うことによって、現行のHDMI(R)のTMDSチャンネルがピクセルクロックの１クロックあたりに伝送する固定のビット数である８ビットより多い１０ビットや、１２ビット、１６ビットが各成分に割り当てられている画素データの伝送、すなわち、３０ビット画像や、３６ビット画像、４８ビット画像といった高階調画像の伝送を、現行のHDMI(R)のTMDSチャンネルをそのまま利用して行うことができる。

【0142】

したがって、現行のHDMI(R)において、２４ビット画像の伝送が行われることを考慮すると、ピクセルクロックの周波数を調整することにより、現行のHDMI(R)のTMDSチャンネルがピクセルクロックの１クロックあたりに伝送する固定のビット数である８ビット以上のビット数が各成分に割り当てられている画素データの伝送、すなわち、例えば、２４ビット画像の他、３０ビット画像や、３６ビット画像、４８ビット画像といった高階調画像の伝送を、現行のHDMI(R)のTMDSチャンネルをそのまま利用して行うことができる。

【0143】

いま、２４ビット画像の他に、高階調画像の伝送を現行のHDMI(R)のTMDSチャンネルをそのまま利用して行うことができる通信インタフェースを、特に、ディープカラー(deep color)HDMI(R)と呼ぶこととすると、例えば、ディープカラーHDMI(R)に準拠したHDMI(R)ソースが、高階調画像の伝送を行う場合には、まず、通信相手であるHDMI(R)シンクがディープカラーHDMI(R)に対応（準拠）しているかどうかを認識する必要がある。

【0144】

ここで、HDMI(R)シンクがディープカラーHDMI(R)に対応しているかどうかは、例えば、そのHDMI(R)シンクの性能に関する性能情報であるE-EDIDに記述しておく（含めておく）ことができる。

【0145】

すなわち、図１０は、E-EDIDにおけるVSDB(Vender Specific Definition Bit)を示している。

【0146】

現行のHDMI(R)では、VSDBのByte#6のLSBから5,6,7ビット目のビット#4,#5,#6は、未使用(Reserved)になっているが、図１０では、そのビット#4,#5,#6に、それぞれ、ビットSuport_30bit,Suport_36bit,Suport_48bitが割り当てられている。

【0147】

VSDBのByte#6のビット#4に割り当てられているビットSuport_30bit、ビット#5に割り当てられているビットSuport_36bit、及びビット#6に割り当てられているビットSuport_48bitは、HDMI(R)シンクが、高階調画像に対応していない場合、すなわち、２４ビット画像のみに対応している場合、例えば、すべて0とされる。

【0148】

そして、HDMI(R)シンクが、高階調画像のうちの３０ビット画像のみに対応している場合、ビットSuport_30bitのみが1とされる。また、HDMI(R)シンクが、高階調画像のうちの３０ビット画像と３６ビット画像に対応している場合、ビットSuport_36bitのみが1とさ

れる。さらに、HDMI(R)シンクが、高階調画像の３０ビット画像、３６ビット画像、及び４８ビット画像のすべてに対応している場合、ビットSuport_48bitのみが1とされる。

【0149】

以上のように、HDMI(R)シンクがディープカラーHDMI(R)に対応しているかどうかを、E-EDIDのVSDBに記述しておくことにより、HDMI(R)ソースは、HDMI(R)シンクから、E-EDIDを読み出し、そのE-EDIDのVSDBを参照することにより、HDMI(R)シンクが高階調画像に対応しているかどうか、さらには、HDMI(R)シンクが高階調画像に対応している場合には、３０ビット画像、３６ビット画像、又は４８ビット画像のうちのいずれに対応しているかを認識することができる。

【0150】

なお、HDMI(R)ソースのE-EDIDのVSDBにも、図１０に示したビットSuport_30bit,Suport_36bit,Suport_48bitを記述しておくことができる。

【0151】

次に、HDMI(R)ソースとHDMI(R)シンクとの間のE-EDIDの交換は、HDMI(R)ソースとHDMI(R)シンクとが接続されたときや、HDMI(R)ソース又はHDMI(R)シンクの電源がオンにされたとき等の特定のタイミングで行われ、周期的に行われるものではない。

【0152】

一方、HDMI(R)ソースとHDMI(R)シンクとが、高階調画像に対応している場合においては、HDMI(R)ソースからHDMI(R)シンクに対して、２４ビット画像が伝送されることと、高階調画像が伝送されることとがあり、さらに、高階調画像が伝送されるケースでは、３０ビット画像、３６ビット画像、又は４８ビット画像が伝送されることがある。

【0153】

画像の伝送は、図４で説明したように、ビデオフィールドのアクティブビデオ区間(Active Video)に割り当てられているビデオデータ区間において行われるから、HDMI(R)シンクにおいて、ビデオデータ区間において伝送されてくる画像が、２４ビット画像、３０ビット画像、３６ビット画像、又は４８ビット画像のうちのいずれであるのかは、ビデオデータ区間を含むビデオフィールドごとに認識することができることが望ましい。

【0154】

この場合、HDMI(R)ソースからHDMI(R)シンクに対して、ビデオフィールドごとに、そのビデオフィールドに含まれるビデオデータ区間において伝送されてくる画像が、２４ビット画像、３０ビット画像、３６ビット画像、又は４８ビット画像のうちのいずれであるのかを表す情報（以下、適宜、ディープカラーモードという）を伝送する必要がある。

【0155】

ここで、HDMI(R)ソースからHDMI(R)シンクに対して、ビデオフィールドごとに伝送される情報として、垂直帰線区間のうちの、図４で説明したコントロール区間において伝送されるゼネラルコントロールパケット(General Control Packet)がある。

【0156】

そこで、ディープカラーモードは、ゼネラルコントロールパケットに含め、これにより、ビデオフィールドごとに、HDMI(R)ソースからHDMI(R)シンクに伝送するようにすることができる。

【0157】

すなわち、図１１は、ゼネラルコントロールパケットのフォーマットを示している。

【0158】

ゼネラルコントロールパケットは、パケットヘッダ(General Contorol Packet Header)と、サブパケット(General Control Subpacket)とを有しており、図１１上側は、パケットヘッダを、図１１下側は、サブパケットを、それぞれ示している。

【0159】

現行のHDMI(R)では、ゼネラルコントロールパケットのサブパケット（図１１下側）のByte#SB1のLSBから1,2,3ビット目のビット#0,#1,#2は、未使用で0とすることになっているが、図１１では、そのビット#0,#1,#2に、それぞれ、ディープカラーモードを表すビット

CD0,CD1,CD2が割り当てられている。

【0160】

図１２は、サブパケットのByte#SB1のビットCD0,CD1,CD2と、そのサブパケットを有するゼネラルコントロールパケットが伝送されるコントロール区間（図４）を含むビデオフィールドに含まれるビデオデータ区間（図４）に伝送される画像との関係を示している。

【0161】

HDMI(R)シンクが高階調画像に対応していない場合(Color Depth not indicated)、ディープカラーモードを表すビットCD0,CD1,CD2は、現行のHDMI(R)と同様に、いずれも0とされる。

【0162】

また、HDMI(R)シンクが高階調画像に対応している場合において、ビデオデータ区間で伝送される画像が２４ビット画像であるときには、ディープカラーモードを表すビットCD0,CD1,CD2は、例えば、それぞれ、0,0,1とされ、ビデオデータ区間で伝送される画像が３０ビット画像であるときには、ディープカラーモードを表すビットCD0,CD1,CD2は、例えば、それぞれ、1,0,1とされる。

【0163】

さらに、ビデオデータ区間で伝送される画像が３６ビット画像であるときには、ディープカラーモードを表すビットCD0,CD1,CD2は、例えば、それぞれ、0,1,1とされ、ビデオデータ区間で伝送される画像が４８ビット画像であるときには、ディープカラーモードを表すビットCD0,CD1,CD2は、例えば、いずれも、1とされる。

【0164】

以上のように、HDMI(R)ソースにおいて、ディープカラーモードを表すビットCD0,CD1,CD2をゼネラルコントロールパケットに含め、ビデオフィールドのコントロール区間に伝送することにより、HDMI(R)シンクでは、そのビデオフィールドのビデオデータ区間に伝送されてくる画像が、２４ビット画像、３０ビット画像、３６ビット画像、又は４８ビット画像のうちのいずれであるのかを認識することができる。

【0165】

なお、現行のHDMI(R)では、図１１に示したゼネラルコントロールパケットのサブパケット（図１１下側）のByte#SB1のLSBから5,6,7ビット目のビット#4,#5,#6は、未使用で0とすることになっているが、図１１では、そのビット#4,#5,#6に、それぞれ、フェーズを表すビットPP0,PP1,PP2が割り当てられている。

【0166】

すなわち、３０ビット画像、３６ビット画像、又は４８ビット画像が伝送される場合には、それぞれ、図７ないし図９で説明したように、フェーズが存在する。サブパケットのByte#SB1のビットPP0,PP1,PP2には、そのサブパケットを有するゼネラルコントロールパケットが伝送されるコントロール区間を含むビデオフィールドに含まれるビデオデータ区間に伝送される画像の画素データのうちの最後に伝送される画素データのフェーズを表す値がセットされる。

【0167】

次に、図１３及び図１４のフローチャートを参照して、図２のHDMI(R)ソース５３及びHDMI(R)シンク６１が、ディープカラーHDMI(R)に対応している場合の、そのHDMI(R)ソース５３及びHDMI(R)シンク６１の動作について説明する。

【0168】

まず、図１３のフローチャートを参照して、図２のHDMI(R)ソース５３の動作について説明する。

【0169】

HDMI(R)ソース５３は、HDMI(R)シンク６１から、図２で説明したDDCを介して、HDMI(R)シンク６１のE-EDIDが送信されてくるのを待って、ステップＳ１１において、そのE-EDIDを受信する。

【0170】

そして、HDMI(R)ソース５３は、ステップＳ１２において、HDMI(R)シンク６１からのE-EDIDのVSDB（図１０）を参照することにより、HDMI(R)シンク６１が受信することができる画像（対応している画像）が、２４ビット画像、３０ビット画像、３６ビット画像、又は４８ビット画像のうちのいずれであるのかを認識し、さらに、その、HDMI(R)シンク６１が対応している画像の中から、ディープカラーモード、つまり、３つのTMDSチャンネル#0ないし#2で伝送する画像を決定する。

【0171】

ここで、HDMI(R)ソース５３では、HDMI(R)シンク６１が対応している画像の中から、例えば、最も階調が高い画像を、３つのTMDSチャンネル#0ないし#2で伝送する画像として決定することができる。この場合、HDMI(R)シンク６１が、例えば、２４ビット画像、３０ビット画像、３６ビット画像、及び４８ビット画像に対応しているときには、最も階調が高い４８ビット画像が、TMDSチャンネル#0ないし#2で伝送する画像として決定される。

【0172】

その後、HDMI(R)ソース５３は、ステップＳ１３において、ピクセルクロックの周波数を調整し、これにより、ステップＳ１２で決定したディープカラーモードに対応したピクセルクロックの出力を開始して、ステップＳ１４に進む。

【0173】

ステップＳ１４では、HDMI(R)ソース５３は、ステップＳ１２で決定したディープカラーモードが表す画像の画素データの、TMDSチャンネル#0ないし#2による伝送を開始する。

【0174】

なお、ディープカラーモードが表す画像の、TMDSチャンネル#0ないし#2による伝送は、ステップＳ１３で出力が開始されたピクセルクロックに同期して行われる。

【0175】

また、ディープカラーモードが表す画像の、TMDSチャンネル#0ないし#2による伝送時には、HDMI(R)ソース５３は、図１１及び図１２で説明したように、ビデオフィールド、つまり、フレームごとに、垂直帰線区間のコントロール区間（図４）において、ビデオデータ区間に伝送される画像のディープカラーモードを表すビットCD0,CD1,CD2が記述されたゼネラルコントロールパケットを伝送する。

【0176】

次に、図１４のフローチャートを参照して、図２のHDMI(R)シンク６１の動作について説明する。

【0177】

HDMI(R)シンク６１は、ステップＳ３１において、自身のE-EDIDを、DDC（図２）を介して、HDMI(R)ソース５３に送信する。

【0178】

その後、HDMI(R)ソース５３において、図１３で説明したように、ピクセルクロックの出力が開始され、ゼネラルコントロールパケットがTMDSチャンネル#0ないし#2を介して伝送されてくると、HDMI(R)シンク６１は、ステップＳ３２において、HDMI(R)ソース５３からのゼネラルコントロールパケット（図１１、図１２）を受信し、そのゼネラルコントロールパケットのビットCD0,CD1,CD2を参照することにより、ビデオデータ区間に伝送されてくる画像のディープカラーモードを認識する。

【0179】

そして、HDMI(R)シンク６１は、ステップＳ３２で認識したディープカラーモードの画像の画素データが、ピクセルクロックに同期して、TMDSチャンネル#0ないし#2を介して、HDMI(R)ソース５３から送信されてくるのを待って、ステップＳ３３において、その画素データを受信する。

【0180】

なお、ステップＳ３２及びＳ３３の処理は、ビデオフィールドごとに行われる。

【0181】

次に、HDMI(R)ソース５３は、図１３で説明したように、ディープカラーモードを決定

し、そのディープカラーモードの画像をTMDSチャンネル#0ないし#2で伝送するが、HDMI(R)ソース５３に対して、伝送対象として供給される画像、すなわち、例えば、コーデック５２（図１）からHDMI(R)ソース５３に供給される伝送対象の画像が、必ずしも、HDMI(R)ソース５３で決定されたディープカラーモードの画像と一致するとは限らない。

【0182】

つまり、伝送対象の画像が、HDMI(R)ソース５３で決定されたディープカラーモードの画像よりも階調が低い画像であることがある。

【0183】

ここで、HDMI(R)ソース５３からHDMI(R)シンク６１に伝送する伝送対象の画像を、以下、適宜、主画像という。

【0184】

このように、主画像が、HDMI(R)ソース５３で決定されたディープカラーモードの画像よりも階調が低い画像である場合、主画像の画素データは、例えば、図１５に示すように伝送される。

【0185】

すなわち、図１５は、ディープカラーモードの画像が３６ビット画像であり、主画像が、ディープカラーモードの画像よりも低い階調の３０ビット画像である場合の、１つのTMDSチャンネルで送信（伝送）される画素データである送信画素データを示している。

【0186】

ディープカラーモードの画像が３６ビット画像である場合、その３６ビット画像の画素データのR,G,Bの各成分は、１２ビットであるから、１つのTMDSチャンネルで送信される送信画素データは、図１５に示すように、１２ビットのデータである。

【0187】

一方、主画像が３０ビット画像である場合、その３０ビット画像の画素データのR,G,Bの各成分は、１０ビットであるから、主画像である３０ビット画像の伝送にあたり、１つのTMDSチャンネルで送信すべき主画像の画素データは、送信画素データのビット数である１２ビットよりも少ない１０ビットのデータである。

【0188】

このように、主画像の画素データが、送信画素データよりもビット数が少ない画像である場合、HDMI(R)ソース５３では、例えば、図１５に示すように、主画像の画素データは、送信画素データの上位ビット側に、いわば詰める形で割り当てられて送信される。

【0189】

したがって、上述のように、主画像の画素データが１０ビットであり、送信画素データが１２ビットである場合には、HDMI(R)ソース５３のトランスミッタ７２（図２）は、図１５に示すように、１０ビットの主画像の画素データを、１２ビットの送信画素データの上位１０ビットに割り当てて送信する。

【0190】

この場合、HDMI(R)シンク６１のレシーバ８１（図２）では、HDMI(R)ソース５３のトランスミッタ７２からの１２ビットの送信画素データが受信されるが、その１２ビットの送信画素データのうちの、上位１０ビットに割り当てられている主画像の画素データだけが処理され、残りの下位２ビットは無視される（破棄される）。

【0191】

ここで、HDMI(R)ソース５３及びHDMI(R)シンク６１が、例えば、上述したように、３６ビット画像に対応している場合、すなわち、HDMI(R)ソース５３が１２ビットの送信画素データを送信し、HDMI(R)シンク６１が１２ビットの送信画素データを受信することができる場合においては、主画像の画素データが、その１２ビット未満の画素データであるときには、３６ビット画像に対応しているHDMI(R)ソース５３では、１２ビットの送信画素データのうちの、主画像の画素データが割り当てられない下位ビットは、無信号(0)とされる。そして、３６ビット画像に対応しているHDMI(R)シンク６１では、HDMI(R)ソース５３からの１２ビットの送信画素データがそのまま処理され、その結果得られる画像が表示

される。この画像の表示では、１２ビットの送信画素データのうちの、主画像の画素データが割り当てられない下位ビットは、無信号(0)であるため、HDMI(R)シンク６１での画像の表示では無視される。その結果、HDMI(R)シンク６１では、１２ビットの送信画素データのうちの上位ビットに割り当てられている画素データによる画像、つまり、主画像が表示される。したがって、HDMI(R)シンク６１では、１２ビットの送信画素データに、例えば、８ビットや１０ビットの画素データが割り当てられていれば、その８ビットや１０ビットの画素データによる画像が表示される。

【0192】

以上のように、主画像の画素データのビット数B1が、送信画素データのビット数B2よりも少ない場合には、ビット数がB1の主画像の画素データが、ビット数がB2の送信画素データの上位ビットに割り当てられ、その送信画素データが、HDMI(R)ソース５３からHDMI(R)シンク６１に送信されるが、この場合、HDMI(R)ソース５３からHDMI(R)シンク６１に送信される送信画素データのうちの、主画像の画素データが割り当てられない下位のB2-B1ビットは、実質的に使用されていないので、非効率的である。

【0193】

そこで、HDMI(R)ソース５３及びHDMI(R)シンク６１では、送信画素データのうちの、主画像の画素データが割り当てられないビットに、主画像とは別の信号（以下、適宜、副信号という）を割り当て、これにより、主画像と副信号とを同時に伝送する、効率的なデータ伝送を行うようにすることができる。

【0194】

ここで、送信画素データのうちの、主画像の画素データが割り当てられないビットを、以下、適宜、余りビットという。

【0195】

図１６は、送信画素データに対して副信号を割り当てる割り当て方法を示している。

【0196】

例えば、図１５で説明したように、送信画素データ（１つのTMDSチャンネルで送信される画素データ）が１２ビットであり、主画像の画素データ（の１つの成分）が１０ビットである場合には、送信画素データの上位１０ビットに、１０ビットの主画像の画素データが割り当てられ、これにより、送信画素データの下位２ビットが、余りビットとなる。

【0197】

いま、副信号が、例えば、８ビットを１単位とする信号（データ）であるとすると、図１６に示すように、１単位の副信号は、余りビットとビット数に等しい２ビットごとの４つのデータに区分され、その４つのデータが、４画素の送信画素データの余りビットである下位２ビットにそれぞれ割り当てられる。

【0198】

この場合、副信号が、例えば、R,G,Bの各成分が８ビットの画像であるとすると、この副信号である画像としては、例えば、主画像の1/4程度の解像度（画素数）の画像を採用することができる。

【0199】

ここで、主画像が、例えば、R,G,Bの各成分が１０ビットの、1920画素×1080ラインの画像であり、送信画素データが、例えば、１２ビットである場合において、副信号が、例えば、R,G,Bの各成分が８ビットの、480画素×360ラインの画像であるときには、その480画素×360ラインの画像としての副信号は、主画像の1080ラインのうちの360ライン分の送信画素データの余りビットである下位２ビットに割り当てることができる。そして、この場合、主画像の1080ライン分の送信画素データのうちの、480画素×360ラインの画像としての副信号が割り当てられていない720(=1080-360)ライン分の送信画素データには、さらに他の副信号を割り当てることができる。

【0200】

また、主画像が、例えば、R,G,Bの各成分が８ビットの、1920画素×1080ラインの画像であり、送信画素データが、例えば、１２ビットである場合には、送信画素データの下位

４ビットが余りビットになる。この場合、主画像の1080ライン分の送信画素データには、R,G,Bの各成分が８ビットの、960画素×720ライン程度の画像を、副信号として割り当てることができる。

【0201】

なお、以下では、副信号は、８ビット単位の信号であるとする。

【0202】

以上のように、送信画素データの余りビットに、副信号を割り当て、主画像とともに、TMDSチャンネル#0ないし#2で、送信画素データを伝送することができるHDMI(R)を、現行のHDMI(R)と区別するために、拡張HDMI(R)と呼ぶこととすると、拡張HDMI(R)に対応したHDMI(R)ソースが、副信号を送信画素データの余りビットに割り当てて伝送する場合には、まず、通信相手であるHDMI(R)シンクが拡張HDMI(R)に対応しているかどうかを認識する必要がある。

【0203】

HDMI(R)シンクが拡張HDMI(R)に対応しているかどうかは、例えば、上述した、HDMI(R)シンクがディープカラーHDMI(R)に対応しているかどうかと同様に、HDMI(R)シンクの性能に関する性能情報であるE-EDIDに記述しておくことができる。

【0204】

すなわち、図１７は、E-EDIDにおけるVSDBを示している。

【0205】

現行のHDMI(R)では、図１０に示したように、VSDBのByte#7のLSBから5,6,7,8ビット目のビット#4,#5,#6,#7は、未使用(Reserved)になっているが、図１７では、そのビット#4,#5,#6,#7に、それぞれ、ビットSub_2bit,Sub_4bit,Sub_8bit,Sub_Data_Supportが割り当てられている。

【0206】

VSDBのByte#7のビット#4に割り当てられているビットSub_2bit、ビット#5に割り当てられているビットSub_4bit、及びビット#6に割り当てられているビットSub_8bitは、HDMI(R)シンクが、副信号を受信することができない場合、すなわち、副信号を扱うことができない場合、例えば、すべて0とされる。

【0207】

そして、HDMI(R)シンクが、送信画素データの下位２ビットを余りビットとして、その２ビットの余りビットに割り当てられた副信号を扱うことができる場合、ビットSub_2bitは1とされる。また、HDMI(R)シンクが、送信画素データの下位４ビットを余りビットとして、その４ビットの余りビットに割り当てられた副信号を扱うことができる場合、ビットSub_4bitは1とされる。さらに、HDMI(R)シンクが、送信画素データの下位８ビットを余りビットとして、その８ビットの余りビットに割り当てられた副信号を扱うことができる場合、ビットSub_8bitは1とされる。

【0208】

ビットSub_Data_Supportは、HDMI(R)シンクが、副信号を扱うことができる場合に1とされ、副信号を扱うことができない場合、つまり、拡張HDMI(R)に対応していない場合に0とされる。

【0209】

なお、ビットSub_Data_Supportが0である場合には、Sub_2bit,Sub_4bit,Sub_8bitは、すべて0となる

【0210】

以上のように、HDMI(R)シンクが拡張HDMI(R)に対応しているかどうかを、E-EDIDのVSDBに記述しておくことにより、HDMI(R)ソースは、HDMI(R)シンクから、E-EDIDを読み出し、そのE-EDIDのVSDBを参照することにより、HDMI(R)シンクが副信号を扱うことができるかどうか、さらには、HDMI(R)シンクが副信号を扱うことができる場合には、送信画素データの下位の何ビットを、余りビットとして、副信号に割り当てることができるのかを認識することができる。

【0211】
なお、HDMI(R)ソースのE-EDIDのVSDBにも、図１７に示したビットSub_2bit,Sub_4bit,Sub_8bit,Sub_Data_Supportを記述しておくことができる。
【0212】
また、図１７では、送信画素データに割り当てる副信号が、２ビット、４ビット、又は８ビットのうちのいずれかであることとしたが、送信画素データに割り当てる副信号のビット数は、これらに限定されるものではない。
【0213】
さらに、VSDBのByte#7のLSBから5ないし8ビット目の４ビット#4ないし#7には、Sub_2bit,Sub_4bit,Sub_8bit,Sub_Data_Supportではなく、送信画素データに割り当てる副信号のビット数に対応する値をセットすることが可能である。この場合、４ビット#4ないし#7によれば、１６通りのビット数を表現することができる。
【0214】
次に、上述したように、HDMI(R)ソースとHDMI(R)シンクとの間のE-EDIDの交換は、HDMI(R)ソースとHDMI(R)シンクとが接続されたときや、HDMI(R)ソース又はHDMI(R)シンクの電源がオンにされたとき等の特定のタイミングで行われ、周期的に行われるものではない。
【0215】
一方、HDMI(R)ソースとHDMI(R)シンクとが、拡張HDMI(R)に対応している場合においては、HDMI(R)ソースからHDMI(R)シンクに対して送信される送信画素データに、副信号が割り当てられているときと、副信号が割り当てられていないときとがありうる。さらに、送信画素データに副信号が割り当てられているときには、その割り当てられている副信号が２ビット、４ビット、又は８ビットであることがある。
【0216】
ここで、説明を簡単にするために、送信画素データに副信号が割り当てられていないことを、以下、適宜、送信画素データに割り当てられている副信号のビット数が０であるとも表現する。
【0217】
送信画素データの伝送は、図４で説明したように、ビデオフィールドのアクティブビデオ区間(Active Video)に割り当てられているビデオデータ区間において行われるから、HDMI(R)シンクにおいて、ビデオデータ区間において伝送されてくる送信画素データに割り当てられている副信号が、０ビット、２ビット、４ビット、又は８ビットのうちのいずれであるのかは、ビデオデータ区間を含むビデオフィールドごとに認識することができることが望ましい。
【0218】
この場合、HDMI(R)ソースからHDMI(R)シンクに対して、ビデオフィールドごとに、そのビデオフィールドに含まれるビデオデータ区間において伝送されてくる送信画素データに割り当てられている副信号が、０ビット、２ビット、４ビット、又は８ビットのうちのいずれであるのかを表す情報（以下、適宜、副信号情報という）を伝送する必要がある。
【0219】
この副信号情報は、上述したディープカラーモードと同様に、垂直帰線区間におけるコントロール区間（図４）に伝送されるゼネラルコントロールパケットに含め、ビデオフィールドごとに、HDMI(R)ソースからHDMI(R)シンクに伝送するようにすることができる。
【0220】
すなわち、図１８は、副信号情報を含むゼネラルコントロールパケットを示している。
【0221】
ゼネラルコントロールパケットは、図１１で説明したように、パケットヘッダ(General Contorol Packet Header)と、サブパケット(General Control Subpacket)とを有しており、図１８上側は、パケットヘッダを、図１８下側は、サブパケットを、それぞれ示している。
【0222】

現行のHDMI(R)では、ゼネラルコントロールパケットのサブパケットのByte#SB2のLSBから1,2,3ビット目のビット#0,#1,#2は、未使用で0とすることになっているが、図１８では、そのビット#0,#1,#2に、それぞれ、副信号情報としてのビットSD0,SD1,SD2が割り当てられている。

【0223】

図１９は、サブパケットのByte#SB2のビットSD0,SD1,SD2と、そのサブパケットを有するゼネラルコントロールパケットが伝送されるコントロール区間（図４）を含むビデオフィールドに含まれるビデオデータ区間（図４）に伝送される送信画素データに割り当てられている副信号のビット数との関係を示している。

【0224】

送信画素データに割り当てられている副信号のビット数が０ビットである場合、つまり、送信画素データに副信号が割り当てられていない場合(Sub Data not Inserted)、副信号情報としてのビットSD0,SD1,SD2は、現行のHDMI(R)と同様に、いずれも0とされる。

【0225】

また、送信画素データに割り当てられているビット数が２ビットである場合、副信号情報としてのビットSD0,SD1,SD2は、例えば、それぞれ、1,0,0とされる。さらに、送信画素データに割り当てられているビット数が４ビットである場合、副信号情報としてのビットSD0,SD1,SD2は、例えば、それぞれ、0,1,0とされ、送信画素データに割り当てられているビット数が８ビットである場合、副信号情報としてのビットSD0,SD1,SD2は、例えば、それぞれ、1,1,0とされる。

【0226】

以上のように、HDMI(R)ソースにおいて、副信号情報としてのビットSD0,SD1,SD2をゼネラルコントロールパケットに含め、ビデオフィールドのコントロール区間に伝送することにより、HDMI(R)シンクでは、そのビデオフィールドのビデオデータ区間に伝送されてくる送信画素データに割り当てられている副信号が、０ビット、２ビット、４ビット、又は８ビットのうちのいずれであるのかを認識することができる。

【0227】

次に、図２０は、図２のHDMI(R)ソース５３が拡張HDMIに対応している場合の、そのHDMI(R)ソース５３が有するソース信号処理部７１の構成例を示している。

【0228】

図２０において、ソース信号処理部７１は、主画像処理部１０１、副信号付加部１０２、副信号処理部１０３、副信号関連情報挿入部１０４、副信号受信可否判定部１０５、副信号割り当てビット数決定部１０６、副信号フレーム情報送信制御部１０７、及びディープカラーモード決定部１０８から構成されている。

【0229】

主画像処理部１０１には、例えば、R,G,Bの各成分を有する主画像が供給される。主画像処理部１０１は、そこに供給される主画像に必要な処理を施し、その主画像の画素データを、副信号付加部１０２に供給する。

【0230】

さらに、主画像処理部１０１は、そこに供給される主画像のビデオフィールド（図４）のビデオデータ区間の画素数（有効画素の画素数）Pを検出し、副信号処理部１０３に供給する。

【0231】

また、主画像処理部１０１は、そこに供給される主画像の画素データの各成分のビット数B1を検出し、副信号割り当てビット数決定部１０６に供給する。

【0232】

副信号付加部１０２には、主画像処理部１０１から、ビット数がB1の主画像の画素データが供給される他、副信号関連情報挿入部１０４から副信号が供給される。さらに、副信号付加部１０２には、ディープカラーモード決定部１０８から、ディープカラーモードが供給されるとともに、副信号割り当てビット数決定部１０６から、送信画素データに割り

当てられる副信号のビット数B3を表す副信号割り当てビット数が供給される。

【0233】

副信号付加部１０２は、ディープカラーモード決定部１０８からのディープカラーモードに基づき、送信画素データのビット数B2を認識する。すなわち、例えば、ディープカラーモードが、２４ビット画像、３０ビット画像、３６ビット画像、又は４８ビット画像を表している場合には、副信号付加部１０２は、それぞれ、８ビット、１０ビット、１２ビット、又は１６ビットを、送信画素データのビット数B2として認識する。

【0234】

そして、副信号付加部１０２は、副信号関連情報挿入部１０４から供給される副信号を、副信号割り当てビット数決定部１０６からの副信号割り当てビット数B3ごとに区分し、その区分した副信号である区分副信号を、主画像処理部１０１から供給されるビット数がB1の画素データの下位ビットとして付加することにより、ディープカラーモード決定部１０８からのディープカラーモードから認識したビット数B2の送信画素データ、つまり、ビット数がB1の主画像の画素データが上位ビットに割り当てられ、ビット数がB3の区分副信号が下位ビットに割り当てられた、ビット数がB2(=B1+B3)の送信画素データを構成する。

【0235】

なお、副信号付加部１０２は、R,G,Bの各成分について、ビット数がB2の送信画素データを構成する。副信号付加部１０２で得られたビット数がB2の、R,G,Bの各成分の送信画素データは、トランスミッタ７２（図２）に供給され、TMDSチャンネル#0ないし#2で、例えば、図６ないし図９で説明したタイミングのうちの、送信画素データのビット数B2に対応したタイミングで送信される。

【0236】

副信号処理部１０３には、上述したように、主画像処理部１０１から、主画像のビデオデータ区間の画素数Pが供給される他、副信号が供給される。さらに、副信号処理部１０３には、副信号割り当てビット数決定部１０３から、副信号割り当てビット数が供給される。

【0237】

副信号処理部１０３は、主画像処理部１０１から供給される、主画像のビデオデータ区間の画素数Pと、副信号割り当てビット数決定部１０３から供給される副信号割り当てビット数B3とから、１のビデオフィールドのビデオデータ区間で送信することができる副信号の最大のデータ量P×B3を求め、その最大のデータ量P×B3の範囲内で、１のビデオフィールド（１フレーム）のビデオデータ区間で送信する副信号のデータ量（以下、適宜、副信号付加単位データ量という）Dを決定する。

【0238】

さらに、副信号処理部１０３は、そこに供給される副信号を、副信号付加単位データ量Dごとに、副信号関連情報挿入部１０４に供給する。

【0239】

また、副信号処理部１０３は、送信画素データに副信号が含まれるかどうかを表す副信号情報を、副信号フレーム情報送信制御部１０７に供給する。

【0240】

すなわち、副信号処理部１０３は、副信号付加単位データ量Dの副信号を、副信号関連情報挿入部１０４に供給する場合、すなわち、送信画素データに割り当てる副信号がある場合、送信画素データに副信号が含まれる旨の副信号情報を、副信号フレーム情報送信制御部１０７に供給する。また、副信号処理部１０３は、副信号付加単位データ量Dの副信号を、副信号関連情報挿入部１０４に供給しない場合、すなわち、副信号関連情報挿入部１０４に供給する副信号がない場合、送信画素データに副信号が含まれない旨の副信号情報を、副信号フレーム情報送信制御部１０７に供給する。

【0241】

副信号関連情報挿入部１０４は、副信号処理部１０３からの副信号付加単位データ量Dの副信号に、その副信号に関連する副信号関連情報を含め（挿入し）、副信号付加部１０

２に供給する。

【0242】

副信号受信可否判定部１０５には、HDMI(R)ソース５３の通信相手のHDMI(R)シンクから読み出されたE-EDIDのVSDB（図１７）が供給される。

【0243】

副信号受信可否判定部１０５は、そこに供給されるVSDBのビットSub_Data_Support（図１７）を参照することにより、HDMI(R)ソース５３の通信相手のHDMI(R)シンクが、副信号を受信することができるかどうか、つまり、副信号を扱うことができるかどうかを判定し、その判定結果を、必要なブロックに供給する。

【0244】

また、副信号受信可否判定部１０５は、HDMI(R)ソース５３の通信相手のHDMI(R)シンクが、副信号を扱うことができると判定した場合、さらに、VSDBのビットSub_2bit,Sub_4bit,Sub_8bit（図１７）を参照することにより、HDMI(R)ソース５３の通信相手のHDMI(R)シンクが扱うことができる副信号のビット数（以下、適宜、対応可能ビット数という）を認識して、副信号割り当てビット数決定部１０６に供給する。

【0245】

副信号割り当てビット数決定部１０６には、上述したように、主画像処理部１０１から、主画像の画素データのビット数B1が供給されるとともに、副信号受信可否判定部１０５から、対応可能ビット数が供給される。さらに、副信号割り当てビット数決定部１０６には、ディープカラーモード決定部１０８から、ディープカラーモードが供給される。

【0246】

副信号割り当てビット数決定部１０６は、ディープカラーモード決定部１０８から供給されるディープカラーモードに基づき、送信画素データのビット数B2を認識し、主画像処理部１０１からの主画像の画素データのビット数B1との差分B2-B1、つまり、送信画素データの余りビットのビット数B2-B1を求める。

【0247】

そして、副信号割り当てビット数決定部１０６は、副信号受信可否判定部１０５からの対応可能ビット数の中に、送信画素データの余りビットのビット数B2-B1と一致するビット数がある場合には、そのビット数を、副信号割り当てビット数B3に決定する。

【0248】

ここで、副信号受信可否判定部１０５からの対応可能ビット数が、例えば、２ビット、４ビット、及び８ビットの３種類である場合には、副信号割り当てビット数B3は、以下の値に決定される。

【0249】

すなわち、送信画素データのビット数B2が、例えば、１０ビットであり、主画素の画素データのビット数B1が、例えば、８ビットであるときには、副信号割り当てビット数B3は、２ビットに決定される。

【0250】

また、送信画素データのビット数B2が、例えば、１２ビットであり、主画素の画素データのビット数B1が、例えば、８ビット又は１０ビットであるときには、副信号割り当てビット数B3は、それぞれ、４ビット又は２ビットに決定される。

【0251】

さらに、送信画素データのビット数B2が、例えば、１６ビットであり、主画素の画素データのビット数B1が、例えば、８ビット又は１２ビットであるときには、副信号割り当てビット数B3は、それぞれ、８ビット又は４ビットに決定される。

【0252】

なお、副信号割り当てビット数決定部１０６は、副信号受信可否判定部１０５からの対応可能ビット数の中に、送信画素データの余りビットのビット数B2-B1と一致するビット数がない場合には、例えば、副信号受信可否判定部１０５からの対応可能ビット数の中で、送信画素データの余りビットのビット数B2-B1未満のビット数に一致する対応可能ビッ

ト数のうちの、例えば、最大値を、副信号割り当てビット数B3に決定することができる。但し、ここでは、説明を簡単にするため、副信号受信可否判定部１０５からの対応可能ビット数の中に、送信画素データの余りビットのビット数B2-B1と一致するビット数がない場合には、HDMI(R)ソース５３では、副信号の送信を行わず、通信相手のHDMI(R)シンクが、副信号を扱うことができないときと同様の処理が行われることとする。

【0253】

副信号割り当てビット数決定部１０６は、副信号割り当てビット数B3を決定すると、その副信号割り当てビット数B3を、副信号付加部１０２、副信号処理部１０３、及び副信号フレーム情報送信制御部１０７に供給する。

【0254】

副信号フレーム情報送信制御部１０７には、上述したように、副信号処理部１０３から、送信画素データに副信号が含まれるかどうかを表す副信号情報が供給されるとともに、副信号割り当てビット数決定部１０６から、副信号割り当てビット数B3が供給される他、ディープカラーモード決定部１０８から、ディープカラーモードが供給される。

【0255】

副信号フレーム情報送信制御部１０７は、副信号処理部１０３からの副信号情報と、ディープカラーモード決定部１０８からのディープカラーモード、さらには、必要に応じて、副信号割り当てビット数決定部１０６から供給される副信号割り当てビット数B3を含むゼネラルコントロールパケット（図１８）を、トランスミッタ７２（図２）に送信させる。

【0256】

すなわち、副信号フレーム情報送信制御部１０７は、副信号処理部１０３からの副信号情報が、送信画素データに副信号が含まれない旨を表している場合には、図１８のビットSD0,SD1,SD2が、いずれも0にセットされ、さらに、ビットCD0,CD1,CD2が、ディープカラーモード決定部１０８からのディープカラーモードを表す値にセットされたゼネラルコントロールパケット（以下、適宜、副信号なしのゼネラルコントロールパケットという）を、トランスミッタ７２に送信させる送信制御を行う。

【0257】

また、副信号フレーム情報送信制御部１０７は、副信号処理部１０３からの副信号情報が、送信画素データに副信号が含まれる旨を表している場合には、図１８のビットSD0,SD1,SD2が、副信号割り当てビット数決定部１０６からの副信号割り当てビット数B3を表す値にセットされ、さらに、ビットCD0,CD1,CD2が、ディープカラーモード決定部１０８からのディープカラーモードを表す値にセットされたゼネラルコントロールパケット（以下、適宜、副信号ありのゼネラルコントロールパケットという）を、トランスミッタ７２に送信させる送信制御を行う。

【0258】

ディープカラーモード決定部１０８には、HDMI(R)ソース５３の通信相手のHDMI(R)シンクから読み出されたE-EDIDのVSDB（図１７）が供給される。

【0259】

ディープカラーモード決定部１０８は、そこに供給されるVSDBのビットSuport_30bit,Suport_36bit,Suport_48bit（図１７）を参照することにより、HDMI(R)ソース５３の通信相手のHDMI(R)シンクが、高階調画像に対応しているかどうかを判定し、対応していないと判定した場合、ディープカラーモード、つまり、３つのTMDSチャンネル#0ないし#2で伝送する画像を、２４ビット画像に決定する。

【0260】

また、ディープカラーモード決定部１０８は、HDMI(R)ソース５３の通信相手のHDMI(R)シンクが、高階調画像に対応していると判定した場合、さらに、VSDBのビットSuport_30bit,Suport_36bit,Suport_48bit（図１７）を参照することにより、HDMI(R)ソース５３の通信相手のHDMI(R)シンク対応している高階調画像を認識し、その、HDMI(R)シンクが対応している高階調画像の中から、ディープカラーモード、つまり、３つのTMDSチャンネル#0

ないし#2で伝送する画像を決定する。

【0261】

すなわち、ディープカラーモード決定部１０８は、例えば、HDMI(R)シンクが対応している画像の中から、例えば、最も階調が高い画像を、ディープカラーモード（３つのTMDSチャンネル#0ないし#2で伝送する画像）として決定する。

【0262】

そして、ディープカラーモード決定部１０８は、ディープカラーモードを、副信号付加部１０２、副信号割り当てビット数決定部１０６、及び副信号フレーム情報送信制御部１０７に供給する。

【0263】

次に、図２１を参照して、図２０の副信号関連情報挿入部１０４が副信号に含める副信号関連情報について説明する。

【0264】

拡張HDMI(R)では、副信号が、ビデオフィールド（図４）のビデオデータ区間の画素データ、つまり、送信画素データの下位ビットに割り当てられ、送信画素データの上位ビットに割り当てられた主画像とともに送信されるが、必ずしも、すべての送信画素データに、副信号が割り当てられるとは限らない。

【0265】

すなわち、副信号のデータ量によっては、ビデオデータ区間の一部の送信画素データだけに、副信号が割り当てられ、残りの送信画素データには、副信号が割り当てられないことがある。

【0266】

このように、ビデオデータ区間の一部の送信画素データに、副信号が割り当てられ、残りの送信画素データに、副信号が割り当てられない場合には、そのような送信画素データを受信するHDMI(R)シンクにおいて、副信号が割り当てられている送信画素データと、割り当てられていない送信画素データとを区別し、副信号が割り当てられている送信画素データについてだけ、その下位ビットを、副信号として抽出する必要がある。

【0267】

そこで、副信号関連情報挿入部１０４では、副信号付加単位データ量Dの副信号、つまり、１つのビデオフィールド（図４）のビデオデータ区間の送信画素データに割り当てられる副信号に、少なくとも、副信号が割り当てられている送信画素データを区別するのに用いられる情報を含む副信号関連情報が含められる。

【0268】

すなわち、副信号関連情報は、例えば、図２１右側に示すように、副信号開始情報と副信号終了情報とからなり、副信号開始情報は、副信号付加単位データ量Dの副信号の先頭に配置され、副信号終了情報は、副信号付加単位データ量の副信号の最後に配置される。

【0269】

そして、副信号開始情報は、例えば、図２１左に示す、ビデオフィールドのビデオデータ区間の第１ライン（上から１番目の水平ライン）を構成する画素の送信画素データに割り当てられ、副信号付加単位データ量の副信号は、第２ライン以降のラインを構成する画素の送信画素データに、順次割り当てられる。

【0270】

いま、副信号付加単位データ量Dの副信号のすべてが、第２ラインないし第M+1ラインを構成する画素の送信画素データに割り当てられたとすると、副信号終了情報は、その直後の第M+2ラインを構成する画素の送信画素データに割り当てられる。

【0271】

以上のように、副信号付加単位データ量Dの副信号の先頭に配置される副信号開始情報には、例えば、第２ライン以降の画素の送信画素データに、副信号が割り当てられている旨や、その副信号が画像データ、音声データ、又はテキストデータであるといった副信号の種類（属性）を表す情報、さらには、副信号のフォーマット、その他の副信号に関連す

る情報を含めることができる。

【0272】

また、副信号付加単位データ量の副信号の最後に配置される副信号終了情報には、副信号の最後であることを表すユニークなコード、さらに、副信号の最後が割り当てられている送信画素データが、第M+1ラインを構成する画素の途中の画素の送信画素データである場合には、その送信画素データの画素の位置を表す情報などを含めることができる。

【0273】

なお、ビデオフィールドのビデオデータ区間の１ラインが、例えば、１９２０画素で構成される場合において、送信画素データの、例えば、下位２ビットに、副信号を割り当てるときには、１ラインを構成する画素の送信画素データに割り当てることができる副信号のデータ量は、２ビット×１９２０画素＝３８４０ビット＝４８０バイトであるから、副信号開始情報と副信号終了情報としては、それぞれ４８０バイトの情報を採用することができる。

【0274】

また、図２０の副信号処理部１０３では、副信号付加単位データ量Dは、それに副信号に含められる副信号開始情報及び副信号終了情報のデータ量を加えたデータ量が、ビデオデータ区間で送信することができる副信号の最大のデータ量P×B3を越えないように決定される。

【0275】

次に、図２２のフローチャートを参照して、図２のHDMI(R)ソース５３が、拡張HDMI(R)に対応しており、そのHDMI(R)ソース５３のソース信号処理部７１が図２０に示したように構成される場合の、HDMI(R)ソース５３の動作について説明する。

【0276】

HDMI(R)ソース５３においては、主画像の画素データが、ソース信号処理部７１（図２０）の主画像処理部１０１に供給され、さらに、必要に応じて、副信号が、副信号処理部１０３に供給される。

【0277】

主画像処理部１０１では、そこに供給される主画像に必要な処理が施され、その処理後の主画像の画素データが、副信号付加部１０２に供給される。

【0278】

また、主画像処理部１０１は、そこに供給される主画像のビデオフィールド（図４）のビデオデータ区間の画素数（有効画素の画素数）Pを検出し、副信号処理部１０３に供給する。

【0279】

さらに、主画像処理部１０１は、主画像の画素データの各成分のビット数B1を検出し、副信号割り当てビット数決定部１０６に供給する。

【0280】

また、HDMI(R)ソース５３は、HDMI(R)シンク６１から、図２で説明したDDCを介して、HDMI(R)シンク６１のE-EDIDが送信されてくるのを待って、ステップＳ１０１において、そのE-EDIDを受信する。

【0281】

HDMI(R)ソース５３において、HDMI(R)シンク６１からのE-EDIDは、ソース信号処理部７１（図２０）の副信号受信可否判定部１０５と、ディープカラーモード決定部１０８に供給される。

【0282】

ディープカラーモード決定部１０８は、ステップＳ１０２において、HDMI(R)シンク６１からのE-EDIDのVSDB（図１７）を参照することにより、HDMI(R)シンク６１が対応している画像が、２４ビット画像、３０ビット画像、３６ビット画像、又は４８ビット画像のうちのいずれであるのかを認識する。　さらに、ディープカラーモード決定部１０８は、DMI(R)シンク６１が対応している画像の中から、３つのTMDSチャンネル#0ないし#2で伝送

する画像を決定し、その画像を表すディープカラーモードを、副信号付加部１０２、副信号割り当てビット数決定部１０６、及び副信号フレーム情報送信制御部１０７に供給する。

【0283】

なお、HDMI(R)シンク６１が対応している画像が、２４ビット画像のみである場合、すなわち、HDMI(R)シンク６１が、高階調画像に対応していない場合、HDMI(R)ソース５３は、後述するステップＳ１０４以降の処理を行わず、現行のHDMI(R)に準拠した処理を行う。したがって、この場合、副信号の伝送は、行われない。

【0284】

その後、HDMI(R)ソース５３は、ステップＳ１０３において、ピクセルクロックの周波数を、ステップＳ１０２で決定したディープカラーモードに対応した周波数に調整し、そのピクセルクロックの出力を開始して、ステップＳ１０４に進む。

【0285】

ステップＳ１０４では、副信号受信可否判定部１０５は、そこに供給される、HDMI(R)シンク６１からのE-EDIDのVSDBのビットSub_Data_Support（図１７）を参照することにより、HDMI(R)シンク６１が、副信号を受信することができるかどうか、つまり、副信号を扱うことができるかどうかを判定する。

【0286】

ステップＳ１０４において、HDMI(R)シンク６１が副信号を扱うことができないと判定された場合、すなわち、VSDBのビットSub_Data_Support（図１７）が、副信号を扱うことができない旨を表す値である0になっている場合、ステップＳ１０５に進み、以下、HDMI(R)ソース５３は、副信号を伝送せずに、ステップＳ１０２で決定されたディープカラーモードが表す画像の画素データを、TMDSチャンネル#0ないし#2で伝送する。

【0287】

すなわち、ステップＳ１０５では、副信号フレーム情報送信制御部１０７が、副信号なしのゼネラルコントロールパケット、つまり、図１８のビットSD0,SD1,SD2が、いずれも0にセットされ、さらに、ビットCD0,CD1,CD2が、ステップＳ１０２でディープカラーモード決定部１０８から供給されたディープカラーモードを表す値にセットされたゼネラルコントロールパケットを、ビデオフィールドの垂直帰線区間のコントロール区間（図４）において、トランスミッタ７２（図２）に送信させ、ステップＳ１０６に進む。

【0288】

ステップＳ１０６では、副信号付加部１０２が、主画像処理部１０１から供給される主画像の画素データだけから、ステップＳ１０２で決定されたディープカラーモードの画像に対応するビット数B2の送信画素データを構成し、トランスミッタ７２に供給する。これにより、トランスミッタ７２が、ビデオフィールドのビデオデータ区間において、送信画素データを送信して、ステップＳ１０７に進む。

【0289】

ここで、送信画素データの送信は、ステップＳ１０３で出力が開始されたピクセルクロックに同期して行われる。

【0290】

ステップＳ１０７では、副信号付加部１０２が、直前のステップＳ１０６で送信画素データを送信したビデオフィールド（以下、適宜、注目ビデオフィールドという）のアクティブビデオ区間に、まだ送信していない送信画素データが存在するかどうかを判定する。

【0291】

ステップＳ１０７において、注目ビデオフィールドのアクティブビデオ区間に、まだ送信していない送信画素データがあると判定された場合、ステップＳ１０６に戻り、注目ビデオフィールドのアクティブビデオ区間の、まだ送信していない送信画素データが送信される。

【0292】

また、ステップＳ１０７において、注目ビデオフィールドのアクティブビデオ区間に、

まだ送信していない送信画素データがないと判定された場合、すなわち、注目ビデオフィールドのアクティブビデオ区間の送信画素データのすべての送信が終了した場合、ステップＳ１０８に進み、副信号付加部１０２は、注目ビデオフィールドの次のビデオフィールド（フレーム）が存在するかどうかを判定する。

【0293】

ステップＳ１０８において、注目ビデオフィールドの次のビデオフィールドが存在すると判定された場合、その、次のビデオフィールドが、新たに、注目ビデオフィールドとされて、ステップＳ１０５に戻り、以下、同様の処理が繰り返される。

【0294】

また、ステップＳ１０８において、注目ビデオフィールドの次のビデオフィールドが存在しないと判定された場合、処理を終了する。

【0295】

一方、ステップＳ１０４において、HDMI(R)シンク６１が副信号を扱うことができると判定された場合、すなわち、VSDBのビットSub_Data_Support（図１７）が、副信号を扱うことができる旨を表す値である1になっている場合、副信号受信可否判定部１０５は、VSDBのビットSub_2bit,Sub_4bit,Sub_8bit（図１７）を参照することにより、HDMI(R)シンク６１が扱うことができる副信号のビット数である対応可能ビット数を認識して、副信号割り当てビット数決定部１０６に供給して、ステップＳ１０９に進む。

【0296】

ステップＳ１０９では、副信号割り当てビット数決定部１０６は、主画像処理部１０１からの主画像の画素データのビット数B1、副信号受信可否判定部１０５からの対応可能ビット数、及びディープカラーモード決定部１０８からのディープカラーモードから認識される送信画素データのビット数B2に基づき、上述したようにして、送信画素データに割り当てられる副信号のビット数である副信号割り当てビット数B3を決定し、副信号付加部１０２、副信号処理部１０３、及び副信号フレーム情報送信制御部１０７に供給して、ステップＳ１１０に進む。

【0297】

ここで、副信号処理部１０３は、主画像処理部１０１から、主画像のビデオデータ区間の画素数Pが供給され、副信号割り当てビット数決定部１０３から、副信号割り当てビット数B3が供給されると、その主画像のビデオデータ区間の画素数Pと副信号割り当てビット数B3とから、上述したようにして、１のビデオフィールドのビデオデータ区間で送信する副信号のデータ量である副信号付加単位データ量Dを決定する。

【0298】

そして、副信号処理部１０３は、ステップＳ１１０において、ビデオフィールドのビデオデータ区間の画素データに付加すべき副信号があるかどうかを判定する。

【0299】

ステップＳ１１０において、ビデオフィールドのビデオデータ区間の画素データに付加すべき副信号があると判定された場合、すなわち、例えば、副信号処理部１０３に副信号が供給されている場合、副信号処理部１０３は、そこに供給されている副信号のうちの、副信号付加単位データ量Dだけの副信号を、副信号関連情報挿入部１０４に供給するとともに、送信画素データに副信号が含まれる旨の副信号情報を、副信号フレーム情報送信制御部１０７に供給して、ステップＳ１１１に進み、以下、HDMI(R)ソース５３は、副信号と、ステップＳ１０２で決定されたディープカラーモードが表す主画像の画素データとを、TMDSチャンネル#0ないし#2で伝送する。

【0300】

すなわち、ステップＳ１１１では、副信号フレーム情報送信制御部１０７が、副信号処理部１０３からの副信号情報に応じて、副信号ありのゼネラルコントロールパケット、つまり、図１８のビットSD0,SD1,SD2が、ステップＳ１０９で副信号割り当てビット数決定部１０６から供給された、送信画素データに割り当てられる副信号のビット数である副信号割り当てビット数B3に応じた値にセットされ、さらに、ビットCD0,CD1,CD2が、ステッ

プＳ１０２でディープカラーモード決定部１０８から供給されたディープカラーモードを表す値にセットされたゼネラルコントロールパケットを、ビデオフィールドの垂直帰線区間のコントロール区間（図４）において、トランスミッタ７２（図２）に送信させ、ステップＳ１１２に進む。

【0301】

ここで、ステップＳ１１０において、ビデオフィールドのビデオデータ区間の画素データに付加すべき副信号があると判定されると、上述したように、副信号処理部１０３が、そこに供給されている副信号のうちの、副信号付加単位データ量Dだけの副信号を、副信号関連情報挿入部１０４に供給する。

【0302】

副信号関連情報挿入部１０４は、副信号処理部１０３からの副信号付加単位データ量Dの副信号が供給されると、その副信号に関連する副信号関連情報を、図２１で説明したように含めて、副信号付加部１０２に供給する。

【0303】

副信号付加部１０２は、ステップＳ１１２において、送信画像データの構成、つまり、主画像処理部１０１からの主画像の画素データへの、副信号関連情報挿入部１０４からの副信号の付加を開始する。

【0304】

すなわち、副信号付加部１０２は、副信号関連情報挿入部１０４からの副信号を、ステップＳ１０９で副信号割り当てビット数決定部１０６から供給された副信号割り当てビット数B3ごとの区分副信号に区分し、主画像処理部１０１からの画素データの下位ビットとして付加することにより、ステップＳ１０２でディープカラーモード決定部１０８から供給されたディープカラーモードから認識したビット数B2の送信画素データ、つまり、ビット数がB1の主画像の画素データが上位ビットに割り当てられ、ビット数がB3の区分副信号が下位ビットに割り当てられた、ビット数がB2の送信画素データを構成する。

【0305】

そして、副信号付加部１０２は、ステップＳ１１２からステップＳ１１３に進み、主画像の画素データが上位ビットに割り当てられ、区分副信号が下位ビットに割り当てられた送信画素データを、トランスミッタ７２に供給し、これにより、トランスミッタ７２が、ビデオフィールドのビデオデータ区間において、送信画素データを送信して、ステップＳ１１４に進む。

【0306】

ここで、送信画素データの送信は、ステップＳ１０３で出力が開始されたピクセルクロックに同期して行われる。

【0307】

ステップＳ１１４では、副信号付加部１０２が、直前のステップＳ１１３で送信画素データとして画素データを送信したビデオフィールドである注目ビデオフィールドのアクティブビデオ区間に、まだ送信していない送信画素データが存在するかどうかを判定する。

【0308】

ステップＳ１１４において、注目ビデオフィールドのアクティブビデオ区間に、まだ送信していない送信画素データがあると判定された場合、ステップＳ１１３に戻り、注目ビデオフィールドのアクティブビデオ区間の、まだ送信していない画素データが送信画素データとして送信される。

【0309】

また、ステップＳ１１４において、注目ビデオフィールドのアクティブビデオ区間に、まだ送信していない送信画素データがないと判定された場合、すなわち、注目ビデオフィールドのアクティブビデオ区間の送信画素データのすべての送信が終了した場合、ステップＳ１１５に進み、副信号付加部１０２は、注目ビデオフィールドの次のビデオフィールドが存在するかどうかを判定する。

【0310】

ステップＳ１１５において、注目ビデオフィールドの次のビデオフィールドが存在すると判定された場合、その、次のビデオフィールドが、新たに、注目ビデオフィールドとされて、ステップＳ１１０に戻り、以下、同様の処理が繰り返される。

【0311】

また、ステップＳ１１５において、注目ビデオフィールドの次のビデオフィールドが存在しないと判定された場合、処理を終了する。

【0312】

一方、ステップＳ１１０において、ビデオフィールドのビデオデータ区間の画素データに付加すべき副信号がないと判定された場合、すなわち、例えば、副信号処理部１０３に副信号が供給されていない場合、副信号処理部１０３は、送信画素データに副信号が含まれない旨の副信号情報を、副信号フレーム情報送信制御部１０７に供給して、ステップＳ１１６に進み、副信号フレーム情報送信制御部１０７は、副信号処理部１０３からの副信号情報に応じて、ステップＳ１０５と同様に、副信号なしのゼネラルコントロールパケット、つまり、図１８のビットSD0,SD1,SD2が、いずれも0にセットされ、さらに、ビットCD0,CD1,CD2が、ステップＳ１０２でディープカラーモード決定部１０８から供給されたディープカラーモードを表す値にセットされたゼネラルコントロールパケットを、ビデオフィールドの垂直帰線区間のコントロール区間（図４）において、トランスミッタ７２（図２）に送信させる。

【0313】

そして、以下、ステップＳ１１３ないしＳ１１５において、HDMI(R)ソース５３は、副信号を伝送せずに、ステップＳ１０２で決定されたディープカラーモードが表す主画像の画素データを、TMDSチャンネル#0ないし#2で伝送する。

【0314】

すなわち、ステップＳ１１６で副信号なしのゼネラルコントロールパケットが送信された場合、ステップＳ１１３では、副信号付加部１０２が、主画像処理部１０１から供給される主画像の画素データだけから、ステップＳ１０２で決定されたディープカラーモードの画像に対応するビット数B2の送信画素データを構成し、トランスミッタ７２に供給する。これにより、トランスミッタ７２が、ビデオフィールドのビデオデータ区間において、送信画素データを送信して、ステップＳ１１４に進む。

【0315】

ここで、送信画素データの送信は、ステップＳ１０３で出力が開始されたピクセルクロックに同期して行われる。

【0316】

ステップＳ１１４では、副信号付加部１０２が、直前のステップＳ１１３で送信画素データとして画素データを送信したビデオフィールドである注目ビデオフィールドのアクティブビデオ区間に、まだ送信していない送信画素データが存在するかどうかを判定する。

【0317】

ステップＳ１１４において、注目ビデオフィールドのアクティブビデオ区間に、まだ送信していない送信画素データがあると判定された場合、ステップＳ１１３に戻り、注目ビデオフィールドのアクティブビデオ区間の、まだ送信していない送信画素データが送信される。

【0318】

また、ステップＳ１１４において、注目ビデオフィールドのアクティブビデオ区間に、まだ送信していない送信画素データがないと判定された場合、すなわち、注目ビデオフィールドのアクティブビデオ区間の送信画素データのすべての送信が終了した場合、ステップＳ１１５に進み、副信号付加部１０２は、注目ビデオフィールドの次のビデオフィールドが存在するかどうかを判定する。

【0319】

ステップＳ１１５において、注目ビデオフィールドの次のビデオフィールドが存在すると判定された場合、その、次のビデオフィールドが、新たに、注目ビデオフィールドとさ

れて、ステップＳ１１０に戻り、以下、同様の処理が繰り返される。

【0320】

また、ステップＳ１１５において、注目ビデオフィールドの次のビデオフィールドが存在しないと判定された場合、処理を終了する。

【0321】

次に、図２３は、図２のHDMI(R)シンク６１が拡張HDMIに対応している場合の、そのHDMI(R)シンク６１が有するシンク信号処理部８２の構成例を示している。

【0322】

図２３において、シンク信号処理部８２は、FIFO(First In First Out)メモリ１２１、副信号有無判定部１２２、分離部１２３、主画像処理部１２４、主画像メモリ１２５、副信号処理部１２６、及び副信号メモリ１２７から構成されている。

【0323】

FIFOメモリ１２１には、レシーバ８１（図２）が受信した、ビデオフィールド（図４）のビデオデータ区間の送信画素データが供給される。

【0324】

FIFOメモリ１２１は、レシーバ８１からの送信画素データを順次記憶し、分離部１２３に供給する。

【0325】

副信号有無判定部１２２には、レシーバ８１が受信した、ビデオフィールド（図４）の垂直帰線区間のコントロール区間のゼネラルコントロールパケットが供給される。

【0326】

副信号有無判定部１２２は、レシーバ８１からのゼネラルコントロールパケット（図１８）のビットSD0,SD1,SD2に基づいて、そのゼネラルコントロールパケットが送信されてきた垂直帰線区間の直後のビデオデータ区間に送信されてくる送信画素データに、副信号が含まれるかどうかを判定し、その判定結果を、分離部１２３に供給する。

【0327】

さらに、副信号有無判定部１２２は、送信画素データに副信号が含まれると判定した場合には、レシーバ８１からのゼネラルコントロールパケット（図１８）のビットSD0,SD1,SD2に基づいて、そのゼネラルコントロールパケットが送信されてきた垂直帰線区間の直後のビデオデータ区間に送信されてくる送信画素データに含まれる副信号の副信号割り当てビット数B3を認識し、分離部１２３に供給する。

【0328】

分離部１２３は、副信号有無判定部１２２から、送信画素データに副信号が含まれない旨の判定結果が供給された場合、FIFOメモリ１２１からの送信画素データを受信し、その送信画素データに割り当てられている主画像の画素データを、主画像処理部１２４に供給する。

【0329】

また、分離部１２３は、副信号有無判定部１２２から、送信画素データに副信号が含まれる旨の判定結果が供給された場合、FIFOメモリ１２１からの送信画素データを受信し、副信号有無判定部１２２から供給される副信号割り当てビット数B3に基づいて、送信画素データから、主画像の画素データと、区分副信号とを分離する。

【0330】

すなわち、分離部１２３は、FIFOメモリ１２１からの送信画素データのうちの、副信号有無判定部１２２からの副信号割り当てビット数B3だけの下位ビットを、区分副信号として抽出し、副信号処理部１２６に供給する。さらに、分離部１２３は、FIFOメモリ１２１からの送信画素データのうちの、残りの上位ビットを、主画像の画素データとして抽出し、主画像処理部１２４に供給する。

【0331】

主画像処理部１２４は、分離部１２３から供給される主画像の画素データに必要な処理を施し、１のビデオフィールド分の主画像を再構成して、主画像メモリ１２５に供給する

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【0332】

主画像メモリ１２５は、主画像処理部１２４から供給される主画像を一時記憶する。なお、主画像メモリ１２５に記憶された主画像は、適宜読み出され、表示制御部６２（図１）に供給される。

【0333】

副信号処理部１２６は、分離部１２３から供給される区分副信号から、元の副信号を再構成して、副信号メモリ１２７に供給する。なお、図２１で説明したように、副信号には、副信号関連情報が含まれており、副信号処理部１２６は、この副信号関連情報を必要に応じて参照して、副信号を再構成する。

【0334】

副信号メモリ１２７は、副信号処理部１２６から供給される副信号を一時記憶する。

【0335】

次に、図２４のフローチャートを参照して、図２のHDMI(R)シンク６１が、拡張HDMI(R)に対応しており、そのHDMI(R)シンク６１のシンク信号処理部８２が図２３に示したように構成される場合の、HDMI(R)シンク６１の動作について説明する。

【0336】

HDMI(R)シンク６１は、ステップＳ１３１において、自身のE-EDIDを、DDC（図２）を介して、HDMI(R)シンク６１に送信する。

【0337】

その後、HDMI(R)シンク６１において、図２２で説明したように、ピクセルクロックの出力が開始され、ゼネラルコントロールパケットがTMDSチャンネル#0ないし#2を介して伝送されてくると、HDMI(R)シンク６１のレシーバ８１（図２）は、ステップＳ１３２において、HDMI(R)シンク６１からのゼネラルコントロールパケット（図１８）を受信し、シンク信号処理部８２の副信号有無判定部１２２（図２３）に供給して、ステップＳ１３３に進む。

【0338】

ステップＳ１３３では、副信号有無判定部１２２は、レシーバ８１からのゼネラルコントロールパケット（図１８）のビットSD0,SD1,SD2に基づいて、そのゼネラルコントロールパケットが送信されてきた垂直帰線区間の直後のビデオデータ区間に送信されてくる送信画素データに、副信号が含まれるかどうかを判定する。

【0339】

ステップＳ１３３において、送信画素データに副信号が含まれないと判定された場合、副信号有無判定部１２２は、その旨の判定結果を、分離部１２３に供給して、ステップＳ１３４に進む。

【0340】

ステップＳ１３４では、HDMI(R)シンク６１のレシーバ８１（図２）が、HDMI(R)ソース５３からのゼネラルコントロールパケットのビットCD0,CD1,CD2が表すディープカラーモードの画像の送信画素データが、ピクセルクロックに同期して、TMDSチャンネル#0ないし#2を介して、HDMI(R)シンク６１から送信されてくるのを待って、その送信画素データを受信し、シンク信号処理部８２のFIFOメモリ１２１を介して、分離部１２３に供給して、ステップＳ１３５に進む。

【0341】

ステップＳ１３５では、分離部１２３は、副信号有無判定部１２２からの、送信画素データに副信号が含まれない旨の判定結果に応じて、FIFOメモリ１２１を介して供給される送信画素データに割り当てられている主画像の画素データを、主画像処理部１２４に供給する。

【0342】

さらに、ステップＳ１３５では、主画像処理部１２４が、１のビデオフィールド分の主画像を再構成するために、分離部１２３からの主画像の画素データを主画像メモリ１２５

に供給して記憶させ、ステップＳ１３６に進む。

【0343】

ステップＳ１３６では、主画像処理部１２４が、１のビデオフィールド分の主画像の画素データの処理が終了したか、つまり、主画像メモリ１２５に、１のビデオフィールド分の主画像が記憶されたかどうかを判定する。

【0344】

ステップＳ１３６において、１のビデオフィールド分の主画像の画素データの処理が終了していないと判定された場合、ステップＳ１３４に戻り、以下、同様の処理が繰り返される。

【0345】

また、ステップＳ１３６において、１のビデオフィールド分の主画像の画素データの処理が終了したと判定された場合、次のビデオフィールドにおいてゼネラルコントロールパケットが送信されてくるのを待って、ステップＳ１３２に戻り、以下、同様の処理が繰り返される。

【0346】

一方、ステップＳ１３３において、送信画素データに副信号が含まれると判定された場合、副信号有無判定部１２２は、レシーバ８１からのゼネラルコントロールパケット（図１８）のビットSD0,SD1,SD2に基づいて、送信画素データに含まれる副信号の副信号割り当てビット数B3を認識し、送信画素データに副信号が含まれる旨の判定結果とともに、分離部１２３に供給して、ステップＳ１３７に進む。

【0347】

ステップＳ１３７では、HDMI(R)シンク６１のレシーバ８１（図２）が、HDMI(R)ソース５３からのゼネラルコントロールパケットのビットCD0,CD1,CD2が表すディープカラーモードの画像の送信画素データが、ピクセルクロックに同期して、TMDSチャンネル#0ないし#2を介して、HDMI(R)シンク６１から送信されてくるのを待って、その送信画素データを受信し、シンク信号処理部８２のFIFOメモリ１２１を介して、分離部１２３に供給して、ステップＳ１３８に進む。

【0348】

ステップＳ１３８では、分離部１２３は、副信号有無判定部１２２からの、送信画素データに副信号が含まれる旨の判定結果に応じて、FIFOメモリ１２１を介して供給される送信画素データから、副信号有無判定部１２２からの副信号割り当てビット数B3だけの下位ビットを分離し、区分副信号として、副信号処理部１２６に供給する。

【0349】

さらに、ステップＳ１３８では、分離部１２３は、FIFOメモリ１２１を介して供給される送信画素データから、残りの上位ビットを分離し、主画像の画素データとして、主画像処理部１２４に供給して、ステップＳ１３９に進む。

【0350】

ステップＳ１３９では、主画像処理部１２４が、１のビデオフィールド分の主画像を再構成するために、分離部１２３からの主画像の画素データを主画像メモリ１２５に供給して記憶させる。さらに、ステップＳ１３９では、副信号処理部１２６が、副信号を再構成するために、分離部１２３からの区分副信号を、副信号メモリ１２７に供給して記憶させる。

【0351】

ステップＳ１４０では、主画像処理部１２４が、１のビデオフィールド分の主画像の画素データの処理が終了したか、つまり、主画像メモリ１２５に、１のビデオフィールド分の主画像が記憶されたかどうかを判定する。

【0352】

ステップＳ１４０において、１のビデオフィールド分の主画像の画素データの処理が終了していないと判定された場合、ステップＳ１３７に戻り、以下、同様の処理が繰り返される。

【0353】
また、ステップＳ１４０において、１のビデオフィールド分の主画像の画素データの処理が終了したと判定された場合、次のビデオフィールドにおいてゼネラルコントロールパケットが送信されてくるのを待って、ステップＳ１３２に戻り、以下、同様の処理が繰り返される。
【0354】
以上のように、HDMI(R)シンク６１（図２）の性能を表す性能情報としてのE-EDIDを受信し、その後、ビデオフィールド（１の垂直同期信号から次の垂直同期信号までの区間）から、水平帰線区間及び垂直帰線区間を除いたアクティブビデオ区間（有効画像区間）に割り当てられたビデオデータ区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する３つのTMDSチャンネル#0ないし#2で、差動信号により、HDMI(R)シンク６１に一方向に送信するHDMI(R)ソース５３では、トランスミッタ７２が、ピクセルクロックの周波数を調整することにより、固定のビット数である８ビット以上のビット数が割り当てられている送信画素データを、３つのTMDSチャンネル#0ないし#2で、差動信号により、HDMI(R)シンク６１に一方向に送信する。
【0355】
この場合において、HDMI(R)ソース５３では、E-EDIDのVSDB（図１７）に基づいて、HDMI(R)シンク６１が副信号を受信することができるか否かが判定され、HDMI(R)シンク６１が副信号を受信することができる場合、トランスミッタ７２により送信される送信画素データよりもビット数が少ない画素データからなる主画像の画素データに、副信号を付加することにより、送信画素データが構成され、トランスミッタ７２により、３つのTMDSチャンネル#0ないし#2で送信される。
【0356】
また、HDMI(R)ソース５３では、垂直帰線区間のコントロール区間（図４）において、その垂直帰線区間の直後のビデオデータ区間に送信される送信画素データに、副信号が含まれるかどうかを表す副信号情報としてのビットSD0,SD1,SD2を含むゼネラルコントロールパケット（図１８）が送信される。
【0357】
一方、E-EDIDを送信し、その後、HDMI(R)ソース５３から、３つのTMDSチャンネル#0ないし#2で、差動信号により送信されてくる画素データを受信するHDMI(R)シンク６１では、レシーバ８１が、３つのTMDSチャンネル#0ないし#2で、差動信号により送信されてくる送信画素データを受信する。
【0358】
さらに、HDMI(R)シンク６１では、垂直帰線区間のコントロール区間（図４）に送信されてくるゼネラルコントロールパケット（図１８）に含まれるビットSD0,SD1,SD2に基づいて、その垂直帰線区間の直後のビデオデータ区間に送信されてくる送信画素データに、副信号が含まれるかどうかが判定され、送信画素データに、副信号が含まれる場合、送信画素データから、副信号が分離される。
【0359】
したがって、主画像の画素データのビット数が、ディープカラーモードによって決まる送信画素データのビット数よりも少ない場合には、送信画素データのビットの、主画像の画素データに割り当てられないビットに、副信号を割り当て、主画像とともに、副信号を伝送するという効率的なデータ伝送を行うことができる。
【0360】
なお、送信画素データのビット数と、主画像の画素データのビット数との差が大であるほど、送信画素データに、データ量が大の副信号（区分副信号）を割り当てることができる。
【0361】
また、本実施の形態では、副信号の用途については、特に言及しなかったが、副信号は

、種々の用途に使用することができる。

【0362】

具体的には、副信号としては、例えば、主画像と同期した低解像度の画像や、主画像と異なる番組の画像、その他の画像を採用することができる。この場合、ディスプレイ４２（図１）では、副信号としての画像を、PinP(Picture in Picture)用の子画面に表示し、あるいはスプリット表示することができる。

【0363】

また、副信号としては、例えば、主画像の表示を制御する制御信号を採用することができる。この場合、ディスプレイ４２では、主画像の表示を、副信号としての制御信号に応じて制御することができる。

【0364】

なお、副信号として、画像（動画）を採用する場合において、その画像に音声が付随するときには、その音声は、送信画素データに割り当てて送信することもできるし、主画像に付随する音声と同様に、データアイランド区間（図４）に送信することもできる。すなわち、HDMI(R)では、データアイランド区間（図４）において、複数の音声チャンネルの音声データの送信をすることができ、副信号としての画像に付随する音声は、主画像に付随する音声データの送信に使用されていない音声チャンネルを用いて行うことができる。

【0365】

次に、上述したソース信号制御部７１やシンク信号処理部８２の一連の処理は、専用のハードウェアにより行うこともできるし、ソフトウェアにより行うこともできる。一連の処理をソフトウェアによって行う場合には、そのソフトウェアを構成するプログラムが、例えば、HDMI(R)ソース５３やHDMI(R)シンク６１を制御するマイクロコンピュータ等のコンピュータにインストールされる。

【0366】

そこで、図２５は、上述した一連の処理を実行するプログラムがインストールされるコンピュータの一実施の形態の構成例を示している。

【0367】

プログラムは、コンピュータに内蔵されている記録媒体としてのEEPROM(Electrically Erasable Programmable Read-only Memory)２０５やROM２０３に予め記録しておくことができる。

【0368】

あるいはまた、プログラムは、フレキシブルディスク、CD-ROM(Compact Disc Read Only Memory), MO(Magneto Optical)ディスク, DVD(Digital Versatile Disc)、磁気ディスク、半導体メモリなどのリムーバブル記録媒体に、一時的あるいは永続的に格納（記録）しておくことができる。このようなリムーバブル記録媒体は、いわゆるパッケージソフトウエアとして提供することができる。

【0369】

なお、プログラムは、上述したようなリムーバブル記録媒体からコンピュータにインストールする他、ダウンロードサイトから、ディジタル衛星放送用の人工衛星を介して、コンピュータに無線で転送したり、LAN(Local Area Network)、インターネットといったネットワークを介して、コンピュータに有線で転送し、コンピュータでは、そのようにして転送されてくるプログラムを、入出力インタフェース２０６で受信し、内蔵するEEPROM２０５にインストールすることができる。

【0370】

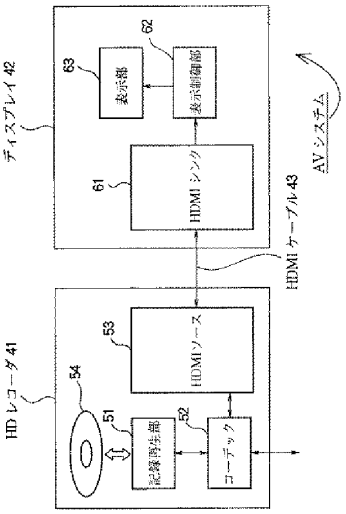
コンピュータは、CPU(Central Processing Unit)２０２を内蔵している。CPU２０２には、バス２０１を介して、入出力インタフェース２０６が接続されており、CPU２０２は、ROM(Read Only Memory)２０３やEEPROM２０５に格納されているプログラムを、RAM(Random Access Memory)２０４にロードして実行する。これにより、CPU２０２は、上述したフローチャートにしたがった処理、あるいは上述したブロック図の構成により行われる処理を行う。

【0371】
ここで、本明細書において、コンピュータに各種の処理を行わせるためのプログラムを記述する処理ステップは、必ずしもフローチャートとして記載された順序に沿って時系列に処理する必要はなく、並列的あるいは個別に実行される処理（例えば、並列処理あるいはオブジェクトによる処理）も含むものである。
【0372】
また、プログラムは、１のコンピュータにより処理されるものであっても良いし、複数のコンピュータによって分散処理されるものであっても良い。
【0373】
なお、本発明の実施の形態は、上述した実施の形態に限定されるものではなく、本発明の要旨を逸脱しない範囲において種々の変更が可能である。
【0374】
すなわち、例えば、主画像の画素データのビット数B1、送信画素データのビット数B2、及び副信号割り当てビット数B3は、いずれも、上述した値に限定されるものではない。さらに、例えば、ビットSuport_30bit,Suport_36bit,Suport_48bitや、ビットSub_2bit,Sub_4bit,Sub_8bit,Sub_Data_Support、副信号情報としてのビットSD0,SD1,SD2等を割り当てる領域も、上述した領域に限定されるものではなく、現行のHDMI(R)において、未使用(Reserved)になっている任意の領域に割り当てることができる。
【0375】
また、本発明は、HDMI(R)の他、受信装置の性能を表す性能情報を受信した後、１の垂直同期信号から次の垂直同期信号までの区間から、水平帰線区間及び垂直帰線区間を除いた区間である有効画像区間において、非圧縮の１画面分の画像の画素データを、ピクセルクロックの１クロックあたりに固定のビット数のデータを伝送する複数のチャンネルで、差動信号により、受信装置に一方向に送信する送信装置と、性能情報を送信した後、送信装置から、複数のチャンネルで、差動信号により送信されてくる画素データを受信する受信装置とからなる通信インタフェースに適用可能である。
【図面の簡単な説明】
【0376】
【図1】本発明を適用したAVシステムの一実施の形態の構成例を示すブロック図である。
【図2】HDMI(R)ソース５３とHDMI(R)シンク６１の構成例を示すブロック図である。
【図3】トランスミッタ７２とレシーバ８１の構成例を示すブロック図である。
【図4】３つのTMDSチャンネル#0ないし#2による伝送の伝送区間を示す図である。
【図5】制御ビットCTL0,CTL1と、データアイランド区間及びコントロール区間との関係を示すタイミングチャートである。
【図6】現行のHDMI(R)のビデオデータ区間において伝送される画像の画素データの伝送のタイミングを表すタイミングチャートである。
【図7】HDMI(R)のビデオデータ区間において３０ビット画像を伝送する場合の画素データの伝送のタイミングを表すタイミングチャートである。
【図8】HDMI(R)のビデオデータ区間において３６ビット画像を伝送する場合の画素データの伝送のタイミングを表すタイミングチャートである。
【図9】HDMI(R)のビデオデータ区間において４８ビット画像を伝送する場合の画素データの伝送のタイミングを表すタイミングチャートである。
【図10】E-EDIDにおけるVSDBのフォーマットを示す図である。
【図11】ゼネラルコントロールパケットのフォーマットを示す図である。
【図12】サブパケットのByte#SB1のビットCD0,CD1,CD2と、ビデオデータ区間に伝送される画像との関係を示す図である。
【図13】ディープカラーHDMI(R)に対応しているHDMI(R)ソース５３の動作を説明するフローチャートである。
【図14】ディープカラーHDMI(R)に対応しているHDMI(R)シンク６１の動作を説明するフローチャートである。

【図15】HDMI(R)ソース５３で決定されたディープカラーモードの画像よりも階調が低い主画像の画素データの伝送を説明する図である。
【図16】送信画素データに対して副信号を割り当てる割り当て方法を説明する図である。
【図17】E-EDIDにおけるVSDBのフォーマットを示す図である。
【図18】ゼネラルコントロールパケットのフォーマットを示す図である。
【図19】サブパケットのByte#SB2のビットSD0,SD1,SD2と、副信号のビット数との関係を示す図である。
【図20】ソース信号処理部７１の構成例を示すブロック図である。
【図21】副信号に含められる副信号関連情報を説明する図である。
【図22】拡張HDMI(R)に対応しているHDMI(R)ソース５３の動作を説明するフローチャートである。
【図23】シンク信号処理部８２の構成例を示すブロック図である。
【図24】拡張HDMI(R)に対応しているHDMI(R)シンク６１の動作を説明するフローチャートである。
【図25】本発明を適用したコンピュータの一実施の形態の構成例を示すブロック図である。
【符号の説明】
【0377】
４１　HDレコーダ，　４２　ディスプレイ，　４３　ケーブル，　５１　記録再生部，　５２　コーデック，　５３　HDMI(R)ソース，　５４　HD，　６１　HDMI(R)シンク，　６２　表示制御部，　６３　表示部，　７１　ソース信号処理部，　７２　トランスミッタ，　７２Ａないし７２Ｃ　エンコーダ／シリアライザ，　８１　レシーバ，　８１Ａないし８１Ｃ　リカバリ／デコーダ，　８２　シンク信号処理部，　１０１　主画像処理部，　１０２　副信号付加部，　１０３　副信号処理部，　１０４　副信号関連情報挿入部，　１０５　副信号受信可否判定部，　１０６　副信号割り当てビット数決定部，　１０７　副信号フレーム情報送信制御部，　１０８　ディープカラーモード決定部，　１２１　FIFOメモリ，　１２２　副信号有無判定部，　１２３　分離部，　１２４　主画像処理部，　１２５　主画像メモリ，　１２６　副信号処理部，　１２７　副信号メモリ，　２０１　バス，　２０２　CPU，　２０３　ROM，　２０４　RAM，　２０５　EEPROM，　２０６　入出力インタフェース

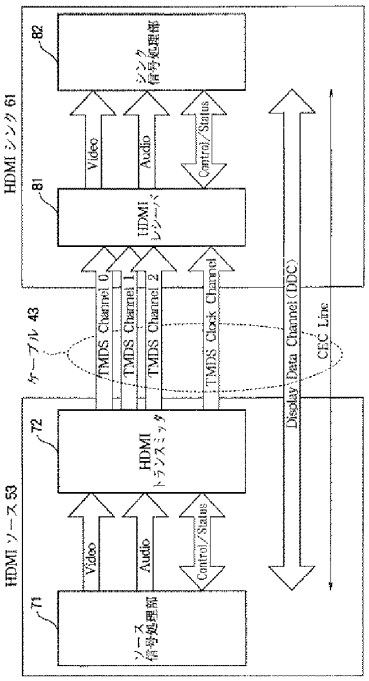
【図1】

図1



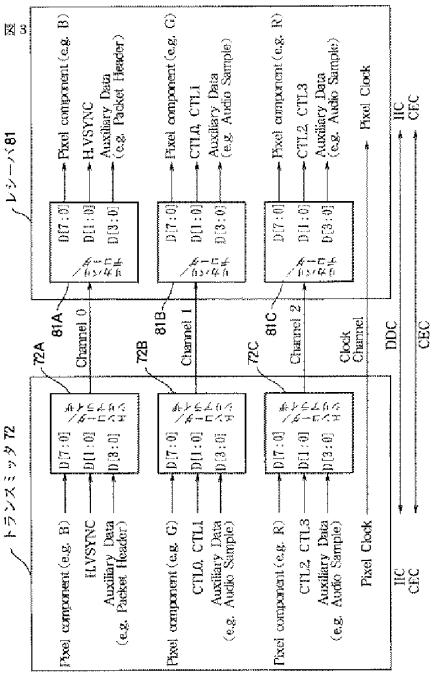
【図2】

図2



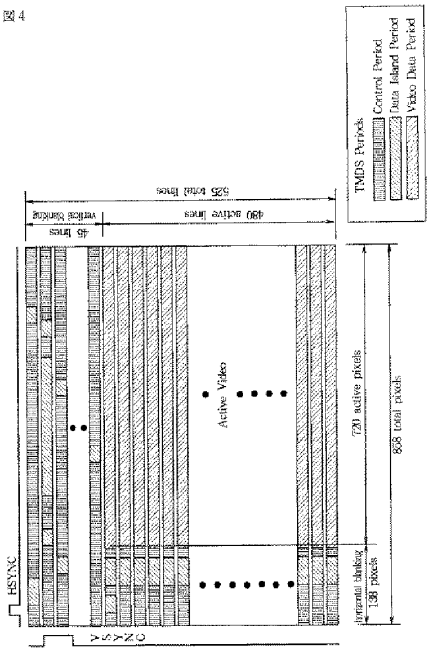
【図3】

図3

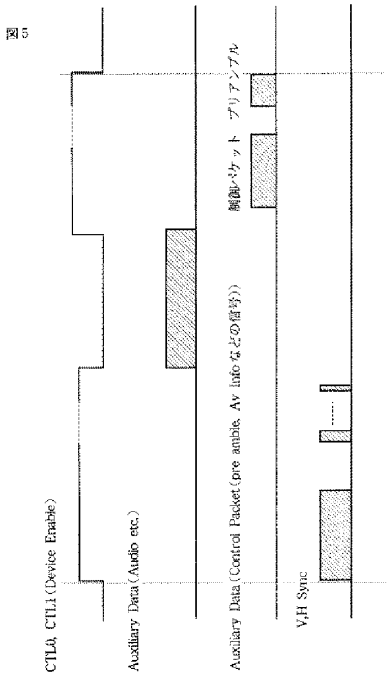


【図4】

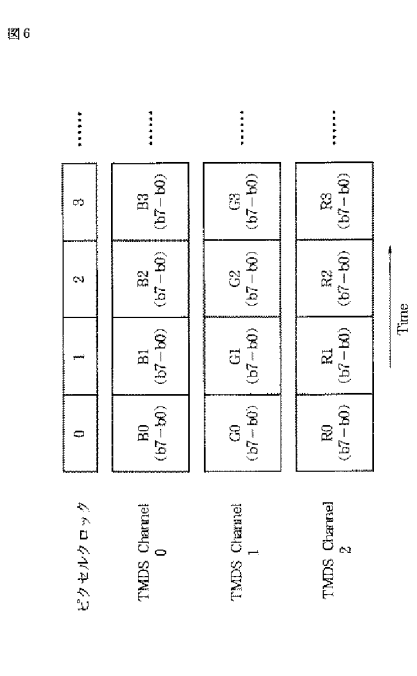
図4



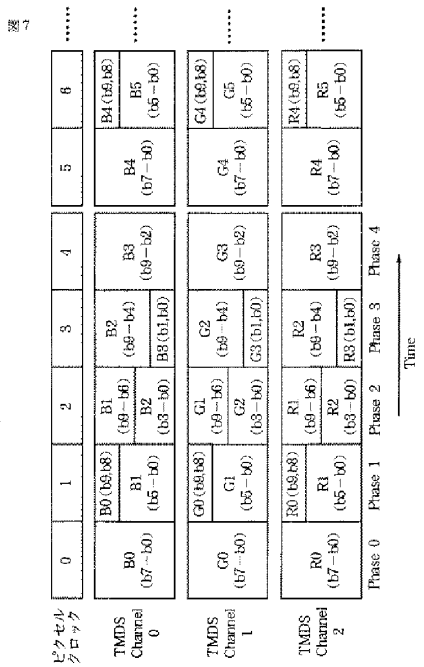
【図5】


図5
CTL0, CTL1 (Device Enable)
Auxiliary Data (Audio etc.)
Auxiliary Data (Control Packet (pre amble, Av info など)の信号))
制御パケット　プリアンブル
V,H Sync

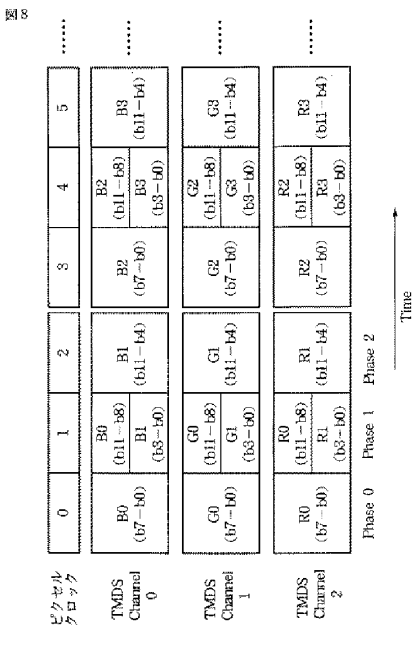
【図6】


図6
0
1
2
3
.....
B0 (b7-b0)
B1 (b7-b0)
B2 (b7-b0)
B3 (b7-b0)
G0 (b7-b0)
G1 (b7-b0)
G2 (b7-b0)
G3 (b7-b0)
R0 (b7-b0)
R1 (b7-b0)
R2 (b7-b0)
R3 (b7-b0)
ピクセルクロック
TMDS Channel 0
TMDS Channel 1
TMDS Channel 2
Time

【図7】

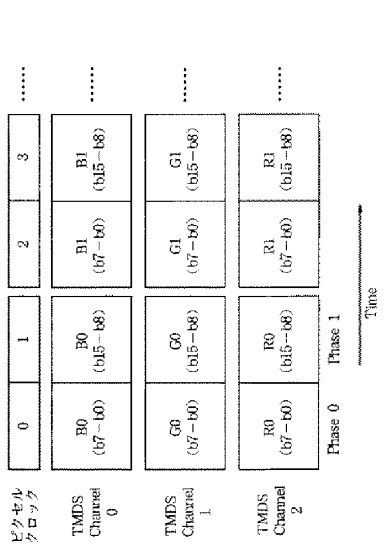

図7
0
1
2
3
4
5
6
.....
ピクセルクロック
TMDS Channel 0
TMDS Channel 1
TMDS Channel 2
B0 (b7-b0)
B1 (b5-b0)
B2 (b3-b0)
B3 (b9-b2)
B4 (b7-b0)
B5 (b5-b0)
G0 (b7-b0)
G1 (b5-b0)
G2 (b3-b0)
G3 (b9-b2)
G4 (b7-b0)
G5 (b5-b0)
R0 (b7-b0)
R1 (b5-b0)
R2 (b3-b0)
R3 (b9-b2)
R4 (b7-b0)
R5 (b5-b0)
B0 (b9,b8)
B1 (b9-b6)
B2 (b6-b4)
B3 (b1,b0)
B4 (b9,b8)
G0 (b9,b8)
G1 (b9-b6)
G2 (b6-b4)
G3 (b1,b0)
G4 (b9,b8)
R0 (b9,b8)
R1 (b9-b6)
R2 (b6-b4)
R3 (b1,b0)
R4 (b9,b8)
Phase 0
Phase 1
Phase 2
Phase 3
Phase 4
Time

【図8】


図8
0
1
2
3
4
5
.....
ピクセルクロック
TMDS Channel 0
TMDS Channel 1
TMDS Channel 2
B0 (b7-b0)
B1 (b3-b0)
B2 (b7-b0)
B3 (b11-b4)
G0 (b7-b0)
G1 (b3-b0)
G2 (b7-b0)
G3 (b11-b4)
R0 (b7-b0)
R1 (b3-b0)
R2 (b7-b0)
R3 (b11-b4)
B0 (b11-b8)
B1 (b11-b4)
B2 (b11-b8)
B3 (b3-b0)
G0 (b11-b8)
G1 (b11-b4)
G2 (b11-b8)
G3 (b3-b0)
R0 (b11-b8)
R1 (b11-b4)
R2 (b11-b8)
R3 (b3-b0)
Phase 0
Phase 1
Phase 2
Time

【図9】

図9



【図10】

図10

Byte #	7	6	5	4	3	2	1	0	
0	Vendor-specific tag code (=3)				Length (=N)				
1	24-bit IEEE Registration Identifier (0×000C03) (least significant byte first)								
2									
3									
4	A				B				
5	C				D				
6	Supports_AI	Supports_48bit		Supports_36bit	Supports_30bit	Reserved (0)			extension fields
7	Reserved								
8,..,N−1	Reserved (0)								
N	Reserved (0)								

【図11】

図11

General Control Packet Header

Byte \ Bit	7	6	5	4	3	2	1	0
HB0	0	0	0	0	0	0	1	1
HB1	0	0	0	0	0	0	0	0
HB2	0	0	0	0	0	0	0	0

General Control Subpacket

Byte \ Bit	7	6	5	4	3	2	1	0
SB0	0	0	0	Clear_AVMUTE	0	0	0	Set_AVMUTE
SB1	0	PP2	PP1	PP0	0	CD2	CD1	CD0
SB2	0	0	0	0	0	0	0	0
SB3	0	0	0	0	0	0	0	0
SB4	0	0	0	0	0	0	0	0
SB5	0	0	0	0	0	0	0	0
SB6	0	0	0	0	0	0	0	0

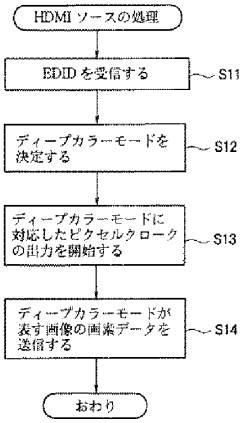
【図12】

図12

CD2	CD1	CD0	Color Depth
0	0	0	Color Depth not indicated
0	0	1	Reserved
0	1	0	Reserved
0	1	1	Reserved
1	0	0	24 bits per pixel
1	0	1	30 bits per pixel
1	1	0	36 bits per pixel
1	1	1	48 bits per pixel

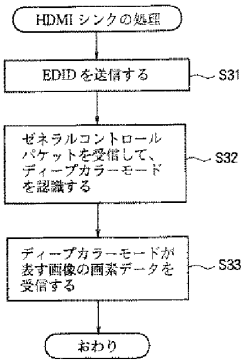
【図13】

図13



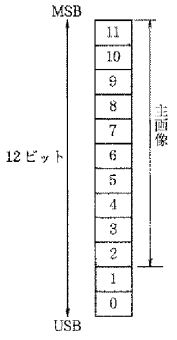
【図14】

図14



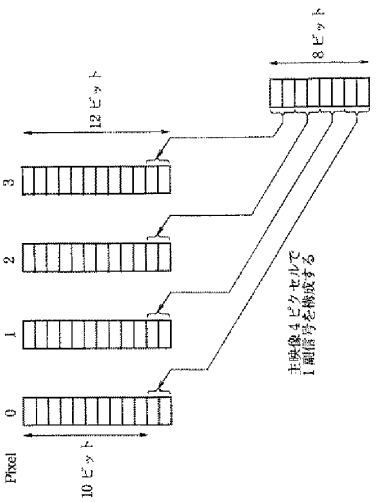
【図15】

図15



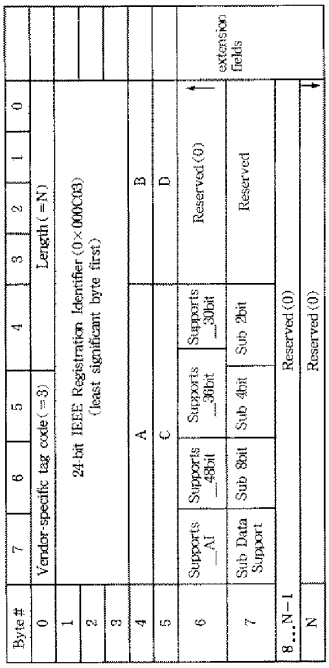
【図16】

図16



【図17】

図17



Byte #	7	6	5	4	3	2	1	0
0	Vendor-specific tag code (=3)				Length (=N)			
1	24-bit IEEE Registration Identifier (0×000C03) (least significant byte first)							
2								
3								
4	A				B			
5	C				D			
6	Supports _AI	Supports _48bit	Supports _36bit	Supports _30bit	Reserved (0)			extension fields
7	Sub Data Support	Sub 8bit	Sub 4bit	Sub 2bit	Reserved			
8…N-1	Reserved (0)							
N	Reserved (0)							

【図18】

図18

General Control Packet Header

Byte \ Bit	7	6	5	4	3	2	1	0
HB0	0	0	0	0	0	0	1	1
HB1	0	0	0	0	0	0	0	0
HB2	0	0	0	0	0	0	0	0

General Control Subpacket

Byte \ Bit	7	6	5	4	3	2	1	0
SB0	0	0	0	Clear_AVMUTE	0	0	0	Set_AVMUTE
SB1	0	PP2	PP1	PP0	0	CD2	CD1	CD0
SB2	0	0	0	0	0	SD2	SD1	SD0
SB3	0	0	0	0	0	0	0	0
SB4	0	0	0	0	0	0	0	0
SB5	0	0	0	0	0	0	0	0
SB6	0	0	0	0	0	0	0	0

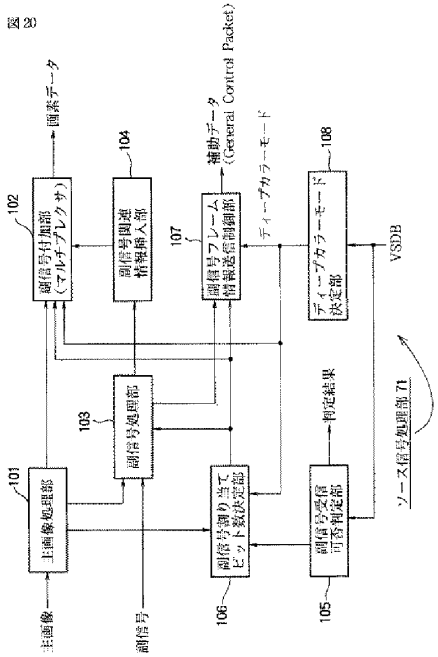
【図19】

図19

SD2	SD1	SD0	Sub Data Bit
0	0	0	Sub Data not Inserted
0	0	1	2 bit sub data
0	1	0	4 bit sub data
0	1	1	8 bit sub data
1	0	0	Reserved
1	0	1	Reserved
1	1	0	Reserved
1	1	1	Reserved

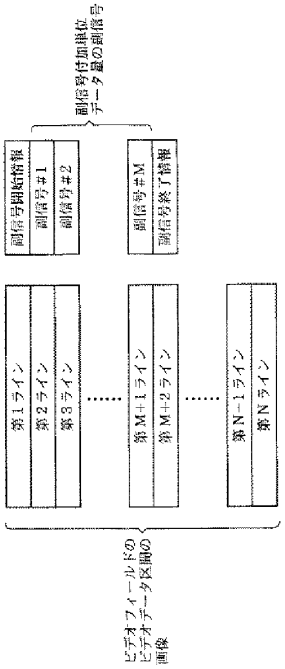
【図20】

図20



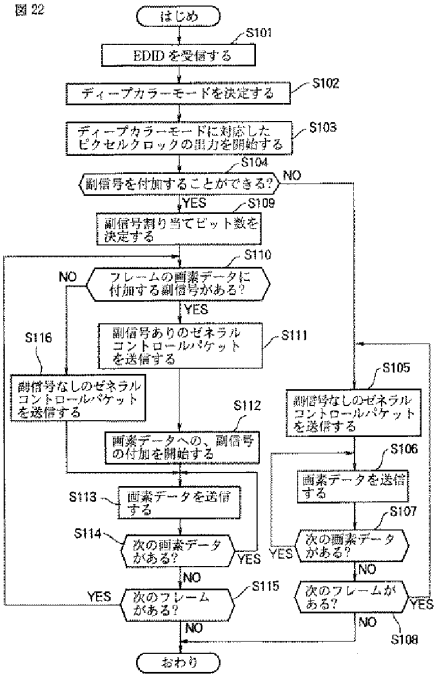
【図21】

図21



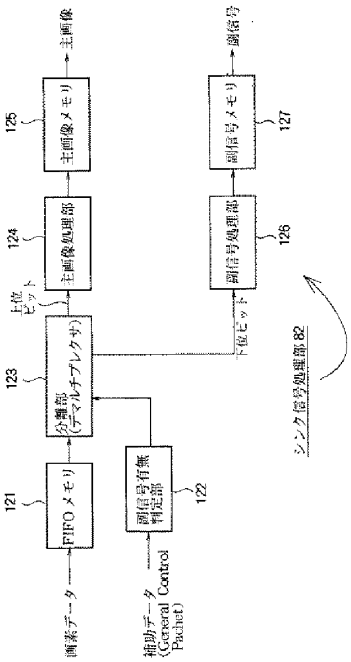
【図22】

図22



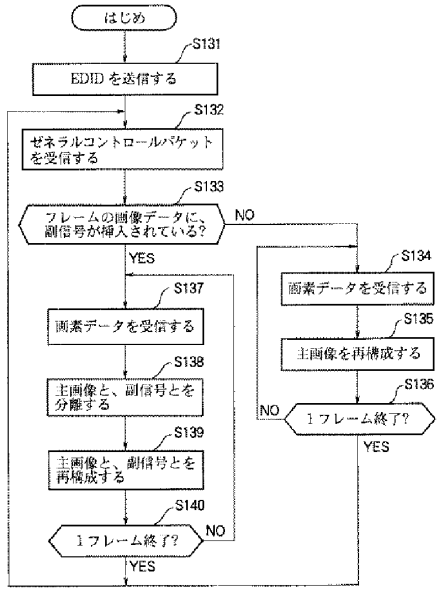
【図23】

図23



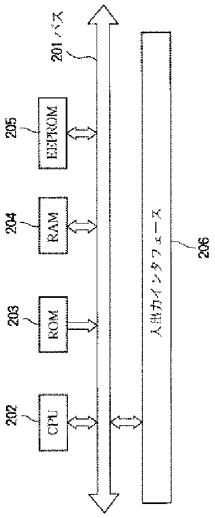
【図24】

図24



【図25】

図25



Espacenet

Bibliographic data: JP2008117289 (A) — 2008-05-22

DATA COMMUNICATION SYSTEM, UNIT AND DATA COMMUNICATION METHOD

No documents available for this priority number.

Inventor(s): KUSAKARI MAKOTO + (KUSAKARI MAKOTO)

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Classification: **- international:** ***G06F13/14; G06F13/38; G06F3/12***
- cooperative:

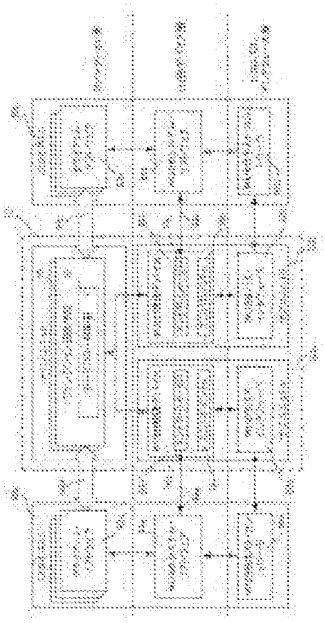
Application number: JP20060301791 20061107

Priority number(s): JP20060301791 20061107

Also published as: JP5030538 (B2)

Abstract of JP2008117289 (A)

PROBLEM TO BE SOLVED: To provide a data communication system, a unit and a data communication method, executing data communication based on the USB specification between an information processor and a peripheral device. SOLUTION: This data communication system 10 comprises a main unit 20 and at least one subunit 50, and executes the data communication with the external device by the USB protocol. The main unit has: a function provision means 40 for providing a function as a USB device; and a data flow control means 46 controlling data transmission with the subunit 50. The subunit 50 has: a USB device provision means 80; a bus interface provision means 82 executing signal transmission with the external device; and a data exchange means with the main unit. ; COPYRIGHT: (C)2008,JPO&INPIT



Last updated: 11.12.2013 Worldwide Database 5.8.15.10; 92p

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DESCRIPTION JP2008117289

[0001]

Universal Serial Bus relates (USB) technology, and more particularly, the data communication system, the present invention relates to a data communication method and a unit for performing data communication according to the USB standard between the peripheral device and the information processing apparatus .

[0002]

Currently, the information processing apparatus personal computers and many other (PC), as an interface for connecting peripheral devices, universal serial bus (USB) interfaces are provided as standard.

In recent years, wireless USB applying the wireless communication technology to the physical layer of the USB (WUSB) standard has been proposed.

[0003]

In USB protocol, the communication between the USB device and the USB host is described using a 3-layer model.

That is, (1) Host USB system, - a USB bus interface layer for controlling a transmission signal physical wireless and wired between devices, in communication with the USB device and (2) USB

host, logical data consists of the function layer that provides communication and logical USB device layer that manages to provide the end point of the transmission, and the client software that runs on (3) USB host, with the function of the USB device.

[0004]

A USB host such as a PC, and USB devices, such as peripherals, and logical communication (in communication buffer as well, located in the second layer) and the communication buffer of the USB host side, the end point of the USB device are connected by a (pipe) path, in the third layer, the function of the USB device and the client software of the USB host, the logic via (constituting the interface) configured pipe bundles from at least one pipe performs a communication, the various device functions of the peripheral devices are provided to the USB host.

[0005]

Further, the USB host is connected one-to-many and multiple USB devices via a hub, the data transfer on the bus is controlled by the USB system software corresponding to the second layer of the USB host.

Because it uses a centralized control type according to the USB host, USB device was not able to be controlled by the USB host in single be shared simultaneously by a USB multiple hosts.

[0006]

Since the convenience is improved and can be shared USB hosts multiple USB devices, for example, JP 2004-295407 Patent Publication (Patent Document 1), the host PC a plurality of connected upstream connector , discloses a USB hub device having a selector for switching the connection state monitoring CPU for monitoring based on the priority status of a host connecting to the downstream side connector from the connection state monitoring CPU.

[0007]

However, in the prior art described above, monitors the connection state of the upstream port, to

determine the power of the host device whether the a or suspended (not connected) or off, and the downstream ports and the upstream port is intended for switching an electrical connection, not a USB device that is recognized by the USB logically multiple hosts simultaneously, it is not satisfactory in terms of convenience.

Japanese Patent Publication No. 2004-295407

[0008]

The present invention, which was made in view of the prior art described above, performs the processing is recognized and connected to the USB host of the plurality, in response to a request from the USB host of the plurality of data flows having high flexibility of the USB device between and it is an object of the invention is to provide a data communication system, data communication method and a unit that provides.

[0009]

Further, the data communication system, object of the present invention, a data communication method and a unit that can be made to function as a relay for USB by a simple operation, to enable data flow control with high degree of freedom of the USB device between It is intended to provide.

[0010]

In order to solve the above problems, the present invention provides a radio main unit comprising a function providing means for providing a function as a USB device and the USB host, USB devices and providing means provides a logical communication path with an external device or to adopt a structure consisting of subunits comprising a USB bus interface provides means for performing the substantial communication with an external device by wire, and the data communication system.

It is connected electrically and logical sub-unit at least one from the external apparatus connected to each subunit, the main unit via a logical communication path provided by the USB device providing means for each subunit and is connected to Te.

The main unit, to identify the sub-unit, the main unit - data transmission between the subunits through the main unit or sub-unit is controlled by the data flow control unit.

[0011]

With the above configuration, for example, the main unit comprising a device function is able to be connected to an external device as a USB host plurality of through subunit and recognized logically by each external device simultaneously .

The main unit to determine the source of the request by identifying the sub-unit, and executes processing in response to a request from each subunit, the main unit enables the sharing of the device capability by a plurality of external devices be.

Further, it is possible by the structure for controlling the data flow between the main unit and the sub units, and also serve as a relay for providing a variety of connection modes of the external device between the connected subunits .

[0012]

That is, according to the present invention, the main unit is composed of subunits of at least one, there is provided a data communication system for performing data communication using the USB protocol with the external device, the main unit is a function of the USB device includes functions and providing means for providing the data flow control unit for controlling data transfer between said sub-units by identifying the sub-unit, the sub unit, perform signal transmission with the external device includes a bus interface providing means for, USB devices and provide means for receiving the arbitration by the data flow control unit, and a data exchange means and said main unit, data communication system is provided.

[0013]

Providing endpoints for establishing a logical communication path with the external device as a USB host, the data exchange unit, the USB device providing means, the data exchange between the main unit and the endpoint it is possible to perform.

Also identifies the sub-units of the source or destination of the data, said data flow control means

controls the data transfer between the sub-units in response to an external command or the processing request from the external device I can be.

[0014]

Further, according to the present invention, there is provided a main unit which includes a slot for one subunit, and execute data communication according to the USB protocol with the external device, at least, the main unit, functions as a USB device The main unit includes a function providing means for providing the data flow control unit in response to an external command or the processing request from the external device, for controlling data transmission between the sub-units are provided.

[0015]

The main unit can be disposed at a distance from each other said plurality of slots.

[0016]

According to the present invention, is mounted on the main unit to provide a function as a USB device, and a sub-unit which is capable of performing data communication using the USB protocol with the external device, wherein the sub-unit of said external device includes a bus interface provides means for performing signal transmission, and USB devices and providing means, and means data exchange with the main unit, sub-unit is provided.

[0017]

Providing endpoints for establishing a logical communication path with the external device as a USB host, the data exchange unit, the USB device providing means, the data exchange between the main unit and the endpoint it is possible to perform.

Further, the sub-unit may comprise a data flow control unit in response to an external command, which controls the data transmission between the main unit.

Further, the sub-unit may comprise a directional antenna.

The subunits may include instruction means for accepting an external command for switching the data flow.

[0018]

According to the present invention, further comprises a data communication system and a one subunit, and a data communication method according to the USB protocol with the external device and at least the main unit, the data communication method, and the sub unit and establishing a logical communication path with the external device, comprising the steps of: via the logical communication channel to transfer the data according to the USB protocol, distinguishably the subunit, the main unit and the sub unit and executing the exchange of the data with the data communication method is provided.

[0019]

The data communication method may include performing a request process in response to the data, and a step of in response to an external command or the request processing, control the exchange of the data.

[0020]

Hereinafter, will be explained with reference to the embodiment shown in the drawings but the invention is not intended to be limited to the embodiments shown in the drawings.

[0021]

Figure 1 is a block diagram illustrating an embodiment of a hardware configuration of the data communication system comprises 10 includes a main unit and the sub unit.

Note that the data communication system 10, FIG 1 illustrates an embodiment in which it functions as an image forming apparatus.

A main unit 20, data communication system 10 is configured comprising a sub-unit A50a, and a subunit B50b.

Includes a CPU22, a ROM24, a memory 26, are interconnected by an internal bus 38, respectively, the main unit 20 executes a job by the user command.

Into the memory 26 from the storage device 32 NVRAM and ROM24, EEPROM, EPROM, such as a hard disk processing program, expand, CPU22 executes the processing for the job that was commanded.

[0022]

A display unit 30 and the operation unit 28, display unit 30 and the operation unit 28 is connected via an internal bus 38 to the CPU22 respectively, the main unit 20 provides a user interface.

The main unit 20 and the subunit 50, which is constituted by containing the (I / F) 36 interface connected to the internal bus 38 is further connected via a configured connection bus 12 as the parallel bus and a serial bus I have to manage the input and output.

USB host to communicate with the sub-unit 50 (hereinafter, regardless of the protocol of the wired and wireless, the printer 34 is referred to as a USB host and external device as a USB host protocol.

And provides a device function to the USB host that receives via the interface 36, and executes the device processing as an image forming apparatus under the control of the CPU22, and printing process, and to communicate the request from).

That is the main unit 20 provides the hardware and processing software for executing the functions corresponding to the layer in the WUSB protocol, device capabilities.

[0023]

Subunit A50a is provided with a controller 52, a memory 54, and a wireless communication unit 56, are connected by an internal bus, respectively, the USB host A, wireless USB, which is based UWB (Ultra Wide Band) communication protocol I have established a communication link conforming to the protocol.

Is connected to the antenna 64, the wireless communication unit 56 is configured comprising a physical layer comprising a UWB radio frequency circuit (UWBRF PHY) 62, a physical layer comprising a UWBBaseBand circuit and (UWB BB PHY) 60.

Performs modulation and demodulation of signals mainly, UWB-RF physical layer 62 performs and waveform shaping of the high frequency signal, these multi-band OFDM UWB-BB physical layer 60, (Multi-bandOrthogonal Frequency Division Multiplexing) system or IEEE802 DS-UWB, such as (Direct Sequence UWB).

And configure the physical layer according to a communication protocol that is compliant with such 15TG3a.

[0024]

It consists comprise NVRAM58, the NVRAM58, stores a connection context for performing wireless USB communication with a USB host, to identify the destination USB host, subunit A50a is, when the encryption and decryption process of the communication data I used to.

It buffers the data transmission from the main unit 20 and the USB host A to connect to, memory 54 of the subunit A50a provides an endpoint in the USB protocol.

Also included in the memory 54, and various setting information device address assigned by the USB host A, such as unit identification value assigned from the main unit 20 is stored.

[0025]

Includes a (Media Access Control) layer 66 MAC, the controller 52 performs control corresponding to the data link layer of the WUSB protocol with the connected USB Host A.

In other words, sub-unit 50 provides the hardware processing and software processing WUSB bus interface layer in the WUSB protocol and corresponding to the WUSB logical device layer.

Further, it is connected to a controller 52, an interface 68 which is connected to the main unit 20 via the connection bus 12, and controls the data transmission with the main unit 20.

[0026]

Further, subunit B50b the other is connected to the main unit 20 is also the same configuration as subunits A50a, is connected via the main unit 20 also interfaces with the USB host B, and performs wireless USB communication.

From the USB host to connect to, device address is assigned independently of each other, from the main unit 20, sub-unit and 50b subunit A50a is identified unit identification value only is assigned.

The number of sub-units 50 connected to the main unit 20 is not particularly limited.

Also shown is the embodiment according to WUSB communication in the above description, in other embodiments, the USB1 wired. USB2 and x.

Physical layer that complies with the standards of 0 and it is configured with a MAC layer may have a wired connection and a USB host and the subunit 50.

[0027]

FIG 2 is a block diagram illustrating an embodiment of a functional configuration of a data communication system constituted 10 and a main unit and the sub unit.

A main unit 20, data communication system 10 is configured comprising a sub-unit 50a, and a sub-unit 50b.

The main unit 20 provides a device function to the USB host includes a function providing unit 40 with at least one will communicate.

[0028]

A processing unit 41, function providing unit 40 is configured and a data flow control unit 46.

Is performed and arbitration of a collision of the processing request from the USB host of the plurality of request via the sub-unit 50, the data flow control section 46, sub-unit - for controlling the flow of data between the main unit.

In response to the processing request from the USB host, the processing unit 41 executes various processes such as printing process as the image forming apparatus.

The unit identification value for identifying the sub-unit 50 are connected, is stored and managed in the unit identification value storage unit 48.

[0029]

Includes a job queue storage unit 44 for managing the processes waiting for execution, the data flow control section 46 receives a processing request from the USB host via a sub-unit 50, the job function providing unit 40 (processing request as a set and a unit identification value assigned to the requesting sub-unit and 50), for example, to an entry in the job queue on a first come, first served basis of processing requests.

The data flow control section 46, the order of entries, was obtained from the subunit 50 and data necessary for processing, receives data from the data flow control unit 46, the processing unit 41 executes the processing order of entries in the job queue.

For example, in a preferred process will be received and printing process, the print data string, during reception of the print data string to complete, the data flow control unit 46, the subunits 50 of the job in progress It may be a control to be executed with priority buffering read and print data.

Further, in other embodiments, executing a print job from the USB host and the other may be a data flow control reporting that work is being done to the USB host other.

[0030]

As a device capability of the main unit 20, for example, in other embodiments that provide storage functionality capable of random access, (as a fragment of the file) the data from the sub-unit 50 both the data read each request and write request The entry in the job queue in sequence, sequentially, to read the data from the sub-unit 50 Nde, it may be a control to be passed to the sub-unit 50 reads from the storage device or write, in a storage device such as HDD or flash memory.

[0031]

In still other embodiments, the device capability of the main unit 20, in the case of providing an output interface features such as a display or a speaker, or arrival order of the request, the USB host that is specified by the operation unit 28 and the USB host, the exclusive it may be a control that is used automatically.

In yet another embodiment, the device capability of the main unit 20, in the case of providing an input interface features such as a keyboard, in response to polling from the USB host to communicate with each sub-unit 50, the notification (interrupt transfer mode status it may be a control to be).

It is not limited particularly, the method of data flow control and arbitration processing of the processing request from the USB host of the plurality may be employed a method according to the device capability of providing.

[0032]

Further, in the exemplary embodiment shown in FIG 2, is constituted comprising a device information storage unit 42, enumeration and USB host to communicate with each subunit 50 function providing unit 40 of the main unit 20, the (connection start During the initial setting), to store information for establishing the USB communication by notifying each USB host device information of itself.

Such information, there is a device descriptor, configuration descriptor, interface descriptor, and endpoint descriptor, it is a device information that is used by the USB protocol.

[0033]

Meanwhile, a setting storage unit 70, a data exchange unit 72, the subunit 50, which is connected to the main unit 20 is configured comprising an end-point portion 74.

Setting storage unit 70 stores a device address assigned by the USB host to connect to, the unit identification value assigned from the main unit 20.

Endpoint zero 76 used in the control control communication, (n represents a natural number, transmission and end-point 74, end point n for sending and receiving data messages and the other

end including a plurality of receiving from a point.

A and a) 78.

Each sub-unit 50 is provided, provided the storage area of the memory 54 RAM FIFO (Random Access Memory) or the like (First In First Out), endpoint n78 and endpoint zero 76, communicates with the main unit 20 I temporarily buffers the data to be transmitted between the USB host of other party.

The identification number is assigned to each endpoint.

[0034]

Endpoint n78 and endpoint zero 76, serves as the end point of the data transmission from the USB host, USB host, perform the transfer of messages and data by specifying the endpoint number and device address.

On the other hand, the function providing unit 40 of the main unit 20 also transmits and receives messages and data by identifying the endpoint number.

Thus, through the endpoint, client software USB host performs the logical communications with the function providing unit 40 of the device.

It should be noted that, in general, logical communication path by the ties of logical endpoint buffer and the USB host on, is referred to as a pipe.

[0035]

Data exchange unit 72, unit identification value stored read, in the setting storage unit 70 and data messages to be buffered in each receiving endpoint of 74 endpoint section when it receives messages and data from the USB host and executing the control of the process by attaching the control data is transmitted to the main unit 20.

When the data transfer is successfully completed, and transits to a receivable state again the endpoint.

Also receives the messages and data from the main unit 20, a data exchange unit 72 performs a

write process for sending the specified endpoint of the end point 74.

The read by the control of the controller 52, messages and data written to the transmitting endpoint is transferred to the USB host.

[0036]

FIG 3 is a diagram illustrating an embodiment of a data structure unit identification value information stored in the main unit, the setting information and stored in the sub-units.

In (a), shows an embodiment of a unit identification value information stored in the main unit 20 FIG.

In the embodiment shown in Figure 3 (a), the unit identification value information 100, USB devices or USB host and field 100b and the item fields 100a, the entry unit identification value, the USB device is connected to each subunit includes the connection type field 100c to entry or.

[0037]

Records of the mounting slots for sub-unit mounting included in the main unit 20 is provided, and Yuki entered in the mounting order of the unit identification value, the sub-unit 50 whether or not it is attached to the mounting slots, and is mounted and manages the identification value when you are.

For example, it is possible during the arbitration process request, is used as a priority, the unit identification value.

The presence of the field 100c type of subunit registers the device or connection type host or connection type is optional, required necessarily be sub-units to be connected to the USB host is attached is in the system configuration of the premise does not.

[0038]

In (b), shows an embodiment of the setting information stored in the sub unit A50a FIG.

In the illustrated embodiment, the setting information 110 is constituted by containing a field 110b in which a field 110a for entry unit identification value, the device address assigned by the USB host in communication with the sub-unit A50a is registered Ru.

Further, field 110b is to be determined can be used to determine the communication with the USB host is whether or not established, if there is an entry of the device address, the communication with the USB host is established possible.

[0039]

In (c), shows an exemplary embodiment of the configuration information stored in the subunit B50b, also includes a field 120a for entry unit identification value, and a field 120b of device address is registered in FIG.

And subunit A50a, and subunit B50b, device address is assigned independently from the USB host of each communication partner, each USB host to communicate with each subunit has identified the communication partner by the device address .

On the other hand, a sub-unit A50a, the subunit B50b, the main unit 20, unit identification values only is applied in the main unit 20, is identified.

[0040]

FIG 4 is a flow chart illustrating an embodiment of the recognition process of the sub-units in the main unit.

First, in step S100, and start receiving power supply from (for example, a wired USB) bus lines and power on the main unit 20, to start the process.

In step S101, the monitoring and load on the power line to the subunit, and attempt to detect new mounting of the sub-unit 50, in step S102, the main unit 20 makes the determination novel mounting of whether or not the detected .

If the determination in step S102, the new attachment is not detected, and by looping back to step S101, and waits for a new attachment.

[0041]

On the other hand, branches to step S103, by assigning a unit identification value to the sub-unit 50 is connected, if the determination in step S102, detects the mounting of the new sub-unit 50, the main unit 20, unit identification value The entry to the information 100, performs initial setting of the sub-unit 50, allowing the logical communication with each endpoint.

Since the initial setting is completed, at step S104, the communication is enabled between the subunit 50 and the main unit 20.

[0042]

Following, I will explain when the USB host is connected to the sub-unit and the main unit, the control flow of the device initialization.

FIG 5 is a flowchart illustrating an exemplary embodiment of (enumeration) device initialization subunits and the main unit, the USB host.

In the embodiment shown in FIG 5, it is assumed a state in which a sub-unit 50 and the main unit 20 is connected electrically and logical already.

[0043]

In step S200, for example, control shown in Figure 5, the process starts by receiving a connection command is issued in response to an instruction from the operator from the operation unit 28 of the main unit 20.

In step S201, sends a connection request towards the USB host, receive the response, at step S202, the sub-unit 50 performs mutual authentication by starting the security enumeration.

In step S203, in response to commands GET_DISCRIPTOR from the USB host, and notifies the USB host various descriptors stored in the device information storage unit.

[0044]

In step S204, in response to a request for setting the device address from the USB host, the sub-unit 50 stores the device address to the setting storage section 70 of its own.

In addition, in response to the command, such as SET_CONFIGURATION and SET_DESCRIPTOR from the USB host, the main unit or subunit Make the required setting process will be up and running as a USB device in step S205.

Then, in step S206, the I want to start the data communication with the USB host.

Note, the enumeration of which is described above, the host - the communication of the data communication between systems, using default pipe is a logical communication path of the control consisting of the control endpoint zero 76 of each subunit 50 It is possible to do in.

[0045]

Figure 6 shows an embodiment of a data structure of a communication packet transmitted by the communication between the main unit and the sub unit.

And field 130a to entry the unit identification value, and field 130b to entry end-point number, the inter-unit packet 130, field to entry the data to be exchanged between the function of the main unit 20 and the client software of the USB host a and a 130c.

Between the main unit 20, and each sub-unit 50, the inter-unit packet 130 is replaced, the sub-unit is identified by unit identification value, the interface of the function providing unit 40 is identified by the endpoint number.

Note, as long as it is possible for the main unit 20, to identify the subunit to send also the source, communication with the sub-unit 50 and the main unit 20 may be implemented in any method or structure.

[0046]

Following, I will describe the data flow in a USB system by sub-unit and the main unit.

General configuration of USB system including a sub-unit and the main unit, and a USB host two, and Figure 7 is a schematic diagram illustrating an embodiment of a data flow in the USB system.

In the embodiment shown in FIG 7, USB system is formed with the data communication system 10, includes a USB host A90a, and a USB host B90b.

Is constructed and a sub-unit 50b and sub-units 50a and the main unit 20 is connected to the main unit, subunit A50a communicates with USB host A90a, data communication system 10 includes a USB host B90b subunit B50b I have done a communication.

[0047]

The main unit 20 is configured comprising a function providing unit 40 for providing the device function corresponding to the function layer in the USB protocol in the embodiment shown in FIG.

Each sub-unit 50, is composed of and a (bus interface providing means) 82a WUSB logical device corresponding to the USB device layer and (USB device providing means) 80a, WUSB bus interface that corresponds to the USB bus interface layer have.

WUSB bus interface 82 of each sub-unit 50, running a substantial communication by wireless communication with the USB host 90.

WUSB logic device 80 is configured comprising an endpoint zero 76 used in the control for controlling the communication, and an end point n78 for sending and receiving data and other messages.

[0048]

WUSB bus interface 82, a control for decoding the packets of the transaction group, including handshaking or token sent from the USB host 90 of the destination responds to the USB host 90 handshakes and NAK or ACK if necessary run.

The writing, WUSB bus interface 82, transmission or endpoint endpoint zero 76 to the end point n78 for reception and endpoint zero 76, the data that is included in the transaction group from the USB host 90 to connect to I have done data transfer in accordance with the schedule managed reading, by the USB host 90 the data stored in the n78.

[0049]

Is electrically connected via a connecting bus 12 and the subunit 50, the function providing unit 40, via a connection bus 12, the main unit 20 performs data exchange with each endpoint of each sub-unit 50, I want to run the process of reading from the receiving endpoint n78 reading and writing of the endpoint zero 76, and writing, to the sending endpoint n78.

[0050]

The configures the interface endpoint n78 used for the same purpose some by gathering, for example, when the main unit 20 to provide a printer function, the function providing unit 40 for providing the printer function, is configured including an interface for printing control for the interface of the print data receiving, USB host 90 performs data transfer with the interface in response to the request process.

[0051]

On the other hand, each USB host 90 is constructed includes the client software 92 that corresponds to the function layer, and WUSB system software 94 that corresponds to the USB device layer, and a USB host controller 96 corresponding to the USB bus interface layer .

Controls the transaction group and the sub-unit 50, a WUSB bus interface 82 of the sub-unit 50, USB host controller 96, to perform the exchange of data and messages.

[0052]

USB system software 94 is composed of a (memory 26 buffers the USB host.

And manages the (pipe) logical channel and each end point of the sub-unit 50), and using the default pipe 84 is a logical connection control for the control of the endpoint zero 76a of the subunit 50 Te, you are managing a device functions subunit 50 and the main unit 20 is provided.

[0053]

By using a pipe bundle 86 which is associated with the set of endpoints subunit 50, the client software 92 manages the interface of the main unit 20.

In order to use the device capability, I / O request packet by (IRPs), client software 92, a data transfer request between the buffer 90 on the USB host, and each endpoint connected subunit 50 is performed, and executes communication with the function providing unit 40 of the main unit 20 makes use of the device capability.

[0054]

That is, the client software 92 of each USB host 90, the function provides a data transfer with an endpoint n78 of subunit 50 connecting, and end point n78 Connections Can electrical and logical sub-unit 50 and the main unit 20 It is possible by the communication unit 40, access to the function providing unit 40 of the main unit 20 utilizes the device capability.

In that case, to identify the requestor by unit identification value, based on the job management by the data flow control unit 46, the function providing unit 40 that executes the request process, and provides to the USB host 90 device functions is made possible.

Hereinafter, embodiments of the job management in the data flow control unit 46 will be described with reference to the data structure of the job management data.

[0055]

FIG 8 is a diagram illustrating an embodiment of a data structure of the job management data to be used for data flow control and arbitration processing of request processing in the data communication system.

Note that the data communication system 10, FIG 8 illustrates an embodiment in which it functions as an image forming apparatus, and executes the printer process.

In the embodiment shown in FIG 8, the job management data 140 includes includes a field 140a for entry job number, a field 140b for entry unit identification value, and a field for entry waiting jobs.

[0056]

For example, receives the request processing such as printing request, to the job management data 140 which is managed by the job queue storage unit 44, data flow control section 46 of the function providing unit 40, slide into the job entry number order.

It looks up the job management data 140, the order of entries in the job management data 140, and acquires first data required for request processing, while monitoring the working state of the processing unit 41, a data flow control unit 46 includes a processing unit l pass data and processing requests to 41.

Iki running jobs received, the processing unit 41 returns a processing response to the data flow control unit 46 as needed.

Data flow control unit 46 executes the process of moving down the job number and other entry Delete an entry with the completion of the job.

[0057]

In the example shown in FIG 8, the USB host A90a in communication with the sub-unit 50 unit identification value of [1], receives a print request, the job number of the job management data 140 in [1] and the "print job 1" has been entered.

In accordance with the job management data 140 in order to reads the print data from the sub-units 50 units identification value [1], by acquiring data from an endpoint, the data flow control section 46 instructs to start printing process to the processing unit 41 be.

Print job 1 from the sub-unit 50 unit identification value of [2] received it since it began processing job number [1], and the print job 2 from the sub-unit 50 unit identification value of [1], job management After you get all the print data entered in the lower data 140, used during the execution of the print job 1 job number [1], go and processed sequentially started.

[0058]

While the data acquisition related to the job-level is performed first, and waits for the read process from the data transfer end-point of 50 subunits of the other.

The data acquisition sub-unit 50 and the other may be made to the sub-unit 50 during data acquisition, and control to preferentially use the bus connection.

The sub-unit 50 waiting, you are control to the USB host that is sending the data transfer request, it responds a handshake negative and NYET and NAK, is waiting for data transmission from the USB host.

[0059]

A main unit 20 connected to the sub-units 50 of a plurality of a function unit of the logical device layer, the arrangement comprising means for identifying the sub-unit, for controlling the flow of data between units and the request processing performed, as a USB device makes it possible to be recognized as a USB logical device at the same time to the USB host and run multiple request processing by identifying the USB host requesting convenience as a USB device and the data communication system 10, the data of the USB device between It is possible to improve the flexibility of the flow.

When this, but it does not require modification of the hardware and processing software of the USB host side.

Further, even if a structure having a data flow control unit, a processing request from the USB host collision of plural, make it possible to execute the request processing from the USB host smoothly, and the convenience of a USB device it is possible to improve the sex.

[0060]

Further, it becomes possible by a structure which is separated into a sub-unit 50 and the main unit 20, that, depending on the use environment, it is mounted using a different a subunits wireless communication subunits wired connection, additional make it possible to reduce a construction (for which corresponds to the connection of both the cable and cable, for example) component structure.

[0061]

Above, the data communication system 10 consisting of the sub-unit 50 and the main unit 20, the embodiments have been described in the case of functioning with only a USB device.

However, in other embodiments, the data communication system 10 can also be configured as a (simultaneously function as both a USB host and the USB device ie) dual role device that conforms USBOTG to (USB On The Go) Standard , it is possible to provide data flow between USB devices flexible further.

At this time, the sub-unit 50 may be configured to include a host controller for to act as a USB host or OTG controller executes a control for operating as a USB host and the USB device.

Following, I will explain between the main unit and the sub unit, for more flexible data flow control.

[0062]

In Figure 9, the main unit 20, a sub-unit A50a in communication with the USB host, USB device (hereinafter, regardless of the protocol of the wired and wireless, is referred to as a USB device and the external device as a device of USB protocol.

Schematic configuration of an embodiment of a data communication system 10 including a subunit B50b in communication with) is shown.

In the embodiment shown in FIG, data communication system 10 is configured comprises a main unit 20, a sub-unit A50a in communication with the USB host, and a subunit B50b in communication with the USB device.

The main unit 20 is configured comprising a function module 43 for implementing the functions of the unit function layer.

Each sub-unit 50 includes includes a USB bus interface module 83 that implements the functions means of the USB bus interface layer, and a USB device module 81 to achieve a functional means of the USB device layer.

[0063]

A bus route selection unit 160, a normal mode in which the sub-unit 50, the function module 43 of the main unit 20 to communicate, the main unit 20, USB bus interface of the sub-unit 50 in the

embodiment shown in FIG- thus enabling that the module 83 to each other are connected, and performs the switching of the bridge operation mode that functions as a relay.

Accepts a switching instruction of the bridge operation mode Normal mode, in response to the instruction from the operator, an operation unit 28 issues a path switch request to the path management section 29 and the operation panel of the main unit 20.

Issue the path switching instruction to the bus route selection unit 160, route management unit 29 that received the request, switching the bridge operation mode and normal operation mode.

That is, the path management section 29 functions as means for controlling the inter-subunit through the main unit 20, a data flow between logical addition, the subunits 50 and the main unit 20.

[0064]

Because the bridge operation mode, it is not preferable USB device between USB or between hosts is connected, the judgment of whether or not the USB device both subunits B50b subunits A50a you want to connect to, or USB host, both it may be controlled if carried out, it is determined that the combination of a USB device and the USB host, performs a process for switching the bridge operation mode.

For example, such determination may be determined by using a unit identification value information 100, for the entry field 100c, and a "true" USB host, and calculates the exclusive OR as a "false" the USB device It is possible, it is possible to determine in any way.

[0065]

In the embodiment shown in FIG 9, a bus line 150 connecting the main unit 20 and the USB bus interface module 83 of each sub-unit 50, a bus connection between the sub-unit 50 and the main unit 20, USB devices and modules formed and a bus line 152 connecting the main unit 20 and 81.

Inside, the bus lines 156, bus the bus lines 152 and bus line 150 is connected to the bus route selection unit 160, also connected to the bus route selection unit 160, a bus line 156 which is connected to the function module 43 and includes a switch 158d and 158a switches for switching the connection to the bus line 152b and the line 152a.

Further, the bus route selection unit 160 includes a bus line 156 for connecting the bus line 150 to each other, and a switch 158c and the switch 158b for switching the connection.

[0066]

The switch switch 158a ~ 158d, in the normal operation mode, switch 158d and 158a switch is turned on, switch 158c and 158b switch is turned off.

In bridge mode of operation, switch 158d and switch 158a is turned off and the switch 158c and 158b switch is turned on.

[0067]

The bridge operation mode, it is possible to function as a hub or repeater in the sub-units together with a USB connector for wired connection, and to extend the connection distance.

In connection with the sub-unit with a WUSB antenna for wireless connection with the sub-unit with the USB connector of the wired connection, acts as a media converter, such as a device wire adapter and a host wire adapter, wireless and wired In the use environment that is mingled, it is possible to improve the degree of freedom of data flow between the USB device and further.

The sub-units together with a WUSB antenna for wireless connection, it is possible that it functions as a relay, to extend the communication range of a wireless USB connection.

[0068]

In the above has described the operation of the bus path is selected with an embodiment of the structure of a main unit which is connected to the two subunits, but may, in those skilled in the art even if it is connected to the sub-units of more than two It will be be easily extended as long.

To connect the sub-units of more than two, and one subunit that communicates with the USB host, and sub-units that communicate with the device is connected to can be selected and configured to function as a USB hub I can be.

In doing so, it can be realized by causing configured as the main unit or sub-unit comprising a

repeater, a hub controller, the transaction translator, and routing logic, the function means for providing a hub function.

[0069]

In Figure 10, I shows a schematic block diagram showing another embodiment of a data communication system 10 for mode switching.

In the embodiment shown in FIG 10, a normal mode in which the bus route selection unit 170 of the main unit 20, and a bus route selection unit 172 of the subunit 50, and the function providing unit 40 of the main unit 20 to communicate, and subunits I to switch the bridge operation mode that functions as a relay 83 between USB bus interface module 50 is connected.

Make it possible to receive a switching instruction of bridge operation mode and the normal mode, an operation unit 28 issues a request for path switching to the path management section 29 upon receiving an instruction from the operator in an operation panel of the main unit 20 be.

A bus route selection unit 170, to the bus route selection unit 172 of each subunit 50, and issues a switching command, the path management section 29 having received the request, switch modes.

[0070]

In the embodiment shown in FIG 10, issues a command to turn on the switch 174 of the bus route selection unit 170, route management unit 29 receives the switching instruction to the normal mode, the bus route selection of each sub-unit 50 at the same time to section 172, I will issue a switch command to the normal mode.

The operator turns on a switch 176 for switching the bus line connecting the main unit 20 and the USB device module 81, each bus route selection unit 172 receives the command and connecting the main unit 20 and the USB bus interface module 83 I want to turn off the switch 178 to switch the bus line.

[0071]

Entered into force the command to turn off the switch 174 of the bus route selection unit 170, to

the bus route selection unit 172 of each subunit 50, the path management section 29 having received a switching instruction to the bridge operation mode, USB devices and modules 81 and issues a command to turn on the switch 178 for switching the bus line which turns off the switch 176 for switching the bus line connecting the main unit 20, and connects the main unit 20 and the USB bus interface module 83.

I will allow a structure of sub-unit 50 includes a bus route selection unit 172, to reduce the complexity of the bus line and the sub-unit 50 and the main unit 20.

[0072]

In Figure 11, I shows a schematic block diagram showing still another embodiment of the data communication system 10 for mode switching.

In the embodiment shown in FIG 11, when it has a configuration of 50 subunits and the main unit 20 includes a bus route selection unit similar to the embodiment shown in FIG 10, and instructs the sub-unit 50 side of the mode switching It is an embodiment of.

And waits for the switching instruction from the operator, the sub-unit 50 is configured such includes a switching instruction unit 88, such as a button switch.

And also controls the path switching of the bus route selection unit 172 of each subunit 50, switching instruction unit 88 controls the routing of the bus route selection unit 172 in response to a command of the mode switching from the main unit 20 .

[0073]

For example, run the path switching of the bus route selection section 172b, to the path management section 29 of the main unit 20, the switching instruction unit 88b of subunit B50b which received the instruction to switch to the bridge mode of operation by the operator, bridge operation mode at the same time I do switch to the notification.

Turns off the switch 174 of the bus route selection unit 170, the switching instruction section 88a of subunit A50a, path management section 29 has received notification of the change-over from the sub-unit B50b issues a mode switching instruction.

Switching instruction portion 88a of the subunit A50a having received the command performs the

path switching of the bus route selection unit 172a.

[0074]

The configuration sub-unit 50 that includes a switching instruction unit of the operation mode, even in the main unit which does not include an operation unit such as a control panel, the switching instruction of the operation mode by a simple pointing means such as a button switch of the subunit it is possible to do.

[0075]

In addition, I will explain the main unit 20, an embodiment of a mounting style with subunit 50 or less.

Figure 12 is a schematic diagram illustrating an embodiment of the mounting manner with the main unit 20 and the subunit 50 of the two.

In the embodiment shown in Figure 12 (a), sub-unit 50 is configured as a wireless USB comprising a directional antenna 64.

The figure shows how each sub-unit 50 in the slot, is different from the direction of the directional antenna 64 of each sub-unit 50 is shown.

By adopting the structure of sub-unit with a directional antenna, even when it is disposed subunit 50 in close proximity, it is possible to reduce appropriately the radio interference 50 between subunits.

[0076]

In (b), shows another embodiment of the mounting manner with the main unit 20 and the subunit 50 in the two FIGS.

In (c), in figures (b), is a side view showing a side surface 20b of the main unit 20 when viewed the main unit 20 in the arrow Y direction of FIG 12 FIG 12.

In the figure, the side surface 20b of the main unit 20, how the slots 49b for mounting the sub-unit 50 is arranged is shown.

Similarly, the slots 49a (not shown) is provided to the other side, to be inserted in the slot 49a of the subunit 50 are possible.

The configuration makes it possible that the main unit 20 having a slot to hold the subunit 50 in spaced reduces suitably radio interference between 50 subunits.

Further, in the embodiment shown in Figure 12 (b), is disposed on the side surface forming the face of the main unit, and further, the mounting slot 49, is it possible to reduce appropriately the interference.

[0077]

The main unit 20 described above, comprises a data communication system 10, it has been described with the embodiment in which to provide a device function as an image forming apparatus subunits 50 Prefecture, the device communication system is provided The function is not limited particularly.

For example, the data communication system may also comprise a device functions as a recording device imaging apparatus such as a digital camera, an image reading apparatus such as a scanner, or storage device.

[0078]

Or, as has been described, according to the present invention, performs the processing is recognized and connected to the USB host of the plurality, in response to a request from the USB host of the plurality of provided data flow having a high flexibility of the USB device between so that it is possible to provide data communication system, data communication method and unit to be.

[0079]

According to the present invention, there is provided a data communication system, data

communication method and a unit that can be made to function as a relay for USB by a simple operation, to enable data flow control with high degree of freedom of the USB device between I can be.

[0080]

Further, it can be implemented by the device-executable program written in such an object-oriented blog ramming languages and legacy programming language Assembler, C, C + +, C #, Java (registered trademark), the functions of the present invention, ROM , it can be distributed to be stored in a device-readable recording medium EEPROM, EPROM, flash memory, a flexible disk, CD-ROM, CD-RW, DVD, SD memory, and MO.

[0081]

It has been described in connection with the embodiment previously shown in the drawings but the invention is not intended to be limited to the embodiments shown in the drawings, other embodiments, add, modify, delete, etc. the skilled artisan will occur can be changed within a range which can be as long as the functions and effects of the present invention, and are intended to be included within the scope of the present invention in any way.

[0082]

Block diagram illustrating an embodiment of a hardware configuration of a data communication system constituted comprising a main unit and the sub unit.

Block diagram showing an exemplary embodiment of the functional configuration of a data communication system constituted comprising a main unit and the sub unit.

Shows an embodiment of a data structure unit identification value information stored in the main unit, the setting information and stored in the sub-units.

Flow chart illustrating an embodiment of the recognition process of the sub-units in the main unit.

Flowchart showing a sub-unit and the main unit, the embodiment of the device initialization with the host.

Shows an embodiment of a data structure of a communication packet transmitted by the communication between the main unit and the sub unit.

Schematic diagram illustrating an embodiment of a data flow between two hosts and data communication system.

Shows an embodiment of a data structure of the job management data to be used for data flow control and arbitration processing for request processing in the data communication system.

Schematic block diagram illustrating an embodiment of the switchable mode data communication system.

Schematic block diagram illustrating another embodiment of a mode switchable data communication system.

Schematic structural view showing still another embodiment of a mode switchable data communication system.

Schematic diagram illustrating an embodiment of a mounting mode of the main unit and the sub unit.

[0083]

10 ... data communication system, connection bus 12 ..., 20 ... main unit, 22 ... CPU, 24 ... ROM, 26 ... memory, the operating unit 28 ..., 29 ... route management unit, display unit 30 ..., 32 ... storage device, 34 printer ..., 36 ... interface (I / F), 38 ... internal bus, 40 ... function providing unit, processing unit 41 ..., 42 ... device information storage unit, 43 ... function module, 44 ... job queue storage unit, 46 ... data flow control unit, 48 ... unit identification value storage unit, 49 ... slot, 50 ... sub-unit, 52 ... controller, memory ... 54, 56 ... wireless communication unit, 60 physical layer ... 58 ... NVRAM (UWB BB PHY), 62 ... physical layer (UWB RF PHY), 64 ... antenna, 66 ... MAC (media access control) layer, 68 ... interface, 70 ... setting storage unit, 72 ... data exchange unit, 74 ... end point unit, 76 ... endpoint Zero, 78 ... end point n, 80 ... WUSB logical device, 81 ... USB device module, 82 ... WUSB bus interface, 83 ... USB bus interface module, 84 ... default pipe, 86 ... pipe bundle, 88 ... switching instruction unit, 90 ... USB host (external device), 92 ... client software,94 ... USB system software, 96 ... USB host controller, 100 ... unit identification value information, configuration information ... 110, 120 ... configuration information, unit 130 ... between packet, 140 ... job management data, 150, 152, 154, 156 ... bus line, 158 ... switch, 160,170,172 ... bus route selection unit, 174, 176, 178 ... switch

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CLAIMS JP2008117289

[0001]

And the main unit is composed of subunits of at least one, and a data communication system for performing data communication using the USB protocol with the external device, the main unit, the function providing means for providing a function as a USB device and, and a data flow control unit for controlling data transfer between said sub-units by identifying the sub-unit, the sub-unit includes a bus interface provides means for performing signal transmission with the external device , and includes a USB device provides means for receiving the arbitration by the data flow control unit, and a data exchange means and said main unit, data communication system.

[0002]

Providing endpoints for establishing a logical communication path with the external device as a USB host, the data exchange unit, the USB device providing means, the data exchange between the main unit and the endpoint The data communication system according to run, to claim 1.

[0003]

Identifying the sub-unit of the source or destination of the data, and controls the data transmission between the sub-units in response to an external command or the processing request from the external device, the data flow control unit is charged The data communication system as claimed in claim 1 or 2.

[0004]

A main unit is provided with a slot for one subunit, and execute data communication according to the USB protocol with the external device, the main unit, the function provided for providing a function as a USB device at least The main unit includes a unit, and a data flow control unit in response to an external command or the processing request from the external device, for controlling data transmission between the subunits.

[0005]

The main unit, the main unit according to arranged apart the plurality of slots to claim 4.

[0006]

Is attached to the main unit to provide a function as a USB device, and a sub-unit that can execute data communication using the USB protocol with the external device, wherein the sub-unit performs the signal transmission with the external device includes a bus interface providing means, USB devices and providing means, and means data exchange with the main unit, sub-unit.

[0007]

Providing endpoints for establishing a logical communication path with the external device as a USB host, the data exchange unit, the USB device providing means, the data exchange between the main unit and the endpoint The subunit according to the run, to claim 6.

[0008]

The subunit-subunit according to claim 6 or 7, a data flow control unit in response to an external command, which controls the data transmission between the main unit.

[0009]

Comprises a directional antenna, the subunit-subunit according to any one of claims 6 to 8.

[0010]

Comprises instruction means for accepting an external command for switching the data flow, the subunit-subunit according to any one of Claims 6 to 9.

[0011]

When configured data communication system and a one subunit, there is provided a data communication method according to the USB protocol with the external device and at least the main unit, the data communication method, logical communication with the external device and the sub unit and establishing a path, comprising the steps of: via the logical communication channel to transfer the data according to the USB protocol, it identifiably the sub-unit, and executes the exchange of the data between the main unit and the sub unit a step of, data communication method.

[0012]

Comprising performing a request process in response to the data, and a step of in response to an external command or the request processing, control the exchange of the data, the data communication method, data communication according to claim 11 way.

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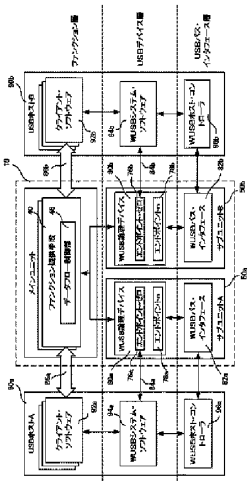
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(54)【発明の名称】データ通信システム、ユニットおよびデータ通信方法

(57)【要約】
【課題】情報処理装置と周辺機器との間のＵＳＢ規格に準拠したデータ通信を実行するデータ通信システム、ユニットおよびデータ通信方法を提供すること。
【解決手段】データ通信システム１０は、メインユニット２０と、少なくとも１つのサブユニット５０とから構成され、外部装置とＵＳＢプロトコルによるデータ通信を実行する。メインユニットは、ＵＳＢ装置としての機能を提供するためのファンクション提供手段４０と、サブユニット５０との間のデータ伝送を制御するデータフロー制御手段４６とを備える。サブユニット５０は、ＵＳＢデバイス提供手段８０と、前記外部装置との信号伝送を実行するバス・インタフェース提供手段８２と、前記メインユニットとのデータ交換手段とを備える。
【選択図】　図７



【特許請求の範囲】
【請求項1】
メインユニットと、少なくとも１つのサブユニットとから構成され、外部装置とＵＳＢプロトコルによるデータ通信を実行するデータ通信システムであって、
前記メインユニットは、
ＵＳＢ装置としての機能を提供するためのファンクション提供手段と、前記サブユニットを識別して前記サブユニットとの間のデータ伝送を制御するデータフロー制御手段とを備え、
前記サブユニットは、
前記外部装置との信号伝送を実行するバス・インタフェース提供手段と、前記データフロー制御手段による調停を受けるＵＳＢデバイス提供手段と、前記メインユニットとのデータ交換手段とを備える、
データ通信システム。
【請求項2】
前記ＵＳＢデバイス提供手段は、ＵＳＢホストとしての前記外部装置との論理的通信路を確立するためのエンドポイントを提供し、
前記データ交換手段は、前記エンドポイントと前記メインユニットとの間のデータ交換を実行する、
請求項１に記載のデータ通信システム。
【請求項3】
前記データフロー制御手段は、
データの送信元または送信先の前記サブユニットを識別し、
前記外部装置からの処理要求または外部指令に応じて前記サブユニットとの間の前記データ伝送を制御する、
請求項１または２に記載のデータ通信システム。
【請求項4】
少なくとも１つのサブユニットを装着するためのスロットを備え、外部装置とＵＳＢプロトコルによるデータ通信を実行可能とするメインユニットであって、
前記メインユニットは、
ＵＳＢ装置としての機能を提供するためのファンクション提供手段と、前記外部装置からの処理要求または外部指令に応じて、前記サブユニットとの間のデータ伝送を制御するデータフロー制御手段とを備える
メインユニット。
【請求項5】
前記メインユニットは、
複数の前記スロットを離間して配設する、請求項４に記載のメインユニット。
【請求項6】
ＵＳＢ装置としての機能を提供するためのメインユニットに装着され、外部装置とＵＳＢプロトコルによるデータ通信を実行可能とするサブユニットであって、
前記サブユニットは、
前記外部装置との信号伝送を実行するバス・インタフェース提供手段と、ＵＳＢデバイス提供手段と、前記メインユニットとのデータ交換手段とを備える、
サブユニット。
【請求項7】
前記ＵＳＢデバイス提供手段は、ＵＳＢホストとしての前記外部装置との論理的通信路を確立するためのエンドポイントを提供し、
前記データ交換手段は、前記エンドポイントと前記メインユニットとの間のデータ交換を実行する、
請求項６に記載のサブユニット。

【請求項8】
　前記サブユニットは、
　外部指令に応じて、前記メインユニットとの間のデータ伝送を制御するデータフロー制御手段を備える
　請求項６または７に記載のサブユニット。
【請求項9】
　前記サブユニットは、指向性アンテナを備える、
請求項６～８のいずれか１項に記載のサブユニット。
【請求項10】
　前記サブユニットは、データフローを切換えるための外部指令を受付ける指示手段を含む、
　請求項６～９のいずれか１項に記載のサブユニット。
【請求項11】
　メインユニットと少なくとも１つのサブユニットとから構成されるデータ通信システムと、外部装置とのＵＳＢプロトコルによるデータ通信方法であって、
　前記データ通信方法は、
　前記サブユニットと前記外部装置との論理的通信路を確立するステップと、
　前記論理的通信路を介して、ＵＳＢプロトコルにしたがいデータを転送するステップと、
　前記サブユニットを識別可能に、前記サブユニットと前記メインユニットとの前記データの交換を実行するステップと
を含む、
　データ通信方法。
【請求項12】
　前記データ通信方法は、
　前記データに応答した要求処理を実行するステップと、
　前記要求処理または外部指令に応答して、前記データの交換を制御するステップとを含む、
　請求項１１に記載のデータ通信方法。
【発明の詳細な説明】
【技術分野】
【0001】
　本発明は、ユニバーサル・シリアル・バス（ＵＳＢ）技術に関し、より詳細には、情報処理装置と周辺機器との間のＵＳＢ規格に準拠したデータ通信を実行するデータ通信システム、ユニットおよびデータ通信方法に関する。
【背景技術】
【0002】
　現在、多くのパーソナル・コンピュータ（ＰＣ）などの情報処理装置には、周辺機器を接続するためのインタフェースとして、ユニバーサル・シリアル・バス（ＵＳＢ）インタフェースが標準的に備えられている。また近年、ＵＳＢの物理層に無線通信技術を適用したワイヤレスＵＳＢ（ＷＵＳＢ）規格も提案されている。
【0003】
　ＵＳＢプロトコルにおいては、ＵＳＢホストとＵＳＢデバイスとの間の通信は、３層モデルを用いて説明される。すなわち、ＵＳＢシステムは、（１）ホスト－デバイス間の有線や無線による物理的な伝送信号を制御するＵＳＢバス・インタフェース層と、（２）ＵＳＢホストとＵＳＢデバイスとの通信における、論理的なデータ伝送の端点を提供し管理するＵＳＢデバイス層と、（３）ＵＳＢホスト上で実行されるクライアント・ソフトウェアと、ＵＳＢデバイスのファンクションとの論理的な通信を提供するファンクション層とから構成される。
【0004】
　ＰＣなどのＵＳＢホストと、周辺機器などのＵＳＢデバイスとは、ＵＳＢホスト側の通

信バッファと、ＵＳＢデバイス側のエンドポイント（同じく通信用バッファで、第２層に位置する）との論理的な通信路（パイプ）により接続され、第３層においては、ＵＳＢホスト側のクライアント・ソフトウェアとＵＳＢデバイス側のファンクションとは、少なくとも１つのパイプから構成されるパイプ・バンドル（インタフェースを構成）を介して論理的な通信を行い、周辺機器の各種デバイス機能がＵＳＢホストに提供される。

【0005】

またＵＳＢホストは、ハブを介して複数のＵＳＢデバイスと一対多で接続され、バス上のデータ転送は、ＵＳＢホスト上の第２層に対応するＵＳＢシステム・ソフトウェアによって制御されている。ＵＳＢホストによる集中制御形式を採用しているため、ＵＳＢデバイスは、単一のＵＳＢホストによって制御され、複数のＵＳＢホストによって同時的に共用されることはできなかった。

【0006】

ＵＳＢデバイスを複数のＵＳＢホスト間で共用させることができると利便性が向上することから、例えば、特開２００４－２９５４０７号公報（特許文献１）は、上流側コネクタに接続される複数のホストＰＣの状態を優先度に基づいて監視する接続状態監視ＣＰＵと、接続状態監視ＣＰＵにより下流側コネクタに接続するホストを切り換えるセレクタとを備えたＵＳＢハブ装置が開示している。

【0007】

しかしながら、上述した従来技術では、上流側ポートの接続状態を監視し、ホスト機器の電源がオフ（あるいは未接続）、またはサスペンド状態となっているかを判断して、上流側ポートと下流側ポートの電気的な接続を切換えるものであり、ＵＳＢデバイスが同時的に複数のＵＳＢホストにより論理的に認識されるというものではなく、利便性の点から充分なものではなかった。

【特許文献1】特開２００４－２９５４０７号公報

【発明の開示】

【発明が解決しようとする課題】

【0008】

本発明は上記従来技術に鑑みてなされたものであり、複数のＵＳＢホストに接続および認識され、複数のＵＳＢホストから要求に応答して処理を実行し、ＵＳＢ装置間の自由度の高いデータフローを提供するデータ通信システム、ユニットおよびデータ通信方法を提供することを目的とする。

【0009】

また、本発明の他の目的は、簡易な操作でＵＳＢの中継器として機能させることができ、ＵＳＢ装置間の自由度の高いデータフロー制御を可能とするデータ通信システム、ユニットおよびデータ通信方法を提供することを目的とする。

【課題を解決するための手段】

【0010】

本発明は、上記課題を解決するために、ＵＳＢホストやＵＳＢデバイスとしてのファンクションを提供するファンクション提供手段を含むメインユニットと、外部装置との論理的な通信路を提供するＵＳＢデバイス提供手段および無線または有線による外部装置との実質的な通信を実行するＵＳＢバス・インタフェース提供手段とを含むサブユニットとからなる、データ通信システムという構成を採用する。メインユニットは、少なくとも１つのサブユニットと電気的・論理的に接続され、各サブユニットと接続される外部装置とは、各サブユニットのＵＳＢデバイス提供手段によって提供される論理的な通信路を介して接続される。メインユニットは、サブユニットを識別し、メインユニット－サブユニット間またはメインユニットを介したサブユニット間のデータ伝送は、データフロー制御手段によって制御される。

【0011】

上記構成により、例えば、デバイス機能を備えるメインユニットは、サブユニットを介して複数のＵＳＢホストとしての外部装置と接続されて、同時的に各外部装置によって論

理的に認識されることが可能となる。メインユニットは、サブユニットを識別することにより要求の送信元を特定し、メインユニットは、各サブユニットからの要求に応答して処理を実行し、複数の外部装置によるデバイス機能の共用を可能とする。また、メインユニットと、複数のサブユニットとの間のデータフローを制御する構成によって、サブユニットに接続される外部装置間の多様な接続様式を提供する中継器としても機能させることが可能となる。

【0012】

すなわち本発明によれば、メインユニットと、少なくとも１つのサブユニットとから構成され、外部装置とＵＳＢプロトコルによるデータ通信を実行するデータ通信システムであって、

前記メインユニットは、

ＵＳＢ装置としての機能を提供するためのファンクション提供手段と、前記サブユニットを識別して前記サブユニットとの間のデータ伝送を制御するデータフロー制御手段とを備え、

前記サブユニットは、

前記外部装置との信号伝送を実行するバス・インタフェース提供手段と、前記データフロー制御手段による調停を受けるＵＳＢデバイス提供手段と、前記メインユニットとのデータ交換手段とを備える、

データ通信システムが提供される。

【0013】

前記ＵＳＢデバイス提供手段は、ＵＳＢホストとしての前記外部装置との論理的通信路を確立するためのエンドポイントを提供し、前記データ交換手段は、前記エンドポイントと前記メインユニットとの間のデータ交換を実行することができる。また、前記データフロー制御手段は、データの送信元または送信先の前記サブユニットを識別し、前記外部装置からの処理要求または外部指令に応じて前記サブユニットとの間の前記データ伝送を制御することができる。

【0014】

また本発明によれば、少なくとも１つのサブユニットを装着するためのスロットを備え、外部装置とＵＳＢプロトコルによるデータ通信を実行可能とするメインユニットであって、

前記メインユニットは、

ＵＳＢ装置としての機能を提供するためのファンクション提供手段と、前記外部装置からの処理要求または外部指令に応じて、前記サブユニットとの間のデータ伝送を制御するデータフロー制御手段とを備える

メインユニットが提供される。

【0015】

前記メインユニットは、複数の前記スロットを離間して配設することができる。

【0016】

さらに本発明によれば、

ＵＳＢ装置としての機能を提供するためのメインユニットに装着され、外部装置とＵＳＢプロトコルによるデータ通信を実行可能とするサブユニットであって、

前記サブユニットは、

前記外部装置との信号伝送を実行するバス・インタフェース提供手段と、ＵＳＢデバイス提供手段と、前記メインユニットとのデータ交換手段とを備える、サブユニットが提供される。

【0017】

前記ＵＳＢデバイス提供手段は、ＵＳＢホストとしての前記外部装置との論理的通信路を確立するためのエンドポイントを提供し、前記データ交換手段は、前記エンドポイントと前記メインユニットとの間のデータ交換を実行することができる。また、前記サブユニットは、外部指令に応じて、前記メインユニットとの間のデータ伝送を制御するデータフ

ロー制御手段を備えることができる。さらに、前記サブユニットは、指向性アンテナを備えることができる。前記サブユニットは、データフローを切換えるための外部指令を受付ける指示手段を含むことができる。

【0018】

本発明によれば、さらに、

メインユニットと少なくとも１つのサブユニットとから構成されるデータ通信システムと、外部装置とのＵＳＢプロトコルによるデータ通信方法であって、

前記データ通信方法は、

前記サブユニットと前記外部装置との論理的通信路を確立するステップと、

前記論理的通信路を介して、ＵＳＢプロトコルにしたがいデータを転送するステップと、

前記サブユニットを識別可能に、前記サブユニットと前記メインユニットとの前記データの交換を実行するステップと

を含む、データ通信方法が提供される。

【0019】

前記データ通信方法は、前記データに応答した要求処理を実行するステップと、

前記要求処理または外部指令に応答して、前記データの交換を制御するステップとを含むことができる。

【発明を実施するための最良の形態】

【0020】

以下、本発明を図面に示した実施形態をもって説明するが、本発明は、図面に示した実施形態に限定されるものではない。

【0021】

図１は、メインユニットとサブユニットを含み構成されるデータ通信システム１０のハードウェア構成の実施形態を示すブロック図である。なお図１は、データ通信システム１０が、画像形成装置としての機能する場合の一実施形態を示している。データ通信システム１０は、メインユニット２０と、サブユニットＡ５０ａと、サブユニットＢ５０ｂとを含み構成される。メインユニット２０は、ＣＰＵ２２と、ＲＯＭ２４と、メモリ２６とを備えており、それぞれ内部バス３８で相互接続されて、ユーザ指令されたジョブを実行している。ＣＰＵ２２は、処理プログラムをＲＯＭ２４やＮＶＲＡＭ、ＥＥＰＲＯＭ、ＥＰＲＯＭ、ハードディスクなどの記憶装置３２からメモリ２６に読み出し、展開し、指令されたジョブのための処理を実行する。

【0022】

メインユニット２０は、操作部２８および表示部３０を備え、操作部２８および表示部３０は、それぞれＣＰＵ２２へと内部バス３８を介して接続され、ユーザ・インタフェースを提供する。メインユニット２０は、さらに内部バス３８に接続されるインタフェース（Ｉ／Ｆ）３６を含み構成され、シリアル・バスおよびパラレル・バスとして構成される接続バス１２を介して接続されるサブユニット５０との入出力を管理している。プリンタ３４は、サブユニット５０と通信するＵＳＢホスト（以下、有線・無線のプロトコルにかかわらず、ＵＳＢプロトコル上のホストとなる外部装置をＵＳＢホストとして参照する。）からの要求を、インタフェース３６を介し受信して、ＣＰＵ２２による制御のもとで、印刷処理などの画像形成装置としてのデバイス処理を実行し、通信するＵＳＢホストにデバイス機能を提供している。すなわちメインユニット２０は、ＷＵＳＢプロトコルにおけるファンクション層に対応する、デバイス機能を実行するためのソフトウェアおよびハードウェア処理を提供する。

【0023】

サブユニットＡ５０ａは、コントローラ５２と、メモリ５４と、無線通信部５６とを備えており、それぞれ内部バスで接続されて、ＵＳＢホストＡと、UWB（Ultra Wide Band）通信プロトコルをベースとしたワイヤレスＵＳＢプロトコルに準拠した通信リンクを確立している。無線通信部５６は、アンテナ６４と接続し、ＵＷＢ高周波回路を含む物理

層（UWB
RF PHY）６２と、ＵＷＢＢａｓｅＢａｎｄ回路を含む物理層（UWB BB PHY）６０とを含み構成される。ＵＷＢ－ＢＢ物理層６０は、おもに信号の変調・復調処理を行い、ＵＷＢ－ＲＦ物理層６２は、高周波信号の波形整形などを行い、これらは、マルチバンドＯＦＤＭ（Multi-band
Orthogonal Frequency Division Multiplexing）方式またはＤＳ－UWB(Direct Sequence UWB)などのＩＥＥＥ８０２．１５ＴＧ３ａなどに準拠した通信プロトコルに従った物理層を構成する。

【0024】

サブユニットＡ５０ａは、ＮＶＲＡＭ５８を含み構成され、ＮＶＲＡＭ５８は、ＵＳＢホストとのワイヤレスＵＳＢ通信を行うための接続コンテキストを格納し、接続先ＵＳＢホストを識別し、通信データの暗号化・復号化処理の際に用いられる。サブユニットＡ５０ａのメモリ５４は、接続先のＵＳＢホストAやメインユニット２０からの伝送データをバッファリングし、ＵＳＢプロトコルにおけるエンドポイントを提供する。またメモリ５４には、ＵＳＢホストAから割当てられるデバイス・アドレスや、メインユニット２０から割当てられるユニット識別値などの各種設定情報が格納される。

【0025】

コントローラ５２は、ＭＡＣ（媒体アクセス制御）層６６を含み、接続先ＵＳＢホストAとのWUSBプロトコルのデータリンク層に相当する制御を行う。すなわち、サブユニット５０は、ＷＵＳＢプロトコルにおけるＷＵＳＢバス・インタフェース層およびＷＵＳＢ論理デバイス層に対応するソフトウェア処理およびハードウェア処理を提供する。さらに、コントローラ５２は、接続バス１２を介してメインユニット２０と接続されるインタフェース６８と接続し、メインユニット２０とのデータ伝送を制御する。

【0026】

また、メインユニット２０に接続される他方のサブユニットＢ５０ｂも、サブユニットＡ５０ａと同様の構成とされ、メインユニット２０ともインタフェースを介して接続され、ＵＳＢホストBと、ワイヤレスＵＳＢ通信を行っている。サブユニットＡ５０ａおよびサブユニット５０ｂは、それぞれ接続先のＵＳＢホストから、独立にデバイス・アドレスが割当てられ、メインユニット２０からは、唯一のユニット識別値が割当てられて識別される。なお、メインユニット２０に接続されるサブユニット５０の数は、特に限定されるものではない。また、上述ではＷＵＳＢ通信による実施形態を示したが、他の実施形態では、有線のＵＳＢ１．ｘやＵＳＢ２．０の規格に準拠した物理層およびＭＡＣ層を備える構成とし、サブユニット５０とＵＳＢホストとを有線接続としてもよい。

【0027】

図２は、メインユニットとサブユニットとを含み構成されるデータ通信システム１０の機能構成の実施形態を示すブロック図である。データ通信システム１０は、メインユニット２０と、サブユニット５０ａと、サブユニット５０ｂとを含み構成される。メインユニット２０は、少なくともひとつのファンクション提供手段４０を含み、通信相手となるＵＳＢホストにデバイス機能を提供している。

【0028】

ファンクション提供手段４０は、処理部４１と、データフロー制御部４６とを含み構成される。データフロー制御部４６は、サブユニット５０を介して要求される複数のＵＳＢホストからの処理要求の衝突の調停などを行い、サブユニット－メインユニット間のデータフローを制御する。処理部４１は、各ＵＳＢホストからの処理要求に応答して、たとえば画像形成装置としての印刷処理などの各種処理を実行する。なお、接続されているサブユニット５０を識別するためのユニット識別値は、ユニット識別値記憶部４８に格納され管理される。

【0029】

ファンクション提供手段４０は、実行待ちの処理を管理するためのジョブキュー記憶部４４を含み、データフロー制御部４６は、サブユニット５０を介したＵＳＢホストからの

処理要求を受信し、ジョブ（処理要求）と要求元サブユニット５０に割当てられたユニット識別値とを組にして、例えば、処理要求の先着順にジョブキューにエントリする。データフロー制御部４６は、エントリ順に、処理に必要なデータをサブユニット５０から取得し、処理部４１は、データフロー制御部４６からデータを受取り、ジョブキューのエントリ順に処理を実行する。例えば印刷処理など、一連の印刷データを受信することが好ましい処理にあっては、データフロー制御部４６は、一連の印刷データの受信が完了するまでの間、ジョブ進行中のサブユニット５０からの印刷データの読込およびバッファリングを優先して実行する制御とすることができる。また、他の実施形態では、一方のＵＳＢホストからの印刷ジョブを実行中は、他のＵＳＢホストに作業中である旨を通知するデータフロー制御としても良い。

【0030】

メインユニット２０のデバイス機能として、例えば、ランダムアクセスが可能なストレージ機能を提供する他の実施形態では、両方のサブユニット５０からのデータ（ファイルの断片としての）書込要求やデータ読出要求ごとに順次ジョブキューにエントリし、逐次、サブユニット５０からデータを読込んで、フラッシュメモリやＨＤＤなどの記憶装置に書込み、または記憶装置から読出してサブユニット５０に受け渡す制御としてもよい。

【0031】

また他の実施形態では、メインユニット２０のデバイス機能として、スピーカやディスプレイなどの出力インタフェース機能を提供する場合では、要求の先着順や、ＵＳＢホストや操作部２８により指定されたＵＳＢホストによって、排他的に利用される制御としてもよい。さらに他の実施形態では、メインユニット２０のデバイス機能として、キーボードなどの入力インタフェース機能を提供する場合では、各サブユニット５０と通信するＵＳＢホストからのポーリングに応じて、状態を通知（インタラプト転送モード）する制御としてもよい。複数のＵＳＢホストからの処理要求の調停処理およびデータフロー制御の方法は、特に限定されるものではなく、提供するデバイス機能に応じた方法を採用することができる。

【0032】

図２に示した実施形態では、また、メインユニット２０のファンクション提供手段４０は、デバイス情報格納部４２を含み構成され、各サブユニット５０と通信するＵＳＢホストとのエニュメレーション（接続開始時の初期設定）の際に、自身のデバイス情報を各ＵＳＢホストへ通知してＵＳＢ通信を確立するための情報を格納する。このような情報としては、デバイス・ディスクリプタ、コンフィギュレーション・ディスクリプタ、インタフェース・ディスクリプタ、エンドポイントディスクリプタなどがあり、ＵＳＢプロトコルで使用されるデバイス情報である。

【0033】

一方、メインユニット２０と接続されるサブユニット５０は、設定記憶部７０と、データ交換部７２と、エンドポイント部７４を含み構成される。設定記憶部７０は、接続先のＵＳＢホストから割当てられるデバイス・アドレスや、メインユニット２０から割当てられるユニット識別値を格納する。エンドポイント部７４は、コントロール制御用通信に用いられるエンドポイント・ゼロ７６と、他のメッセージやデータを送受信するためのエンドポイントｎ（ｎは自然数を表し、送信用および受信用を含む複数のエンドポイントから構成される。）７８とを含み構成される。なお、エンドポイント・ゼロ７６およびエンドポイントｎ７８は、各サブユニット５０が備える、ＲＡＭ（Random Access Memory）やＦＩＦＯ（First In First Out）などのメモリ５４の記憶領域により与えられ、メインユニット２０と通信相手のＵＳＢホストとの間を伝送するデータを一時的にバッファリングする。また、各エンドポイントには識別番号が割当てられている。

【0034】

エンドポイント・ゼロ７６およびエンドポイントｎ７８は、ＵＳＢホストからのデータ伝送の端点として機能し、ＵＳＢホストは、デバイス・アドレスとエンドポイント番号を指定してメッセージやデータの転送を行う。一方、メインユニット２０のファンクション

提供手段４０も、エンドポイント番号を識別してメッセージやデータの送受信を行う。よって、ＵＳＢホスト上のクライアント・ソフトウェアは、各エンドポイントを介して、デバイスのファンクション提供手段４０との論理的な通信を実行する。なお、ＵＳＢホスト上のバッファとエンドポイントとの論理的な結びつきによる論理的通信路は、一般に、パイプと呼称される。

【0035】

データ交換部７２は、ＵＳＢホストからのメッセージやデータを受取った際にエンドポイント部７４の各受信用エンドポイントにバッファリングされるメッセージやデータを読込み、設定記憶部７０に格納されるユニット識別値および制御データを添付して、メインユニット２０へ送信する処理の制御を実行する。データ転送が正常に完了した際には、該エンドポイントを再び受信可能状態に遷移させる。またデータ交換部７２は、メインユニット２０からのデータやメッセージを受取り、エンドポイント部７４の指定された送信用エンドポイントに書込み処理を行う。なお、送信用エンドポイントに書き込まれたデータやメッセージは、コントローラ５２の制御により読出され、ＵＳＢホストへ転送される。

【0036】

図３は、メインユニットに格納されるユニット識別値情報、およびサブユニットに格納される設定情報のデータ構造の実施形態を示す図である。図３（ａ）は、メインユニット２０に格納されるユニット識別値情報の実施形態を示す。図３（ａ）に示した実施形態では、ユニット識別値情報１００は、項目フィールド１００ａと、ユニット識別値をエントリするフィールド１００ｂと、各サブユニットに接続されているＵＳＢ装置がＵＳＢホストかＵＳＢデバイスかをエントリする接続タイプ・フィールド１００ｃとを含んで構成される。

【0037】

メインユニット２０が備えるサブユニット装着のための装着スロット数のレコードが用意され、ユニット識別値には装着順にエントリされてゆき、各装着スロットにサブユニット５０が装着されているか否か、装着されている場合にはその識別値を管理している。このユニット識別値を、例えば、処理要求の調停の際に、優先順位としても使用することもできる。なお、サブユニットのタイプがホスト接続タイプかデバイス接続タイプかを登録するフィールド１００ｃの有無は任意であり、ＵＳＢホストが接続されるサブユニットが装着されることが前提のシステム構成であれば必ずしも要しない。

【0038】

図３（ｂ）は、サブユニットＡ５０ａに格納される設定情報の実施形態を示す。図に示した実施形態では、設定情報１１０は、ユニット識別値をエントリするフィールド１１０ａと、サブユニットＡ５０ａと通信しているＵＳＢホストによって割当てられるデバイス・アドレスが登録されるフィールド１１０ｂとを含み構成される。また、フィールド１１０ｂは、ＵＳＢホストとの通信が確立しているか否かの判断に用いることができ、デバイス・アドレスのエントリがあれば、ＵＳＢホストとの通信が確立していると判断することができる。

【0039】

図３（ｃ）は、サブユニットＢ５０ｂに格納される設定情報の実施形態を示し、同じく、ユニット識別値をエントリするフィールド１２０ａと、デバイス・アドレスが登録されるフィールド１２０ｂとを含む。サブユニットＡ５０ａと、サブユニットＢ５０ｂとは、各通信相手のＵＳＢホストから独立してデバイス・アドレスが割当てられ、各サブユニットと通信する各ＵＳＢホストは、デバイス・アドレスにより通信相手を特定している。一方、サブユニットＡ５０ａと、サブユニットＢ５０ｂとは、メインユニット２０から、同メインユニット２０内において唯一のユニット識別値が付与され、特定される。

【0040】

図４は、メインユニットにおけるサブユニットの認識処理の実施形態を示すフローチャートである。まず、ステップＳ１００で、メインユニット２０の電源オンやバスライン（有線ＵＳＢの場合など）による電源供給を受けて起動し、処理を開始する。ステップＳ１

０１で、メインユニット２０は、サブユニットへの電源ラインにかかる負荷などを監視し、サブユニット５０の新規装着の検出を試み、ステップＳ１０２で、新規装着が検出されたか否かの判断を行う。ステップＳ１０２の判断で、新規装着が検出されなかった場合には、再びステップＳ１０１へループさせ、新規装着を待受ける。

【0041】

一方、ステップＳ１０２の判断で、新規サブユニット５０の装着を検出した場合は、ステップＳ１０３へ処理を分岐し、メインユニット２０は、接続されたサブユニット５０にユニット識別値を割当てて、ユニット識別値情報１００へエントリし、サブユニット５０との初期設定を行い、各エンドポイントとの論理的な通信を可能とする。初期設定が完了した以降、ステップＳ１０４で、メインユニット２０とサブユニット５０との間で通信が可能となる。

【0042】

以下、メインユニットおよびサブユニットにＵＳＢホストが接続される際の、デバイス初期設定の制御フローについて説明する。図5は、メインユニットおよびサブユニットと、ＵＳＢホストとのデバイス初期設定（エニュメレーション）の実施形態を示すフローチャートである。図5に示した実施形態では、既にメインユニット２０とサブユニット５０とが電気的・論理的に接続されている状態を想定している。

【0043】

図5に示した制御は、ステップＳ２００で、例えば、メインユニット２０の操作部２８からのオペレータから指示に応じて発行される接続指令を受けて処理が開始される。ステップＳ２０１では、サブユニット５０は、ＵＳＢホストに向けて接続要求を送信し、応答を受けて、ステップＳ２０２で、セキュリティ・エニュメレーションを開始して相互認証を行う。ステップＳ２０３では、ＵＳＢホストからのＧＥＴ＿ＤＩＳＣＲＩＰＴＯＲのコマンドに応答して、デバイス情報格納部に保存されている各種ディスクリプタをＵＳＢホストに通知する。

【0044】

ステップＳ２０４では、ＵＳＢホストからのデバイス・アドレスの設定要求を受けて、サブユニット５０は、自身の設定記憶部７０へデバイス・アドレスを格納する。ステップＳ２０５ではさらに、ＵＳＢホストからのＳＥＴ＿ＤＥＳＣＲＩＰＴＯＲやＳＥＴ＿ＣＯＮＦＩＧＵＲＡＴＩＯＮといったコマンドを受けて、サブユニットやメインユニットは必要な設定処理を行い、ＵＳＢデバイスとして稼働状態になる。そして、ステップＳ２０６で、ＵＳＢホストとのデータ通信を開始する。なお、上述したエニュメレーション中における、ホスト－データ通信システム間の通信は、各サブユニット５０のエンドポイント・ゼロ７６から構成されるコントロール制御用の論理的な通信路であるデフォルト・パイプを用いて行うことが可能である。

【0045】

図6は、メインユニットとサブユニットとの通信によって伝送される通信パケットのデータ構造の実施形態を示す。ユニット間パケット１３０は、ユニット識別値をエントリするフィールド１３０ａと、エンドポイント番号をエントリするフィールド１３０ｂと、ＵＳＢホストのクライアント・ソフトウェアとメインユニット２０のファンクションとの間で交換されるデータをエントリするフィールド１３０ｃとを含み構成される。メインユニット２０と、各サブユニット５０との間では、ユニット間パケット１３０が交換され、ユニット識別値によってサブユニットが識別され、エンドポイント番号によってファンクション提供手段４０のインタフェースが識別される。なお、メインユニット２０とサブユニット５０との通信は、メインユニット２０が、送信元また送信先となるサブユニットを特定することができる限りにおいて、いかなる構成や方法によって実現することができる。

【0046】

以下、メインユニットおよびサブユニットによって構成されるＵＳＢシステムにおけるデータフローについて説明する。図7は、メインユニットおよびサブユニットと、２つのＵＳＢホストとを含むＵＳＢシステムの概略構成、およびＵＳＢシステムにおけるデータ

フローの実施形態を示す概略図である。図７に示した実施形態では、ＵＳＢシステムは、データ通信システム１０と、ＵＳＢホストＡ９０ａと、ＵＳＢホストＢ９０ｂとを含んで形成されている。データ通信システム１０は、メインユニット２０と、メインユニットに接続されるサブユニット５０ａおよびサブユニット５０ｂとを含み構成され、サブユニットＡ５０ａはＵＳＢホストＡ９０ａと通信を行い、サブユニットＢ５０ｂはＵＳＢホストＢ９０ｂと通信を行っている。

【0047】

図に示した実施形態ではメインユニット２０は、ＵＳＢプロトコルにおけるファンクション層に対応するデバイス機能を提供するためのファンクション提供手段４０を含み構成される。各サブユニット５０は、ＵＳＢデバイス層に対応するＷＵＳＢ論理デバイス（ＵＳＢデバイス提供手段）８０ａと、ＵＳＢバス・インタフェース層に対応するＷＵＳＢバス・インタフェース（バス・インタフェース提供手段）８２ａとを含み構成されている。各サブユニット５０のＷＵＳＢバス・インタフェース８２は、ＵＳＢホスト９０とのワイヤレス通信による実質的な通信を実行している。ＷＵＳＢ論理デバイス８０は、コントロール制御用通信に用いられるエンドポイント・ゼロ７６と、他のメッセージやデータを送受信するためのエンドポイントｎ７８とを含み構成される。

【0048】

ＷＵＳＢバス・インタフェース８２は、接続先のＵＳＢホスト９０から送信されたトークンやハンドシェークなどを含むトランザクション・グループのパケットをデコードし、必要に応じてＡＣＫやＮＡＫといったハンドシェークをＵＳＢホスト９０へ応答する制御を実行する。またＷＵＳＢバス・インタフェース８２は、接続先のＵＳＢホスト９０からのトランザクション・グループに含まれるデータを、エンドポイント・ゼロ７６や受信用のエンドポイントｎ７８へ書込み、エンドポイント・ゼロ７６や送信用エンドポイントｎ７８に格納されるデータを読出し、ＵＳＢホスト９０により管理されたスケジュールに従ったデータ転送を行っている。

【0049】

メインユニット２０は、各サブユニット５０と接続バス１２を介して電気的に接続され、ファンクション提供手段４０は、接続バス１２を介して、各サブユニット５０の各エンドポイントとのデータ交換を行い、エンドポイント・ゼロ７６の読書き、送信用エンドポイントｎ７８への書込み、および受信用エンドポイントｎ７８からの読出し処理を実行する。

【0050】

なお、いくつかの同一の目的で用いられるエンドポイントｎ７８が集合してインタフェースを構成し、例えば、メインユニット２０がプリンタ機能を提供する場合には、プリンタ機能を提供するファンクション提供手段４０には、印字コントロール用のインタフェースと、印刷データ受信用のインタフェースとを含み構成され、ＵＳＢホスト９０は、要求処理に応じたインタフェースとのデータ転送を行う。

【0051】

一方、各ＵＳＢホスト９０は、ファンクション層に対応するクライアント・ソフトウェア９２と、ＵＳＢデバイス層に対応するＷＵＳＢシステム・ソフトウェア９４と、ＵＳＢバス・インタフェース層に対応するＵＳＢホストコントローラ９６とを含み構成される。ＵＳＢホストコントローラ９６は、サブユニット５０とのトランザクション・グループを制御し、サブユニット５０のＷＵＳＢバス・インタフェース８２と、データおよびメッセージの交換を実行する。

【0052】

ＵＳＢシステム・ソフトウェア９４は、ＵＳＢホスト上のバッファ（メモリ２６により構成される。）とサブユニット５０の各エンドポイントとの論理的通信路（パイプ）の管理を行い、サブユニット５０のエンドポイント・ゼロ７６ａとのコントロール制御用の論理的な接続であるデフォルト・パイプ８４を用いて、メインユニット２０およびサブユニット５０が提供するデバイス機能を管理している。

【0053】
クライアント・ソフトウェア９２は、サブユニット５０のエンドポイントのセットと関連付けられるパイプ・バンドル８６を用いて、メインユニット２０のインタフェースを管理する。クライアント・ソフトウェア９２は、デバイス機能を利用するために、Ｉ／Ｏリクエスト・パケット（ＩＲＰｓ）によって、ＵＳＢホスト９０上のバッファと、接続先サブユニット５０の各エンドポイントとの間のデータ転送要求を行い、メインユニット２０のファンクション提供手段４０との通信を実行し、デバイス機能を利用している。
【0054】
すなわち、各ＵＳＢホスト９０のクライアント・ソフトウェア９２は、接続するサブユニット５０のエンドポイントｎ７８とのデータ転送と、メインユニット２０とサブユニット５０の電気的・論理的な接続によるエンドポイントｎ７８とファンクション提供手段４０の通信とにより、メインユニット２０のファンクション提供手段４０へアクセスし、デバイス機能を利用することが可能となっている。その際は、ファンクション提供手段４０は、ユニット識別値によって要求元を特定し、データフロー制御部４６によるジョブ管理のもと、要求処理を実行し、デバイス機能を各ＵＳＢホスト９０へ提供することを可能としている。以下、データフロー制御部４６におけるジョブ管理の実施形態について、ジョブ管理データのデータ構造を参照しながら説明する。
【0055】
図８は、データ通信システムにおける要求処理の調停処理およびデータフロー制御に使用されるジョブ管理データのデータ構造の実施形態を示す図である。なお図８は、データ通信システム１０が、画像形成装置として機能し、プリンタ処理を実行する場合の実施形態を例示している。図８に示した実施形態では、ジョブ管理データ１４０は、ジョブ番号をエントリするフィールド１４０ａと、ユニット識別値をエントリするフィールド１４０ｂと、待ちジョブをエントリするフィールドとを含み構成される。
【0056】
ファンクション提供手段４０のデータフロー制御部４６は、例えば、印刷要求などの処理要求を受取り、ジョブキュー記憶部４４で管理されているジョブ管理データ１４０へ、ジョブ番号順にエントリしてゆく。データフロー制御部４６は、ジョブ管理データ１４０をルックアップし、ジョブ管理データ１４０のエントリ順に、要求処理に必要なデータを優先的に取得し、処理部４１の作業状態を監視しながら、処理部４１へ処理要求およびデータを受け渡す。処理部４１は、受取ったジョブを実行して行き、必要に応じてデータフロー制御部４６に処理応答を返す。データフロー制御部４６は、ジョブの完了と共にエントリを削除および他エントリのジョブ番号の繰り下げ処理を実行する。
【0057】
図８に示した例では、ユニット識別値［１］のサブユニット５０と通信しているＵＳＢホストＡ９０ａから、印刷要求を受取り、ジョブ管理データ１４０のジョブ番号［１］に「印刷ジョブ１」がエントリされている。データフロー制御部４６は、ジョブ管理データ１４０に従って、ユニット識別値［１］のサブユニット５０からの印刷データを読込むために、エンドポイントからデータを取得して、処理部４１に印刷処理の開始を指令する。ジョブ番号［１］の処理を開始した以降に受取った、ユニット識別値［１］のサブユニット５０からの印刷ジョブ２およびユニット識別値［２］のサブユニット５０からの印刷ジョブ１は、ジョブ管理データ１４０の下位にエントリされ、ジョブ番号［１］の印刷ジョブ1の実行の際に用いられる印刷データを全て取得してから、順次開始され処理されて行く。
【0058】
上位のジョブに関連するデータ取得が優先的に行われている間は、他のサブユニット５０のデータ転送用エンドポイントからの読出処理を待機する。また、一方のサブユニット５０からのデータ取得は、データ取得中のサブユニット５０に対して、接続バスを優先的に使用させる制御とすることができる。待機中のサブユニット５０は、データ転送要求を送付しているＵＳＢホストに対して、ＮＡＫやＮＹＥＴといった否定的なハンドシェーク

を応答し、ＵＳＢホストからのデータ伝送を待機させる制御としている。

【0059】

論理デバイス層の機能手段を備える複数のサブユニット５０と接続されるメインユニット２０と、サブユニットを識別し、要求処理実行およびユニット間のデータフローを制御する手段を含む構成により、ＵＳＢデバイスとしてのデータ通信システム１０は、複数のＵＳＢホストに同時にＵＳＢ論理デバイスとして認識され、要求元のＵＳＢホストを識別して要求処理を実行することが可能となり、ＵＳＢデバイスとしての利便性およびＵＳＢ装置間のデータフローの自由度を向上させることができる。この際は、ＵＳＢホスト側のソフトウェアおよびハードウェア処理の改変を要求しない。また、データフロー制御手段を有する構成により、複数のＵＳＢホストからの処理要求が衝突した場合であっても、円滑に各ＵＳＢホストからの要求処理を実行することを可能とし、ＵＳＢデバイスとしての利便性を向上させることができる。

【0060】

また、メインユニット２０とサブユニット５０とに分離した構成とすることにより、使用環境に応じて、有線接続用のサブユニットとワイヤレス通信用のサブユニットとを使い分けて装着することが可能となり、余分な部品構成（例えば有線・有線の両方の接続に対応させるための構成）を低減させることを可能とする。

【0061】

以上、メインユニット２０およびサブユニット５０からなるデータ通信システム１０は、ＵＳＢデバイスとしてのみとして機能する場合の実施形態について説明してきた。しかしながら、他の実施形態では、データ通信システム１０は、ＵＳＢＯＴＧ（USB On The Go）規格に準拠するデュアル・ロール・デバイス（つまりＵＳＢホストおよびＵＳＢデバイスの両方として同時に機能）として構成とすることもでき、さらに自由度の高いＵＳＢ装置間のデータフローを提供することができる。その際には、サブユニット５０に、ＵＳＢホストおよびＵＳＢデバイスとして機能させるための制御を実行するＯＴＧコントローラ、またはＵＳＢホストとして機能させるためのホストコントローラを含む構成とすることができる。以下、メインユニットとサブユニットとの間の、より柔軟なデータフロー制御について説明する。

【0062】

図９には、メインユニット２０と、ＵＳＢホストと通信するサブユニットＡ５０ａと、ＵＳＢデバイス（以下、有線・無線のプロトコルにかかわらず、ＵＳＢプロトコル上のデバイスとなる外部装置をＵＳＢデバイスとして参照する。）と通信するサブユニットＢ５０ｂとを含むデータ通信システム１０の実施形態の概略構成が示されている。図に示した実施形態では、データ通信システム１０は、メインユニット２０と、ＵＳＢホストと通信するサブユニットＡ５０ａと、ＵＳＢデバイスと通信するサブユニットＢ５０ｂとを含み構成される。メインユニット２０は、ファンクション層の機能手段を実現するファンクション・モジュール４３を含み構成される。各サブユニット５０は、ＵＳＢバス・インタフェース層の機能手段を実現するＵＳＢバス・インタフェース・モジュール８３と、ＵＳＢデバイス層の機能手段を実現するＵＳＢデバイス・モジュール８１とを含み構成される。

【0063】

図に示した実施形態ではメインユニット２０は、バス経路選択部１６０を備え、サブユニット５０と、メインユニット２０のファンクション・モジュール４３とが通信する通常モードと、サブユニット５０のＵＳＢバス・インタフェース・モジュール８３同士が接続され、中継器として機能するブリッジ動作モードとの切換えを行うことを可能としている。メインユニット２０の操作パネルなどで構成される操作部２８は、通常モードとブリッジ動作モードの切換え指示を受付け、オペレータからの指示を受けて、経路管理部２９へ経路切換要求を発行する。要求を受けた経路管理部２９は、バス経路選択部１６０へ経路切換指令を発行し、通常動作モードとブリッジ動作モードとを切換える。すなわち、経路管理部２９は、メインユニット２０とサブユニット５０との間、またメインユニット２０を介したサブユニット間の、論理的なデータフローを制御する手段として機能する。

【0064】
ブリッジ動作モードでは、ＵＳＢホスト同士またはＵＳＢデバイス同士が接続されると好ましくないため、接続するサブユニットＡ５０ａとサブユニットＢ５０ｂとが、両方ともＵＳＢホスト、または両方ともＵＳＢデバイスであるか否かの判断を行い、ＵＳＢホストとＵＳＢデバイスとの組合せであると判断された場合に、ブリッジ動作モードに切換える処理を行う制御としてもよい。このような判断は、例えば、ユニット識別値情報１００を用いて、フィールド１００ｃのエントリについて、ＵＳＢホストを「真」とし、ＵＳＢデバイスを「偽」として排他論理和を算出することにより判断することができるが、いかなる方法によっても判断することができる。
【0065】
図９に示した実施形態では、メインユニット２０とサブユニット５０とのバス接続は、各サブユニット５０のＵＳＢバス・インタフェース・モジュール８３とメインユニット２０とを結ぶバスライン１５０と、ＵＳＢデバイス・モジュール８１とメインユニット２０とを結ぶバスライン１５２とを含み構成される。バスライン１５０およびバスライン１５２は、バス経路選択部１６０に接続され、バス経路選択部１６０は、ファンクション・モジュール４３に接続されるバスライン１５６と接続し、また内部に、バスライン１５６と、バスライン１５２ａおよびバスライン１５２ｂとの接続を切換えるためのスイッチ１５８ａおよびスイッチ１５８ｄを含んでいる。さらに、バス経路選択部１６０は、バスライン１５０同士を接続させるためのバスライン１５６と、接続を切換えるためのスイッチ１５８ｂとスイッチ１５８ｃとを含んでいる。
【0066】
スイッチ１５８ａ～スイッチ１５８ｄは、通常動作モードでは、スイッチ１５８ａおよびスイッチ１５８ｄがオンとなり、スイッチ１５８ｂおよびスイッチ１５８ｃがオフとなる。ブリッジ動作モードでは、スイッチ１５８ａおよびスイッチ１５８ｄがオフとなり、スイッチ１５８ｂおよびスイッチ１５８ｃがオンとなる。
【0067】
ブリッジ動作モードでは、有線接続のＵＳＢコネクタを備えたサブユニット同士ではハブまたはリピータとして機能し、接続距離を延長させることができる。有線接続のＵＳＢコネクタを備えたサブユニットと無線接続のＷＵＳＢアンテナを備えたサブユニットとの接続では、ホスト・ワイヤ・アダプタやデバイス・ワイヤ・アダプタなどのメディア変換器として機能し、有線および無線が入り混じった利用環境では、さらにＵＳＢ装置間のデータフローの自由度を向上させることができる。無線接続のＷＵＳＢアンテナを備えたサブユニット同士では、中継器として機能し、ワイヤレスＵＳＢ接続の通信可能距離を延長させることが可能となる。
【0068】
なお、上述では、２つのサブユニットと接続するメインユニットとの構成の実施形態をもってバス経路選択における動作について述べたが、３つ以上のサブユニットと接続する場合であってもよく、当業者であれば容易に拡張することができるであろう。３つ以上のサブユニットと接続する場合には、ＵＳＢホストと通信を行うひとつのサブユニットと、デバイスと通信を行う複数のサブユニットとが選択可能に結線され、ＵＳＢハブとして機能する構成とすることができる。その際には、リピータ、ハブコントローラ、トランザクション・トランスレータ、ルーティング・ロジックといった、ハブ機能を提供する機能手段を備えるサブユニットまたはメインユニットとして構成させることで実現できる。
【0069】
図１０には、モード切換を行うデータ通信システム１０の他の実施形態を示す概略構成図を示す。図１０に示した実施形態では、メインユニット２０のバス経路選択部１７０と、サブユニット５０のバス経路選択部１７２とによって、メインユニット２０のファンクション提供手段４０とが通信する通常モードと、サブユニット５０のＵＳＢバス・インタフェース・モジュール８３同士が接続され中継器として機能するブリッジ動作モードの切換えを行う。メインユニット２０の操作パネルなどで構成される操作部２８は、通常モー

ドとブリッジ動作モードの切換え指示を受けることを可能とし、オペレータからの指示を受けて経路管理部２９へ経路切換の要求を発行する。要求を受けた経路管理部２９は、バス経路選択部１７０と、各サブユニット５０のバス経路選択部１７２へ、切換え指令を発行し、モードを切換える。

【0070】

図１０に示した実施形態では、通常モードへの切換指令を受けた経路管理部２９は、バス経路選択部１７０のスイッチ１７４をオンとする指令を発行し、同時に各サブユニット５０のバス経路選択部１７２へ、通常モードへの切換指令を発行する。指令を受けた各バス経路選択部１７２は、ＵＳＢデバイス・モジュール８１とメインユニット２０とを結ぶバスラインの切換えを行うスイッチ１７６をオンとし、ＵＳＢバス・インタフェース・モジュール８３とメインユニット２０とを結ぶバスラインの切換えを行うスイッチ１７８をオフとする。

【0071】

ブリッジ動作モードへの切換指令を受けた経路管理部２９は、バス経路選択部１７０のスイッチ１７４をオフとする指令を発効し、各サブユニット５０のバス経路選択部１７２へ、ＵＳＢデバイス・モジュール８１とメインユニット２０とを結ぶバスラインの切換えを行うスイッチ１７６をオフとし、ＵＳＢバス・インタフェース・モジュール８３とメインユニット２０とを結ぶバスラインの切換えを行うスイッチ１７８をオンとする指令を発行する。バス経路選択部１７２を含むサブユニット５０という構成により、メインユニット２０とサブユニット５０とのバスラインの複雑化を低減することを可能とする。

【0072】

図１１には、モード切換を行うデータ通信システム１０のさらに他の実施形態を示す概略構成図を示す。図１１に示した実施形態では、図１０に示した実施形態と同様のバス経路選択部を含むメインユニット２０およびサブユニット５０としての構成を有し、モード切換をサブユニット５０側から指示する場合の実施形態である。サブユニット５０は、オペレータからの切換指示を待受ける、例えばボタンスイッチなどの切換指示部８８を含み構成される。切換指示部８８は、各サブユニット５０のバス経路選択部１７２の経路切換を制御し、また、メインユニット２０からのモード切換の指令に応答してバス経路選択部１７２の経路選択の制御を行う。

【0073】

例えば、オペレータによりブリッジ動作モードへの切換指示を受けたサブユニットＢ５０ｂの切換指示部８８ｂは、バス経路選択部１７２ｂの経路切換を実行し、同時にメインユニット２０の経路管理部２９へ、ブリッジ動作モードへ切換通知を行う。サブユニットＢ５０ｂからの切換通知を受けた経路管理部２９は、バス経路選択部１７０のスイッチ１７４をオフとし、サブユニットＡ５０ａの切換指示部８８ａに、モード切換指示を発行する。指令を受けたサブユニットＡ５０ａの切換指示部８８ａは、バス経路選択部１７２ａの経路切換を行う。

【0074】

サブユニット５０が動作モードの切換指示部を備えるという構成により、操作パネルなどの操作部を備えないメインユニットであっても、サブユニットのボタンスイッチなどの簡易な指示手段によって動作モードの切換指示を行うことが可能となる。

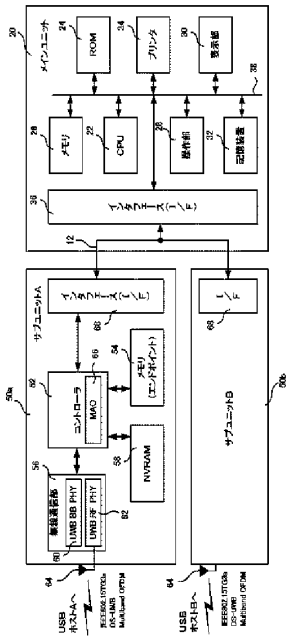
【0075】

以下さらに、メインユニット２０と、サブユニット５０との装着様式の実施形態について説明する。図１２は、メインユニット２０と、２つのサブユニット５０との装着様式の実施形態を示す概略図である。図１２（ａ）に示した実施形態では、サブユニット５０は、指向性アンテナ６４を備えるワイヤレスＵＳＢとしての構成されている。図には、各サブユニット５０はスロットに装着され、各サブユニット５０の指向性アンテナ６４の向きが異なっている様子が示されている。指向性アンテナを備えるサブユニットという構成を採用することによって、サブユニット５０が近接して配設された場合であっても、サブユニット５０間の電波干渉を好適に低減させることができる。

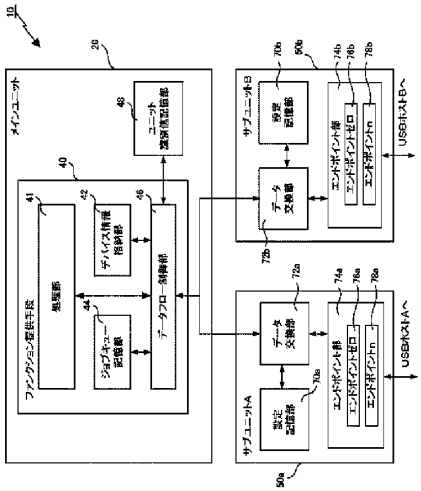
【0076】
図１２（ｂ）は、メインユニット２０と、２つのサブユニット５０との装着様式の他の実施形態を示す。図１２（ｃ）は、図１２（ｂ）の図において、矢印Y方向からメインユニット２０を視た場合のメインユニット２０の側面２０ｂを示す側面図である。図には、メインユニット２０の側面２０ｂには、サブユニット５０を装着するためのスロット４９ｂが配設されている様子が示されている。同様に、他方の側面にもスロット４９ａ（図示せず）が備えられ、サブユニット５０をスロット４９ａに装着することが可能である。離間してサブユニット５０を装着するスロットを備えたメインユニット２０という構成により、サブユニット５０間の電波干渉を好適に低減させることが可能となる。さらに、図１２（ｂ）に示した実施形態では、装着スロット４９は、メインユニットの対面を構成する側面に配置され、さらに、電波干渉を好適に低減させることが可能としている。
【0077】
なお、上述のメインユニット２０と、サブユニット５０とから構成されるデータ通信システム１０は、画像形成装置としてのデバイス機能を提供する場合の実施形態をもって説明してきたが、データ通信システムが提供するデバイス機能としては、特に限定されるものではない。データ通信システムは、例えば、デジタル・カメラなどの撮像装置、スキャナなどの画像読取装置、ストレージデバイスなどの記録装置としてのデバイス機能を備えることもできる。
【0078】
以上、説明したように、本発明によれば、複数のＵＳＢホストに接続および認識され、複数のＵＳＢホストから要求に応答して処理を実行し、ＵＳＢ装置間の自由度の高いデータフローを提供するデータ通信システム、ユニットおよびデータ通信方法を提供することができる。
【0079】
また、本発明によれば、簡易な操作でＵＳＢの中継器として機能させることができ、ＵＳＢ装置間の自由度の高いデータフロー制御を可能とするデータ通信システム、ユニットおよびデータ通信方法を提供することができる。
【0080】
また、本発明の上記機能は、アセンブラ、Ｃ、Ｃ＋＋、Ｃ＃、Ｊａｖａ（登録商標）、などのレガシープログラミング言語やオブジェクト指向プログラミング言語などで記述された装置実行可能なプログラムにより実現でき、ＲＯＭ、ＥＥＰＲＯＭ、ＥＰＲＯＭ、フラッシュメモリ、フレキシブルディスク、ＣＤ－ＲＯＭ、ＣＤ－ＲＷ、ＤＶＤ、ＳＤメモリ、ＭＯなど装置可読な記録媒体に格納して頒布することができる。
【0081】
これまで本発明を図面に示した実施形態をもって説明してきたが、本発明は図面に示した実施形態に限定されるものではなく、他の実施形態、追加、変更、削除など、当業者が想到することができる範囲内で変更することができ、いずれの態様においても本発明の作用・効果を奏する限り、本発明の範囲に含まれるものである。
【図面の簡単な説明】
【0082】
【図1】メインユニットとサブユニットを含み構成されるデータ通信システムのハードウェア構成の実施形態を示すブロック図。
【図2】メインユニットとサブユニットを含み構成されるデータ通信システムの機能構成の実施形態を示すブロック図。
【図3】メインユニットに格納されるユニット識別値情報、およびサブユニットに格納される設定情報のデータ構造の実施形態を示す図。
【図4】メインユニットにおけるサブユニットの認識処理の実施形態を示すフローチャート。
【図5】メインユニットおよびサブユニットと、ホストとのデバイス初期設定の実施形態を示すフローチャート。

【図6】メインユニットとサブユニットとの通信によって伝送される通信パケットのデータ構造の実施形態を示す図。
【図7】データ通信システムと２つのホストとのデータフローの実施形態を示す概略図。
【図8】データ通信システムにおける要求処理の調停処理およびデータフロー制御に使用されるジョブ管理データのデータ構造の実施形態を示す図。
【図9】モード切換可能なデータ通信システムの実施形態を示す概略構成図。
【図10】モード切換可能なデータ通信システムの他の実施形態を示す概略構成図。
【図11】モード切換可能なデータ通信システムのさらに他の実施形態を示す概略構成図。
【図12】メインユニットとサブユニットとの装着様式の実施形態を示す概略図。
【符号の説明】
【0083】
１０…データ通信システム、１２…接続バス、２０…メインユニット、２２…ＣＰＵ、２４…ＲＯＭ、２６…メモリ、２８…操作部、２９…経路管理部、３０…表示部、３２…記憶装置、３４…プリンタ、３６…インタフェース（Ｉ／Ｆ）、３８…内部バス、４０…ファンクション提供手段、４１…処理部、４２…デバイス情報格納部、４３…ファンクション・モジュール、４４…ジョブキュー記憶部、４６…データフロー制御部、４８…ユニット識別値記憶部、４９…スロット、５０…サブユニット、５２…コントローラ、５４…メモリ、５６…無線通信部、５８…ＮＶＲＡＭ、６０…物理層（UWB BB PHY）、６２…物理層（UWB RF PHY）、６４…アンテナ、６６…ＭＡＣ（媒体アクセス制御）層、６８…インタフェース、７０…設定記憶部、７２…データ交換部、７４…エンドポイント部、７６…エンドポイント・ゼロ、７８…エンドポイントｎ、８０…ＷＵＳＢ論理デバイス、８１…ＵＳＢデバイス・モジュール、８２…ＷＵＳＢバス・インタフェース、８３…ＵＳＢバス・インタフェース・モジュール、８４…デフォルト・パイプ、８６…パイプ・バンドル、８８…切換指示部、９０…ＵＳＢホスト（外部装置）、９２…クライアント・ソフトウェア、９４…ＵＳＢシステム・ソフトウェア、９６…ＵＳＢホストコントローラ、１００…ユニット識別値情報、１１０…設定情報、１２０…設定情報、１３０…ユニット間パケット、１４０…ジョブ管理データ、１５０、１５２、１５４、１５６…バスライン、１５８…スイッチ、１６０、１７０、１７２…バス経路選択部、１７４、１７６、１７８…スイッチ

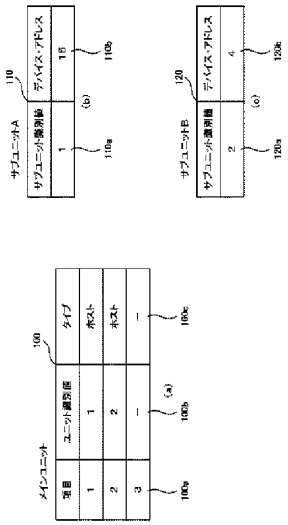
【図1】



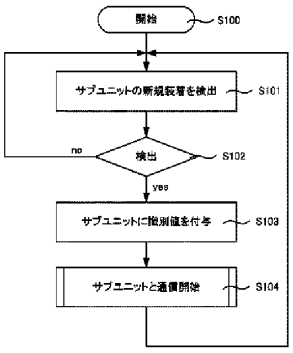
【図2】



【図3】

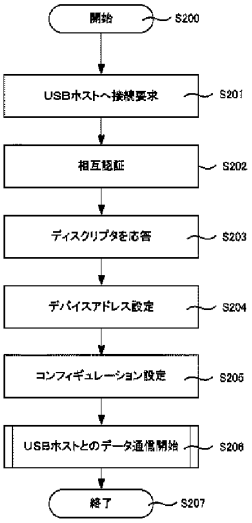


【図4】

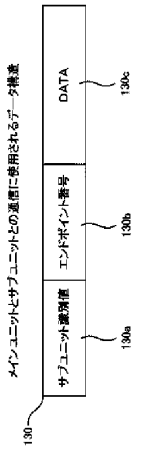


メインユニットによるサブユニットの認識処理

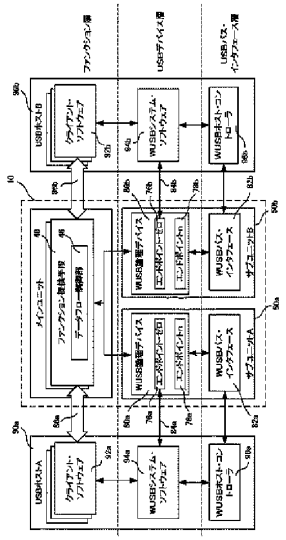
【図5】


開始
S200
USBホストへ接続要求
S201
相互認証
S202
ディスクリプタを応答
S203
デバイスアドレス設定
S204
コンフィギュレーション設定
S205
USBホストとのデータ通信開始
S206
終了
S207

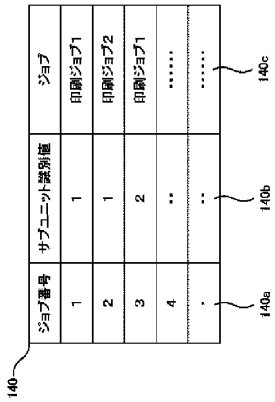
【図6】


メインユニットとサブユニットとの通信に使用されるデータ構造
サブユニット識別値
エンドポイント番号
DATA
130a
130b
130c
130

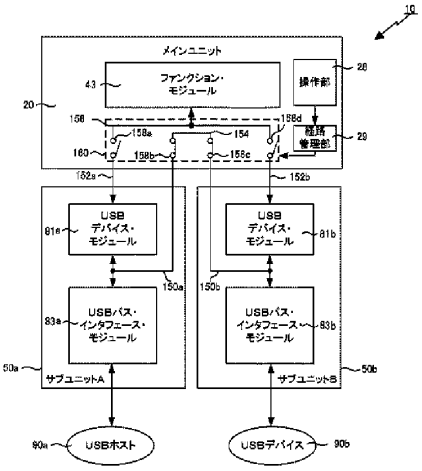
【図7】



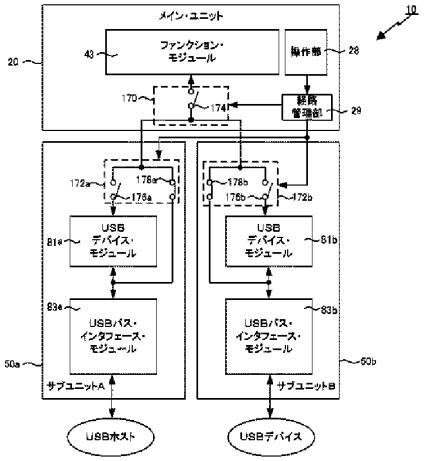
【図8】


ジョブ番号
サブユニット識別値
ジョブ
1
1
印刷ジョブ1
2
1
印刷ジョブ2
3
2
印刷ジョブ1
4
..
.....
.
..
.....
140
140a
140b
140c

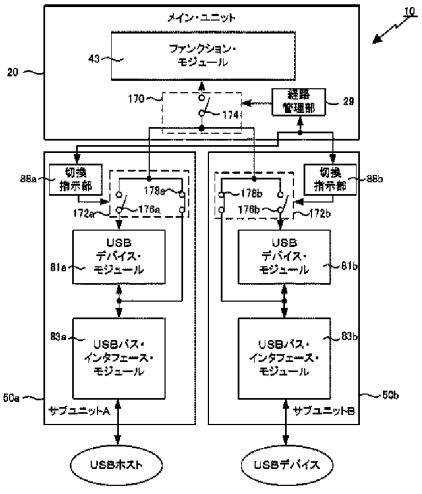
【図9】



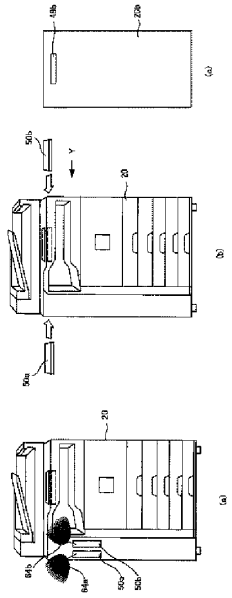
【図10】



【図11】



【図12】



Electronic Acknowledgement Receipt	
EFS ID:	18800668
Application Number:	12808685
International Application Number:	
Confirmation Number:	5071
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh Shepherd
Customer Number:	24737
Filer:	Michael E. Belk/Elissa DeLuccy
Filer Authorized By:	Michael E. Belk
Attorney Docket Number:	2007P01979WOUS
Receipt Date:	18-APR-2014
Filing Date:	17-JUN-2010
Time Stamp:	11:01:04
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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Warnings:					
Information:					
		Total Files Size (in bytes):	16044733		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc code: RCEX
Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
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 contains a valid OMB control number.

REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	12808658	Filing Date	2010-06-17	Docket Number (if applicable)	2007P01979WOUS	Art Unit	2487
First Named Inventor	Nicoll Burleigh Shepherd			Examiner Name	Nam D. Pham		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☒ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

☐ Other _____

☐ Enclosed

☐ Amendment/Reply

☐ Information Disclosure Statement (IDS)

☐ Affidavit(s)/ Declaration(s)

☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

☒ The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 141270

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

☐ Applicant Signature

PTO/SB/30EFS (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
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 contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature	/Michael E. Belk/	Date (YYYY-MM-DD)	2014-04-17
Name	Michael E. Belk	Registration Number	33357

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. 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, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal	
Application Number:	12808685
Filing Date:	17-Jun-2010
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh Shepherd
Filer:	Michael E. Belk/Elissa DeLuccy
Attorney Docket Number:	2007P01979WOUS
Filed as Large Entity	

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
RCE - 2nd and Subsequent Request	1820	1	1700	1700
		Total in USD ($)		**1700**

Electronic Acknowledgement Receipt	
EFS ID:	18795605
Application Number:	12808685
International Application Number:	
Confirmation Number:	5071
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh Shepherd
Customer Number:	24737
Filer:	Michael E. Belk/Elissa DeLuccy
Filer Authorized By:	Michael E. Belk
Attorney Docket Number:	2007P01979WOUS
Receipt Date:	17-APR-2014
Filing Date:	17-JUN-2010
Time Stamp:	16:37:39
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1700
RAM confirmation Number	3410
Deposit Account	141270
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. 1.492 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Continued Examination (RCE)	2007P01979WOUS_RCE.pdf	697784 a1238c24153b825d109716f0d8f025e989565815	no	3
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30483 4311cf2742bbfbdef802b8d21e8868f85bbb981d	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	728267		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. 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.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/808,685	Filing Date 06/17/2010	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)		
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	04/17/2014	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0	X $80 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $420 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/DONNA 1. SMALLS LOGAN/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. 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, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/808,685	06/17/2010	Nicoll Burleigh Shepherd	2007P01979WOUS	5071

24737 7590 04/04/2014

PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

EXAMINER	
PHAM, NAM D	
ART UNIT	PAPER NUMBER
2487	

NOTIFICATION DATE	DELIVERY MODE
04/04/2014	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

debbie.henn@philips.com
marianne.fox@philips.com

Advisory Action Before the Filing of an Appeal Brief	**Application No.** 12/808,685	**Applicant(s)** SHEPHERD, NICOLL BURLEIGH	
	Examiner NAM PHAM	**Art Unit** 2487	**AIA (First Inventor to File) Status** No

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 17 March 2014 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

NO NOTICE OF APPEAL FILED

1. ☒ The reply was filed after a final rejection. No Notice of Appeal has been filed. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114 if this is a utility or plant application. Note that RCEs are not permitted in design applications. The reply must be filed within one of the following time periods:
   a) ☐ The period for reply expires _____months from the mailing date of the final rejection.
   b) ☒ The period for reply expires on: (1) the mailing date of this Advisory Action; or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.
   c) ☐ A prior Advisory Action was mailed more than 3 months after the mailing date of the final rejection in response to a first after-final reply filed within 2 months of the mailing date of the final rejection. The current period for reply expires months from the mailing date of *the prior Advisory Action* or SIX MONTHS from the mailing date of the final rejection, whichever is earlier.
   Examiner Note: If box 1 is checked, check either box (a), (b) or (c). ONLY CHECK BOX (b) WHEN THIS ADVISORY ACTION IS THE FIRST RESPONSE TO APPLICANT'S FIRST AFTER-FINAL REPLY WHICH WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. ONLY CHECK BOX (c) IN THE LIMITED SITUATION SET FORTH UNDER BOX (c). See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) or (c) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. ☒ The proposed amendments filed after a final rejection, but prior to the date of filing a brief, will not be entered because
   a) ☒ They raise new issues that would require further consideration and/or search (see NOTE below);
   b) ☐ They raise the issue of new matter (see NOTE below);
   c) ☒ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
   d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.
   NOTE: _____. (See 37 CFR 1.116 and 41.33(a)).
4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☐ Applicant's reply has overcome the following rejection(s): _____.
6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
7. ☒ For purposes of appeal, the proposed amendment(s): (a) ☒ will not be entered, or (b) ☐ will be entered, and an explanation of how the new or amended claims would be rejected is provided below or appended.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.
9. ☐ The affidavit or other evidence filed after final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
10. ☐ The affidavit or other evidence filed after the date of filing the Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing of good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
11. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

12. ☐ The request for reconsideration has been considered but does NOT place the application in condition for allowance because: _____.
13. ☐ Note the attached Information *Disclosure Statement*(s). (PTO/SB/08) Paper No(s). _____
14. ☐ Other: _____.

STATUS OF CLAIMS

15. The status of the claim(s) is (or will be) as follows:
    Claim(s) allowed: .
    Claim(s) objected to: .
    Claim(s) rejected: 50-67.
    Claim(s) withdrawn from consideration: .

/Dave Czekaj/ Supervisory Patent Examiner, Art Unit 2487	Nam Pham Examiner, Art Unit 2487

RESPONSE UNDER 37 CFR 1.116
EXPEDITED PROCEDURE
TECHNOLOGY CENTER 2487

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	Shepherd, N. B.	Attn. No.: 2007P01979WOUS	
SERIAL NO.:	12/808,685	EXAMINER:	Pham, N.D.
FILED:	June 17, 2010	ART UNIT:	2487
		CONFIRMATION No.: 5071	

FOR: ***TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE***

Mail Stop: AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AFTER FINAL OFFICE ACTION

Dear Sir:

In response to the Office Action dated January 17, 2014, the Applicant hereby submits this paper within two (2) months (until **March 17, 2014**) of the mailing date of the Office Action, and requests amendment of the above-identified application as follows wherein:

Amendments made to the Claims begin on page 2,

Remarks begin on page 8.

As this paper is being filed within two (2) months of the mailing date of the instant Office Action, applicant respectfully requests that the entry of this paper into the record be expedited to allow the Examiner sufficient time to review the arguments presented herein within the statutory time period.

/Nam Pham/ 04/01/2014

RESPONSE UNDER 37 CFR 1.116
EXPEDITED PROCEDURE
TECHNOLOGY CENTER 2487

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	Shepherd, N. B.	Attn. No.: 2007P01979WOUS	
SERIAL NO.:	12/808,685	EXAMINER:	Pham, N.D.
FILED:	June 17, 2010	ART UNIT:	2487
		CONFIRMATION No.: 5071	

FOR: ***TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE***

Mail Stop: AF
Commissioner for Patents
P.O. Box 1450
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Amendments made to the Claims begin on page 2,

Remarks begin on page 8.

As this paper is being filed within two (2) months of the mailing date of the instant Office Action, applicant respectfully requests that the entry of this paper into the record be expedited to allow the Examiner sufficient time to review the arguments presented herein within the statutory time period.

IN THE CLAIMS:
Kindly replace the claims of record with the following full set of claims:

1-49. (Canceled)

50. (Currently amended) A digital display interface part, for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter, in accordance with signal information received from the second audio-device, is operable in:

a first mode to generate a stream of first data elements, which carry pixel data of a 2D image; and,

a second mode to generate a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using and characteristics of said steam of second data elements, and wherein the second data elements have a capacity that is no greater than the corresponding first data elements.

51. (Previously presented) The interface part according to claim 50, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used in the second mode.

52. (Previously presented) The interface part according to claim 51, wherein the signaling information is carried in a horizontal or vertical blanking period.

53. (Previously presented) The interface part according to claim 50, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet between image data.

54. (Previously presented) The interface part according to claim 53, said signaling information received across the interface specifies capabilities of the second audio-visual device.

55. (Previously presented) The interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data.

56. (Previously presented) The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data sequentially.

57. (Previously presented) The interface part according to claim 56, wherein an indication of the left and right image data being indicated by signaling information carried directly adjacent a position of the image data.

58. (Previously presented) The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data by line interleaving.

59. (Previously presented) The interface part according to claims 50, wherein the stereoscopic image data components are 2D image data and image depth data.

60. (Previously presented) The interface part according to claim 59, wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data.

61. (Currently amended) A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract image data, the processor being operable, in accordance with capabilities of said second audio-visual device, In:

a first mode in which the processor extracts pixel image data for a 2D

image from a stream of first data elements; and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, the interface part arranged to receive signaling information across the interface, the signaling information identifying which mode the formatter is using and characteristics of said steam of second data elements, and wherein the second data elements have a capacity that is no greater than the corresponding first data elements.

62. (Previously presented) The interface part according to claim 61, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used, the interface part arranged to determine a stereoscopic image format being used.

63. (Previously presented) The interface part according to claim 61, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is received in a Data Island Packet between image data.

64. (Previously presented) The interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data.

65. (Currently amended) A method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information the method comprising:

receiving image data;

formatting the image data for transport over the interface, in accordance with capabilities of the second audio-visual device received in a signaling information, by:

generating a stream of first data elements which carry pixel data of a 2D image in a first mode; and,

generating a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image in a second mode, wherein characteristics of said steam of second data elements is presented in said signaling information and the second data elements have a capacity that is no greater than the corresponding first data elements.

66. (Previously presented) The method according to claim 65, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used.

67. (Currently amended) A method of processing image data at a digital display interface part of an audio-visual device, the digital display interface for transmitting

uncompressed pixel information the method comprising:

receiving signaling information and formatted image data from the interface;

extracting image data in accordance with capabilities of said audiovisual device, by:

extracting pixel image data for a 2D image from a stream of first data elements in a first mode; and,

demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image in a second mode, wherein characteristics of said steam of second data elements are presented in said signaling information and wherein the second data elements have a capacity that is no greater than the corresponding first data elements.

REMARKS

Entry of this Amendment and reconsideration are respectfully requested in view of the amendments made to the claims and for the remarks made herein.

Claims 50-67 are pending.

Claims 50-67 stand rejected.

Claims 50, 61, 63 and 67 are independent claims.

Claims 50, 61, 63 and 67 have been amended.

Claims 50-67 stand rejected under 35 USC 103(a) as being unpatentable over Ha (US 20060279750) in view of Wolf (US 6914637), Kim (US 20060044388) and Nomura (US 20060192776).

Claims 50-67, of which claims 50, 61, 63 and 67 are independent claims, stand rejected under 35 USC 103(a) as being unpatentable over Ha in view of Wolf, Kim and Nomura

In supporting the rejection of the claims, the Office Action refers to Ha for teaching a digital display, an input for receiving image data (i.e., storage unit, image characteristic parameter generator), a formatter (encoder Fig. 1, para. 0070) arranged to format the data for transport over the interface, wherein the formatter is operable in: a first mode in which the formatter generates a stream of first data elements, which carry pixel data of a 2D image (para. 0067, page 5) and a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image (3D image, para. 0067, page 5)) wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using (i.e., the 2D/3D image data obtained from the storage unit 600 and the image characteristic parameter created from the image characteristic parameter generator 610 are

converted into a transport stream format while the image data is stored into the payload of the transport stream without concerning the size of 2D/3D image, para. 0070, page 5, fig. 3, 6).

The Office Action acknowledges that Ha does not explicitly disclose about the encoder receives signal information and the size of the 3D image is no greater than the size of the 2D image.

The Office Action refers to Wolf for teaching "in accordance with signal information received from the second audio-device (i.e., *the transmitter preferably uses a DDC channel to determine the capabilities and characteristics of the receiver, col. 46, lines 5-15*)."

The Office Action further refers to Kim for teaching "and wherein the second data elements have a capacity that is no greater than the first data elements" (i.e., generate a progressive stereoscopic image signal by multiplexing the left eye image signal and the right eye image signal and scaling up or down the progressive stereoscopic image signal with a desired level of resolution according to a resolution provided by a display device, para. 0039-0052, Fig. 5 and 6)."

The Office Action further refers to Nomura for disclosing an alternating field system in which the left eye image and right eye image are interlaced on alternative horizontal lines of one pixel, so that the left eye image and right eye image will be switched and displayed alternately. The left eye image and right eye image therefore have half the vertical resolution compared to that in normal –dimensional display mode.

The Office Action concludes that it would be obvious to modify the teachings of Ha, Wolf with Kim and Nomura in order to create a digital display interface to display a 2D/3D image in different modes based on capabilities of the second device.

Applicant respectfully disagrees with and explicitly traverses the rejection of the claims.

Ha, as read by the applicant, discloses a system that provides an indication of whether a transmitted signal is one of a 2D image or a 3D image and using the indication

determines whether an operation mode conversion is necessary for converting the received image.

Ha fails to provide any teaching regarding first and second data elements or the element of "and wherein the second data elements have a capacity that is no greater than the first data elements."

Wolf, as read by the applicant, discloses a communication system for encoding audio/video material, wherein the transmitting system may determine characteristics of a receiving system by probing a memory (i.e., 23) in the receiving system, via a separate channel, that includes the characteristics of the receiving system. Wolf teaches that the transmitting system may determine from the receiver memory the decryption capabilities (if any) of the receiver. (see col. 46, lines 13-15).

Wolf fails to provide any teaching regarding first and second data elements or the element of "and wherein the second data elements have a capacity that is no greater than the first data elements."

Kim, as read by the applicant, discloses a system of transmitting an image wherein scan lines associated with individual right and left eyes are interpolated between adjacent ones of the individual right eye scan lines and left eye scans. The resultant interpolated scan lines are then multiplexed to provide a resultant image. (see for example, para. 0044, "in a method of scaling a stereoscopic image signal … a scaled stereoscopic image signal is generated by generating new scanning lines for the left eye image signal using scanning lines of the left eye image signal, generating new scanning lines of the right eye image signal using scanning lines of the right eye image signal and multiplexing the scanning lines of a input stereoscopic image signal and the newly generated lines through an interpolation operation."). Fig. 7 illustrates the resultant interpolated image, wherein the interpolated scanning lines are presented.

In addition, Kim teaches with regard to Fig. 6 that 4 scanning lines (602, 604, 606 and 608) are output as 6 scanning lines (602, 604, 610, 612, 606, and 608), wherein scanning lines 610 is interpolated from corresponding adjacent scanning lines 602 and 606 (of one eye image), and adjacent scanning line 612 (of a second eye image) is

interpolated from corresponding scanning lines 604 and 608). (see para. 46-49, "thereafter, the interpolation results are multiplexed and then output. That is, lines are multiplexed and the output in order to 602, 604, 60, 12, 606 and 608).

Hence, Kim teaches generating a resultant image that has a greater resolution than the original image as the number of scanning lines used in a transmitted image includes the original scanning lines and the interpolated scanning lines.

Hence, contrary to the assertion that Kim teaches the element of "and wherein the second data elements have a capacity that is no greater than the first data elements," Kim teaches that incorporating interpolated scanning lines increases the resolution of the resultant image.

Hence, Kim fails to disclose the element of "and wherein the second data elements have a capacity that is no greater than the first data elements."

Nomura discloses an alternating field system in which scanning lines of a left eye image and a right eye image are alternated such that the resolution of the left eye image or the right eye image is half the resolution compared to that in a normal 2-dimensional display mode.

In supporting the rejection of the claims, the Office Action appears to assert that because either the left eye image or the right eye image is one-half the resolution of a normal 2-dimensional display mode, that Nomura discloses the element of "and wherein the second data elements have a capacity that is no greater than the first data elements."

However, contrary to the assertion made in the Office Action, the stereoscopic image resulting from the combined right eye image and left eye image requires greater bandwidth to transmit the alternated right eye image information and the left eye image information as opposed to a 2-dimensional image.

On the other hand, if only half the right eye image information and left eye image information are transmitted, then the resultant 3-D image has half the resolution of the 2-D image.

Thus, assuming that the lower resolution 3D image is comparable to the second data elements and the original 2D image is comparable to the second data element, nowhere does Nomura disclose that "the second data elements have a capacity that is no greater than the first data elements."

In addressing obviousness determination under 35 USC §103, the Supreme Court in *KSR International v. Teleflex Inc.* (citation omitted) addressed the standard for obviousness that had been imposed in decisions rendered by the CAFC in that there must be some teaching, suggestion or motivation (TSM) to combine the known elements in the same manner set forth in the claims and found that the TSM to combine provides a "helpful hint" in determining whether claimed subject matter is obvious. The Court however stated that the application of the TSM (teaching, suggestion, motivation) test is not to be applied in a rigid manner and a bright light application of such a test is adverse to those factors for determining obviousness enumerated in the *Graham v. John Deere* (i.e., the scope and content of the prior art, the level of ordinary skill in the art, the differences between the claimed invention and the prior art and objective indicia of non-obviousness) (citation omitted).

The teaching, suggestion and motivation test held that a claimed invention is prima facie obvious when three basic criteria are met. First, there must be some suggestion or motivation, either in the reference themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the teachings therein. Second, there must be a reasonable expectation of success. And, third, the prior art reference or combined references must teach or suggest all the claim limitations.

The Court also reaffirmed that "a patent composed of several elements is not …. obvious merely by demonstrating that each of its elements was, independently, known in the prior art." In this regard, the KSR court stated that "it can be important to identify a reason that would have prompted a person of ordinary skill in the … field to combine the elements in the way the claimed new invention does … because inventions in most,

if not all, instances rely upon building blocks long since uncovered and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known."

Furthermore, the Court did not diminish the requirement for objective evidence of obviousness ("[r]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness."). When prior art references require a selected combination to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gained from the invention. i.e., something in the prior art as a whole must suggest the desirability and thus the obviousness of making the combination. *Uniroyal Inc. V. Rudlkin-Wiley Corp* (citation omitted).

Neither Ha, Wolf, Kim nor Nomura provides any teaching regarding the element of "and wherein the second data elements have a capacity that is no greater than the first data elements."

Applicant submits that for the amendments made to the independent claims, the combination of Ha, Wolf, Kim and Nomura fails to render unpatentable the subject matter recited in the independent claims as the combination of the references fails to teach at least one element recited in the claims and the references, as a whole, fail to provide any suggestion or motivation to develop the subject matter found to be deficient in the combination of the cited references.

For the remarks made herein, applicant submits that the reason for the rejection of the independent claims, and the claims dependent therefrom, has been overcome.

Notwithstanding the arguments above, the independent claims have been amended to further recite the element of "the signaling information identifying which mode the formatter is using and characteristics of said steam of second data elements."

No new matter has been added. Support for the amendment may be found at least on page 11, lines 15-30

"The signaling can also indicate further details of the multiplexing scheme, such as which color depth mode is being used to carry the multiplexed data, the number of bits per data element that are allocated to 2D data and the number of bits per data element that are allocated to depth data. This signaling allows flexibility in how the stereo data is allocated to data carrying elements sent across the interface 40 and allows for the amount of Depth information to be changed dynamically, according to the requirements of the content which is to be displayed. …. If depth data is carried both within the pixel data carrying data elements and other places of the stream, the signaling can indicate where the depth data is to be found. The amount of depth data and the location(s) of the depth data can vary on a dynamic basis during an image, or sequence of images, depending on the required color depth, resolution or complexity of the image (e.g. the amount of depth information within an image)."

None on the cited references provides any teaching regarding signaling information identifying which mode the formatter is using and characteristics of said steam of second data elements.

For at least this reason also, applicant submits that the cited references fail to render unpatentable the subject matter claimed.

Applicant submits that for the, amendments made to the claims and for the arguments presented herein, applicant submits that the objections and rejections of the claims have been overcome and respectfully requests that the objections and rejections be withdrawn and that a Notice of Allowance be issued.

Applicant denies any statement, position or averment stated in the Office Action that is not specifically addressed by the foregoing. Any rejection and/or points of argument not addressed are moot in view of the presented arguments and no

arguments are waived and none of the statements and/or assertions made in the Office Action is conceded.

Applicant makes no statement regarding the patentability of the subject matter recited in the claims prior to this Amendment and has amended the claims solely to facilitate expeditious prosecution of this patent application. Applicant respectfully reserves the right to pursue claims, including the subject matter encompassed by the originally filed claims, as presented prior to this Amendment, and any additional claims in one or more continuing applications during the pendency of the instant application.

In order to advance the prosecution of the matter, applicant respectively requests that any errors in form that do not alter the substantive nature of the arguments presented herein be transmitted telephonically to the applicant's representative so that such errors may be quickly resolved or pursuant to MPEP 714.03 be entered into the record to avoid continued delay of the prosecution of this matter any further.

MPEP 714.03 affords the Examiner the discretion, pursuant to 37 CFR 1.135 (c), to enter into the record a bona fide attempt to advance the application that includes minor errors in form.

"[a]n Examiner may treat an amendment not fully responsive to a non-final Office Action by: (A) accepting the amendment as an adequate reply to the non-final Office action to avoid abandonment … (B) notifying the applicant that the reply must be completed… (C) setting a new time period for applicant to complete the reply …

The treatment to be given to the amendment depends upon:

(A) whether the amendment is bona fide; (B) whether there is sufficient time for applicant's reply … (C) the nature of the deficiency.

Where an amendment substantially responds to the rejections, objections or requirements in a non-final Office action (and is bona fide attempt to advance the application to final action) but contains a minor deficiency (e.g., fails to treat every rejection, objection or requirement), the examiner may simply act on the amendment and issue a new (non-final or final) Office action. The new Office action may simply reiterate the rejection, objection or requirement not addressed by the amendment (or otherwise indicate that such rejection, objection or requirement is no longer applicable).

This course of action would not be appropriate in instances in which an amendment contains a serious deficiency (e.g., the amendment is unsigned or does not appear to have been filed in reply to the non-final Office action)…"

However, if the Examiner believes that such minor errors in form cannot be entered into the record or that the disposition of any issues arising from this response may be best resolved by a telephone call, then the Examiner is invited to contact applicant's representative at the telephone number listed below to resolve such minor errors or issues.

No fees are believed necessary for filing this paper.

Respectfully submitted,

Michael E. Belk, reg. no. 33,357

Date: March 17, 2014

/Carl A. Giordano/

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Electronic Acknowledgement Receipt	
EFS ID:	18499970
Application Number:	12808685
International Application Number:	
Confirmation Number:	5071
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh Shepherd
Customer Number:	24737
Filer:	Carl Alfonse Giordano
Filer Authorized By:	
Attorney Docket Number:	2007P01979WOUS
Receipt Date:	17-MAR-2014
Filing Date:	17-JUN-2010
Time Stamp:	18:56:53
Application Type:	U.S. National Stage under 35 USC 371

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2007P01979WOUS_ResponseToFOA_Jan172014.pdf	499622 5ba66e18cfaa4521fee258f33eb13604acb6f2e3	yes	17

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Response After Final Action	1	1
	Claims	2	7
	Applicant Arguments/Remarks Made in an Amendment	8	17
Warnings:			
Information:			
	Total Files Size (in bytes):	499622	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/808,685	Filing Date 06/17/2010	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 = *		X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 = *		X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT **03/17/2014**

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0	X $80 =	0
Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $420 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	**0**

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/DONNA 1. SMALLS LOGAN/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. 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, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/808,685	06/17/2010	Nicoll Burleigh Shepherd	2007P01979WOUS	5071

24737 7590 01/17/2014

PHILIPS INTELLECTUAL PROPERTY & STANDARDS
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BRIARCLIFF MANOR, NY 10510

EXAMINER	
PHAM, NAM D	

ART UNIT	PAPER NUMBER
2487	

NOTIFICATION DATE	DELIVERY MODE
01/17/2014	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

debbie.henn@philips.com
marianne.fox@philips.com

Office Action Summary	Application No. 12/808,685	Applicant(s) SHEPHERD, NICOLL BURLEIGH	
	Examiner NAM PHAM	Art Unit 2487	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 October 2013*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *50-67* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *50-67* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

The present application is being examined under the pre-AIA first to invent provisions.

DETAILED ACTION

Summary

1. This office action for US Patent application 12/808685 is responsive to communications filed on October 03, 2013. Currently, claims 50-67 are pending are presented for examination.

Response to Arguments

2. Applicant's arguments with respect to claims 50, 61, 65 and 67 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. **Claims 50-67** is/are rejected under 35 U.S.C §103 (a) unpatentable over **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)**.

Regarding claim 50, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

A digital display interface part **[i.e. an image transmitting apparatus; paragraph. 0064, page. 4, Fig. 6]**, for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information, the interface part comprising:

an input for receiving image data **[i.e. storage unit, image characteristic parameter generator; Fig. 6]**;

a formatter **[i.e. encoder; paragraph. 0070, page. 5, Fig. 1]** arranged to format the data for transport over the interface, wherein the formatter is operable in:

a first mode to generate a stream of first data elements, which carry pixel data of a 2D image **[i.e. 2D image signal; paragraph. 0067, page. 5]**; and,

a second to generate a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image **[i.e. 3D image signal; paragraph. 0067, page. 5]**, wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using **[i.e. the 2D/3D image data obtained from the storage unit 600 and the image characteristic parameter created from the image characteristic parameter generator 610 are converted into a transport stream format while the image data is stored into the payload of the transport stream without concerning the size of 2D/3D image; paragraph. 0070, page. 5, Fig. 3, 6]**.

However, **Ha (US 20060279750 A1** does not explicitly disclose about the encoder receives signal information from a decoder and the size of a 3D image is no greater than the size of a 2D image.

In the same field of endeavor, **Wolf et al. (US 6914637 B1)** meets the claim limitations as follows:

> In accordance with signal information received from the second audio-device **[i.e. the transmitter preferably uses a DDC channel to determine the capabilities and characteristics of the receiver; col. 46, ll. 5-15].**

In the same field of endeavor, **Kim et al. (US 20060044388 A1)** meets the claim limitations as follows:

> And wherein the second data elements have a capacity that is no greater than the corresponding first data elements **[i.e. generate a progressive stereoscopic image signal by multiplexing the left-eye image signal and the right-eye image signal, and scaling up or down the progressive stereoscopic image signal with a desired level of resolution according to a resolution provided by a display device; abstract, paragraph. 0039-0052, Fig. 5 and 6].**

In the same field of endeavor, **Nomura et al. (US 20060192776 A1)** discloses an alternating-field system in which the left-eye image and right-eye image are interlaced on alternate horizontal lines of one pixel, so that the left-eye image and right-eye image will be switched and displayed alternately. The left-eye image and right-eye image therefore have half the vertical resolution compared to that in normal 2-dimensional display mode **[paragraph. 0005, Fig. 16].**

It would have been obvious to one with ordinary skill in the art at the time of invention to modify the teachings of **Ha (US 20060279750 A1), Wolf et al. (US 6914637 B1), Kim et al. (US 20060044388 A1)** with **Nomura et al. (US 20060192776 A1)** in order to create a digital display interface to display a 2D/3D image in different modes based on capabilities of the second device while the 3D image data have a capacity that is no greater than the corresponding 2D image data.

Regarding claim 51, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 50, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used in the second mode **[i.e. the image characteristic parameter 302 may include 2D/3D identification information 302a, camera viewpoint number information 302b or display format information 302c for a 3D image; paragraph. 0056, page. 4, Fig. 3]**.

Regarding claim 52, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)** meets the claim limitations as set forth in claim 51,

Furthermore, **Wolf et al. (US 6914637 B1)** meets the claim limitations, as follows:

> The interface part according to claim 51, wherein the signaling information is carried in a horizontal or vertical blanking period **[i.e. send a signal to a receiver during each vertical blanking period; col. 3, ll. 35-45]**.

Regarding claim 53, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 50, wherein the interface is a High Definition Multimedia Interface (HDMI) **[i.e. the system consists of a decoder and an encoder used for providing services with high picture quality; paragraph. 0005, page. 1, Fig. 1 and 6]** and

Furthermore, **Wolf et al. (US 6914637 B1)** meets the claim limitations, as follows:

> the signaling information is sent in a Data Island Packet between image data **[i.e. the transmitter receives signal information about capabilities and characteristics of the receiver in the data island mode; col. 46, ll. 5-15]**.

Regarding claim 54, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)** meets the claim limitations as set forth in claim 53,

Furthermore, **Wolf et al. (US 6914637 B1)** meets the claim limitations, as follows:

> The interface part according to claim 53, said signaling information received across the interface specifies capabilities of the second audio-visual device **[i.e. the transmitter receives signal information about capabilities and characteristics of the receiver through a channel in the data island mode; col. 46, ll. 5-15].**

Regarding claim 55, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data **[i.e. a 3D image includes a left-eye image and a right- eye image; paragraph. 0062 and 0066, page 4 and 5]**.

Regarding claim 56, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)** meets the claim limitations as set forth in claim 55,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data sequentially **[i.e. sending a 3D image via transport stream format; paragraph. 0070, page. 5]**.

Regarding claim 57, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)** meets the claim limitations as set forth in claim 56,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 56, wherein an indication of the left and right image data being indicated by signaling information carried directly adjacent a position of the image data **[i.e. a header indicating 2D/3D information**

adjacent to a payload (image data) in the transport stream format; paragraph. 0012, page. 1, Fig. 3].

Regarding claim 58, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)** meets the claim limitations as set forth in claim 55,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data by line interleaving **[i.e. display formats of a 3D image; paragraph. 0061, page. 4, Fig. 5A-5D]**.

Regarding claims 59 , **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** does not explicitly disclose the following claim limitations:

The interface part according to claims 50, wherein the stereoscopic image data components are 2D image data and image depth data **[i.e. a 3D image can be any format, It can include a left image and a right image (stereoscopy) or it can include a 2D image and a depth image (autostereoscopy); paragraph. 0006, page. 1]**.

Regarding claims 60, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)** meets the claim limitations as set forth in claim 59.

Furthermore, **Ha (US 20060279750 A1)** does not explicitly disclose the following claim limitations:

The interface part according to claim 59, wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data **[i.e. a 3D image with stereoscopic or autostereoscopic format may be displayed under a disclosed stream structure indicated by the display format information 302c in the header; paragraph 0013, 0014 and 0056, page. 1 and 4, Fig. 3 and 6]**.

Regarding claim 61, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

A digital display interface **[i.e. operation mode of a display apparatus; paragraph 0013, page 1; Fig. 1]** part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and second audio-visual device, the digital display interface for transmitting uncompressed pixel information the interface part comprising:

an input for receiving formatted image data from the interface **[i.e. receiver; paragraph. 0055, page. 4, Fig. 1 and 3]**;

a processor **[i.e. decoder 110, parameter detector 120, operation mode conversion determining unit 130; paragraph. 0034, page. 2, Fig. 1]** arranged to extract image data **[i.e. decoded transport stream; paragraph. 0034, page. 2, Fig. 3]**, the processor being operable in:

a first mode in which the processor extracts pixel image data for a 2D image from a stream of first data elements **[i.e. 2D detector 122; paragraph. 0034, page. 2, Fig. 1];** and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a

multiplexed combination of components of a stereoscopic image **[i.e. 3D detector 122; paragraph. 0036, Fig. 1]**, the interface part arranged to receive signaling information across the interface, the signaling information identifying which mode the formatter is using **[i.e. 3D detector determines whether image data included in the payload of the image signal represents a 3D image to display according to image characteristic parameters in the header; paragraph. 0034, page. 2, Fig. 1], and**

However, **Ha (US 20060279750 A1** does not explicitly disclose about the encoder receives signal information from a decoder and the size of a 3D image is no greater than the size of a 2D image.

In the same field of endeavor, **Wolf et al. (US 6914637 B1)** meets the claim limitations as follows:

In accordance with capabilities of said second audio-device **[i.e. the transmitter preferably determines what type of encryption to use in response to determining the decryption (or any) capabilities of the receiver; col. 46, ll. 5-15].**

In the same field of endeavor, **Kim et al. (US 20060044388 A1)** meets the claim limitations as follows:

wherein the second data elements have a capacity that is no greater than the first corresponding data elements **[i.e. generate a progressive stereoscopic image signal by multiplexing the left-eye image signal and the right-eye image signal, and scaling up or down the progressive stereoscopic image signal with a desired level of resolution according to a resolution provided by a display device; abstract, paragraph. 0039-0052, Fig. 5 and 6].**

In the same field of endeavor, **Nomura et al. (US 20060192776 A1)** discloses an alternating-field system in which the left-eye image and right-eye image are interlaced on alternate horizontal lines of one pixel, so that the left-eye image and right-eye image will be switched and displayed alternately. The left-eye image and right-eye image therefore have half the vertical resolution compared to that in normal 2-dimensional display mode **[paragraph. 0005, Fig. 16].**

It would have been obvious to one with ordinary skill in the art at the time of invention to modify the teachings of **Ha (US 20060279750 A1), Wolf et al. (US 6914637 B1), Kim et al. (US 20060044388 A1)** with **Nomura et al. (US 20060192776 A1)** in order to create a digital display interface to display a 2D/3D image in different modes based on capabilities of the second device.

Regarding claim 62, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)** meets the claim limitations as set forth in claim 61,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 61, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used **[i.e. the header of the image signal of a transport stream format indicate a 2D/3D mode for displaying; paragraph. 0032, page. 2, Fig. 3]**, the interface part arranged to determine a stereoscopic image format being used **[i.e. a 3D image with stereoscopic or autostereoscopic format may be displayed under a disclosed stream structure indicated by the**

display format information 302c in the header; paragraph. 0013, 0014 and 0056, page. 1 and 4, Fig. 3 and 6].

Regarding claim 63, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)** meets the claim limitations as set forth in claim 61,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

The interface part according to claim 61, wherein the interface is a High Definition Multimedia Interface (HDMI) **[i.e. the system consists of a decoder and an encoder used for providing services with high picture quality; paragraph. 0005, page. 1, Fig. 1 and 6]**

Furthermore, **Wolf et al. (US 6914637 B1)** meets the claim limitations, as follows:

and the signaling information is received in a Data Island Packet between image data **[i.e. the transmitter receives signal information about capabilities and characteristics of the receiver in the data island mode; col. 46, ll. 5-15]**.

Regarding claim 64, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kim et al. (US 20060044388 A1)** further in view of **Nomura et al. (US 20060192776 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

The interface part according to 61, wherein the stereoscopic image data components are left eye image data and right eye image data **[i.e. stereo image; paragraph. 0062 and 0066, page. 4 and 5]**.

Regarding claim 65, all claimed limitations are set forth and rejected as per discussion for claim 50.

Regarding claim 66, all claimed limitations are set forth and rejected as per discussion for claim 51.

Regarding claim 67, all claimed limitations are set forth and rejected as per discussion for claim 61.

New Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications form the examiner should be directed to Nam Pham, whose can be contacted by phone at (571)270-7352. The examiner can normally be reached on Mon—Thurs.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, CZEKAJ DAVID, can be reached on (571)272-7327.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) AT 866-217-9197 (too free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Nam Pham/
Examiner, Art Unit 2487

/Dave Czekaj/
Supervisory Patent Examiner, Art Unit 2487

Notice of References Cited	Application/Control No. 12/808,685	Applicant(s)/Patent Under Reexamination SHEPHERD, NICOLL BURLEIG	
	Examiner NAM PHAM	Art Unit 2487	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2006/0279750 A1	12-2006	Ha, Tae-Hyeun	358/001.2
*	B	US-6,914,637 B1	07-2005	Wolf et al.	348/473
*	C	US-2006/0044388 A1	03-2006	Kim et al.	348/042
*	D	US-2006/0192776 A1	08-2006	Nomura et al.	345/419
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12808685	SHEPHERD, NICOLL BURLEIGH
	Examiner	**Art Unit**
	NAM PHAM	4184

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	09/05/2012	06/19/2013	12/24/2013						
	50	✓	✓	✓						
	51	✓	✓	✓						
	52	✓	✓	✓						
	53	✓	✓	✓						
	54	✓	✓	✓						
	55	✓	✓	✓						
	56	✓	✓	✓						
	57	✓	✓	✓						
	58	✓	✓	✓						
	59	✓	✓	✓						
	60	✓	✓	✓						
	61	✓	✓	✓						
	62	✓	✓	✓						
	63	✓	✓	✓						
	64	✓	✓	✓						
	65	✓	✓	✓						
	66	✓	✓	✓						
	67	✓	✓	✓						

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12808685	SHEPHERD, NICOLL BURLEIGH
	Examiner	Art Unit
	NAM PHAM	4184

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
348	46	09/05/2012	/N.P./

SEARCH NOTES		
Search Notes	Date	Examiner
Inventor search	06/19/2013	/N.P./
East search	12/24/2013	/N.P./

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	Shepherd, N. B.	Attn. No.:	2007P01979WOUS
SERIAL NO.:	12/808,685	EXAMINER:	Pham, N.D.
FILED:	June 17, 2010	ART UNIT:	2487
		CONFIRMATION No.:	5071

FOR: ***TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE***

Mail Stop: Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT

Dear Sir:

In response to the Office Action dated July 3, 2013, the Applicant hereby submits this paper within three (3) months (until **October 3, 2013**) of the mailing date of the Office Action, and requests amendment of the above-identified application as follows wherein:

Amendments made to the Claims begin on page 2,

Remarks begin on page 8.

IN THE CLAIMS:

Kindly replace the claims of record with the following full set of claims:

1-49. (Canceled)

50. (Currently amended) A digital display interface part, for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter, in accordance with signal information received from the second audio-device, is operable in:

a first mode to generate a stream of first data elements, which carry pixel data of a 2D image; and,

a second mode to generate a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using, and wherein the second data elements have a capacity that is no greater than the corresponding first data elements.

51. (Previously presented) The interface part according to claim 50, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used in the second mode.

52. (Previously presented) The interface part according to claim 51, wherein the signaling information is carried in a horizontal or vertical blanking period.

53. (Previously presented) The interface part according to claim 50, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet between image data.

54. (Previously presented) The interface part according to claim 53, said signaling information received across the interface specifies capabilities of the second audio-visual device.

55. (Previously presented) The interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data.

56. (Previously presented) The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data sequentially.

57. (Previously presented) The interface part according to claim 56, wherein an indication of the left and right image data being indicated by signaling information carried directly adjacent a position of the image data.

58. (Previously presented) The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data by line interleaving.

59. (Previously presented) The interface part according to claims 50, wherein the stereoscopic image data components are 2D image data and image depth data.

60. (Previously presented) The interface part according to claim 59, wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data.

61. (Currently amended) A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract image data, the processor being operable, in accordance with capabilities of said second audio device, In:

a first mode in which the processor extracts pixel image data for a 2D

image from a stream of first data elements; and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, the interface part arranged to receive signaling information across the interface, the signaling information identifying which mode the formatter is using and wherein the second data elements have a capacity that is no greater than the corresponding first data elements.

62. (Previously presented) The interface part according to claim 61, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used, the interface part arranged to determine a stereoscopic image format being used.

63. (Previously presented) The interface part according to claim 61, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is received in a Data Island Packet between image data.

64. (Previously presented) The interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data.

65. (Currently amended) A method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface

between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information the method comprising:

receiving image data;

formatting the image data for transport over the interface, in accordance with capabilities of the second audio-visual device received in a signaling information, by:

generating a stream of first data elements which carry pixel data of a 2D image in a first mode; and,

generating a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image in a second mode, the second data elements have a capacity that is no greater than the corresponding first data elements.

66. (Previously presented) The method according to claim 65, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used.

67. (Currently amended) A method of processing image data at a digital display interface part of an audio-visual device, the digital display interface for transmitting uncompressed pixel information the method comprising:

receiving formatted image data from the interface;

extracting image data in accordance with capabilities of said audiovisual device, by:

extracting pixel image data for a 2D image from a stream of first data elements in a first mode; and,

demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image in a second mode, wherein the second data elements have a capacity that is no greater than the corresponding first data elements.

REMARKS

Entry of this Amendment and reconsideration are respectfully requested in view of the amendments made to the claims and for the remarks made herein.

Claims 50-67 are pending.

Claims 50-67 stand rejected.

Claims 50, 61, 63 and 67 are independent claims.

Claims 50, 61, 63 and 67 have been amended.

Claims 50-67 stand rejected under 35 USC 103(a) as being unpatentable over Ha (US 20060279750) in view of Wolf (US 6914637) and Kaye (US 20050146521).

Claims 50-67, of which claims 50, 61, 63 and 67 are independent claims, stand rejected under 35 USC 103(a) as being unpatentable over Ha in view of Wolf and Kaye

In supporting the rejection of the claims, the Office Action refers to Ha for teaching a digital display, an input for receiving image data (i.e., storage unit, image characteristic parameter generator), a formatter (encoder Fig. 1, para. 0070) arranged to format the data for transport over the interface, wherein the formatter is operable in: a first mode in which the formatter generates a stream of first data elements, which carry pixel data of a 2D image (para. 0067, page 5) and a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image (3D image, para. 0067, page 5)) wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using and the second data elements have a capacity that is no greater than the first data elements (i.e., the 2D/3D image data obtained from the storage unit 600 and the image characteristic parameter created from the image characteristic parameter generator 610 are converted into a transport stream format while the image data is stored into the

payload of the transport stream without concerning the size of 2D/3D image, para. 0070, page 5, fig. 3, 6).

The Office Action acknowledges that Ha does not explicitly disclose about the encoder receives signal information and the size of the 3D image is no greater than the size of the 2D image.

The Office Action refers to Wolf for teaching "in accordance with signal information received from the second audio-device (i.e., the transmitter preferably uses a DDC channel to determine the capabilities and characteristics of the receiver, col. 46, lines 5-15)."

The Office Action further refers to Kaye for teaching "and wherein the second data elements have a capacity that is no greater than the first data elements (i.e., a 3D image has been scaled down to a smaller number of pixels and/or smaller color depth size than a 2D image, para. 0063, page 6)."

The Office Action concludes that it would be obvious to modify the teachings of Ha, Wolf with Kaye in order to create a digital display interface to display a 2D/3D image in different modes based on capabilities of the second device.

Applicant respectfully disagrees with and explicitly traverses the rejection of the claims.

Ha, as read by the applicant, discloses a system that provides an indication of whether a transmitted signal is one of a 2D image or a 3D image and using the indication determines whether an operation mode conversion is necessary for converting the received image.

Ha fails to provide any teaching regarding first and second data elements or the element of "and wherein the second data elements have a capacity that is no greater than the first data elements."

Wolf, as read by the applicant, discloses a communication system for encoding audio/video material, wherein the transmitting system may determine characteristics of a receiving system by probing a memory (i.e.,23) in the receiving system, via a separate

channel, that includes the characteristics of the receiving system. Wolf teaches that the transmitting system may determine from the receiver memory the decryption capabilities (if any) of the receiver. (see col. 46, lines 13-15).

Wolf fails to provide any teaching regarding first and second data elements or the element of "and wherein the second data elements have a capacity that is no greater than the first data elements."

Kaye, as read by the applicant, discloses a system in which high-resolution 2D images are scaled to a lower resolution prior to being converted to a 3D image. Kaye discloses that by operating on a lower resolution image, faster conversion to 3D images may be performed with little or negligible deterioration of the image and depth factors associated with a 3D image is obtained.

Kaye further discloses the low-resolution scaling of the 2D image in based on an expected image projection size (i.e., a screen size). See for example, claim 1, "selecting a screen size ... scaling depth information associated with objects in a [3D] image to preserve depths when the [3D] image is projected on the selected screen size."

However, Kaye fails to provide any teaching that the 3D image formed from the low resolution 2D image is "no greater than the first data elements."

Although the Office Action has referred to para. 0063 of Kaye for teaching the element of "the second data element being no greater than the first data elements," Applicant submits that Kaye teaches that the conversion process is performed on a smaller number of pixels because the resolution of the 2D image is smaller. (i.e., "for example, the 2D-to-3D conversion process ... is performed on images that have been scaled down to a smaller number of pixels and/or smaller color depth size.").

Nowhere does Kaye disclose that the resultant 3D image satisfies the element of "and wherein the second data elements have a capacity that is no greater than the first data elements."

Rather, Kaye merely teaches that the resultant 3D image is based on a lower resolution 2D image.

Thus, assuming that the lower resolution 2D image is comparable to the first data elements and the resultant 3D image is comparable to the second data element, nowhere does Kaye disclose that "the second data elements have a capacity that is no greater than the first data elements."

In addressing obviousness determination under 35 USC §103, the Supreme Court in *KSR International v. Teleflex Inc.* (citation omitted) addressed the standard for obviousness that had been imposed in decisions rendered by the CAFC in that there must be some teaching, suggestion or motivation (TSM) to combine the known elements in the same manner set forth in the claims and found that the TSM to combine provides a "helpful hint" in determining whether claimed subject matter is obvious. The Court however stated that the application of the TSM (teaching, suggestion, motivation) test is not to be applied in a rigid manner and a bright light application of such a test is adverse to those factors for determining obviousness enumerated in the *Graham v. John Deere* (i.e., the scope and content of the prior art, the level of ordinary skill in the art, the differences between the claimed invention and the prior art and objective indicia of non-obviousness) (citation omitted).

The teaching, suggestion and motivation test held that a claimed invention is prima facie obvious when three basic criteria are met. First, there must be some suggestion or motivation, either in the reference themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the teachings therein. Second, there must be a reasonable expectation of success. And, third, the prior art reference or combined references must teach or suggest all the claim limitations.

The Court also reaffirmed that "a patent composed of several elements is not .... obvious merely by demonstrating that each of its elements was, independently, known in the prior art." In this regard, the KSR court stated that "it can be important to identify a reason that would have prompted a person of ordinary skill in the ... field to combine the elements in the way the claimed new invention does ... because inventions in most,

if not all, instances rely upon building blocks long since uncovered and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known."

Furthermore, the Court did not diminish the requirement for objective evidence of obviousness ("[r]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness."). When prior art references require a selected combination to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gained from the invention. i.e., something in the prior art as a whole must suggest the desirability and thus the obviousness of making the combination. *Uniroyal Inc. V. Rudlkin-Wiley Corp* (citation omitted).

Neither Ha, Wolf nor Kaye provides any teaching regarding the element of "and wherein the second data elements have a capacity that is no greater than the first data elements."

Rather Kaye, which is referred to for teaching the cited claim element teaches that the 3D conversion is based on a lower resolution 2D image. Kaye does not disclose any relationship between the 3D image and the lower resolution 2D image from which the 3D is formed.

Applicant submits that for the amendments made to the independent claims, the combination of Ha, Wolf and Kaye fails to render unpatentable the subject matter recited in the independent claims as the combination of the references fails to teach at least one element recited in the claims and the references, as a whole, fail to provide any suggestion or motivation to develop the subject matter found to be deficient in the combination of the cited references.

For the remarks made herein, applicant submits that the reason for the rejection of the independent claims, and the claims dependent therefrom, has been overcome.

For the amendments made to the claims and for the arguments presented herein, applicant submits that the objections and rejections of the claims have been overcome and respectfully requests that the objections and rejections be withdrawn and that a Notice of Allowance be issued.

Applicant denies any statement, position or averment stated in the Office Action that is not specifically addressed by the foregoing. Any rejection and/or points of argument not addressed are moot in view of the presented arguments and no arguments are waived and none of the statements and/or assertions made in the Office Action is conceded.

Notwithstanding the arguments presented above, the independent claims have been amended to provide further clarity to the subject matter as the invention. Specifically, the independent claims have been amended to recite "and wherein the second data elements have a capacity that is no greater than the corresponding first data elements," in order to clarify the relationship between first and second data elements.

Hence, even if it could be said that the 3D image resulting from the conversion of the low resolution 2D image, disclosed by Kaye, were smaller than the original higher resolution 2D image, the amendment to the claims provides clarity with regard to the first and second elements being associated with images of the same resolution.

For at least this reason also, applicant submits that the cited references fail to render unpatentable the subject matter claimed.

Applicant makes no statement regarding the patentability of the subject matter recited in the claims prior to this Amendment and has amended the claims solely to facilitate expeditious prosecution of this patent application. Applicant respectfully

reserves the right to pursue claims, including the subject matter encompassed by the originally filed claims, as presented prior to this Amendment, and any additional claims in one or more continuing applications during the pendency of the instant application.

In order to advance the prosecution of the matter, applicant respectively requests that any errors in form that do not alter the substantive nature of the arguments presented herein be transmitted telephonically to the applicant's representative so that such errors may be quickly resolved or pursuant to MPEP 714.03 be entered into the record to avoid continued delay of the prosecution of this matter any further.

MPEP 714.03 affords the Examiner the discretion, pursuant to 37 CFR 1.135 (c), to enter into the record a bona fide attempt to advance the application that includes minor errors in form.

"[a]n Examiner may treat an amendment not fully responsive to a non-final Office Action by: (A) accepting the amendment as an adequate reply to the non-final Office action to avoid abandonment ... (B) notifying the applicant that the reply must be completed... (C) setting a new time period for applicant to complete the reply ...

The treatment to be given to the amendment depends upon:

(A) whether the amendment is bona fide; (B) whether there is sufficient time for applicant's reply ... (C) the nature of the deficiency.

Where an amendment substantially responds to the rejections, objections or requirements in a non-final Office action (and is bona fide attempt to advance the application to final action) but contains a minor deficiency (e.g., fails to treat every rejection, objection or requirement), the examiner may simply act on the amendment and issue a new (non-final or final) Office action. The new Office action may simply reiterate the rejection, objection or requirement not addressed by the amendment (or otherwise indicate that such rejection, objection or requirement is no longer applicable).

This course of action would not be appropriate in instances in which an amendment contains a serious deficiency (e.g., the amendment is unsigned or does not appear to have been filed in reply to the non-final Office action)..."

However, if the Examiner believes that such minor errors in form cannot be entered into the record or that the disposition of any issues arising from this response may be best resolved by a telephone call, then the Examiner is invited to contact applicant's representative at the telephone number listed below to resolve such minor errors or issues.

No fees are believed necessary for filing this paper.

Respectfully submitted,

Michael E. Belk, reg. no. 33,357

Date: September 24, 2013

/Carl A. Giordano/

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Electronic Acknowledgement Receipt	
EFS ID:	17032919
Application Number:	12808685
International Application Number:	
Confirmation Number:	5071
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh Shepherd
Customer Number:	24737
Filer:	Michael E. Belk/Elissa DeLuccy
Filer Authorized By:	Michael E. Belk
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Filing Date:	17-JUN-2010
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2007P01979WOUS_Amd.pdf	154533 8830758bf362a9a14e67420dd9fd0da42542a1e1	yes	15

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	7
	Applicant Arguments/Remarks Made in an Amendment	8	15
Warnings:			
Information:			
	Total Files Size (in bytes):	154533	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/808,685	Filing Date 06/17/2010	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)		
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	10/03/2013	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0	X $80 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $420 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/ROZENIA HARMON/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. 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, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/808,685	06/17/2010	Nicoll Burleigh Shepherd	2007P01979WOUS	5071

24737 7590 07/03/2013

PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

EXAMINER	
PHAM, NAM D	
ART UNIT	PAPER NUMBER
2487	

NOTIFICATION DATE	DELIVERY MODE
07/03/2013	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

debbie.henn@philips.com
marianne.fox@philips.com

Office Action Summary	Application No.	Applicant(s)	
	12/808,685	SHEPHERD, NICOLL BURLEIGH	
	Examiner	Art Unit	
	NAM PHAM	2487	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 June 2013*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *50-67* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *50-67* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *20101102*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 04/01/13 has been entered.

Summary

1. This office action for US Patent application 12/808685 is responsive to communications filed on April 01, 2013. Currently, claims 50-67 are pending are presented for examination.

Response to Arguments

2. Applicant's arguments with respect to claims 50, 61, 65 and 67 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:
1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. **Claims 50-67** is/are rejected under 35 U.S.C §103 (a) unpatentable over **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)**.

Regarding claim 50, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

A digital display interface part **[i.e. an image transmitting apparatus; paragraph. 0064, page. 4, Fig. 6]**, for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information, the interface part comprising:

an input for receiving image data **[i.e. storage unit, image characteristic parameter generator; Fig. 6]**;

a formatter **[i.e. encoder; paragraph. 0070, page. 5, Fig. 1]** arranged to format the data for transport over the interface, wherein the formatter is operable in:

a first mode to generate a stream of first data elements, which carry pixel data of a 2D image **[i.e. 2D image signal; paragraph. 0067, page. 5]**; and,

a second to generate a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image **[i.e. 3D image signal; paragraph. 0067, page. 5]**, wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using **[i.e. the 2D/3D image data obtained from the storage unit 600 and the image characteristic parameter created from the image characteristic parameter generator 610 are converted into a transport stream format while the image data is stored into the payload of the transport stream without concerning the size of 2D/3D image; paragraph. 0070, page. 5, Fig. 3, 6]**.

However, **Ha (US 20060279750 A1** does not explicitly disclose about the encoder receives signal information from a decoder and the size of a 3D image is no greater than the size of a 2D image.

In the same field of endeavor, **Wolf et al. (US 6914637 B1)** meets the claim limitations as follows:

> In accordance with signal information received from the second audio-device **[i.e. the transmitter preferably uses a DDC channel to determine the capabilities and characteristics of the receiver; col. 46, ll. 5-15].**

In the same field of endeavor, **Kaye et al. (US 20050146521 A1)** meets the claim limitations as follows:

> And wherein the second data elements have a capacity that is no greater than the first data elements **[i.e. a 3D image has been scaled down to a smaller number of pixels and/or a smaller color depth size than a 2D image; paragraph. 0063, page. 6].**

It would have been obvious to one with ordinary skill in the art at the time of invention to modify the teachings of **Ha (US 20060279750 A1), Wolf et al. (US 6914637 B1)** with **Kaye et al. (US 20050146521 A1)** in order to create a digital display interface to display a 2D/3D image in different modes based on capabilities of the second device.

Regarding claim 51, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

The interface part according to claim 50, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used in the second mode **[i.e. the image characteristic parameter 302 may include 2D/3D identification information 302a, camera viewpoint number information 302b or display format information 302c for a 3D image; paragraph. 0056, page. 4, Fig. 3]**.

Regarding claim 52, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)** meets the claim limitations as set forth in claim 51,

Furthermore, **Wolf et al. (US 6914637 B1)** meets the claim limitations, as follows:

The interface part according to claim 51, wherein the signaling information is carried in a horizontal or vertical blanking period **[i.e. send a signal to a receiver during each vertical blanking period; col. 3, ll. 35-45]**.

Regarding claim 53, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

The interface part according to claim 50, wherein the interface is a High Definition Multimedia Interface (HDMI) **[i.e. the system consists of a decoder and an encoder used for providing services with high picture quality; paragraph. 0005, page. 1, Fig. 1 and 6]** and

Furthermore, **Wolf et al. (US 6914637 B1)** meets the claim limitations, as follows:

the signaling information is sent in a Data Island Packet between image data **[i.e. the transmitter receives signal information about capabilities and characteristics of the receiver in the data island mode; col. 46, ll. 5-15]**.

Regarding claim 54, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)** meets the claim limitations as set forth in claim 53,

Furthermore, **Wolf et al. (US 6914637 B1)** meets the claim limitations, as follows:

The interface part according to claim 53, said signaling information received across the interface specifies capabilities of the second audio-visual device **[i.e. the transmitter receives signal information about capabilities and characteristics of the receiver through a channel in the data island mode; col. 46, ll. 5-15]**.

Regarding claim 55, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

The interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data **[i.e. a 3D image includes a left-eye image and a right- eye image; paragraph. 0062 and 0066, page 4 and 5]**.

Regarding claim 56, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)** meets the claim limitations as set forth in claim 55,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data sequentially **[i.e. sending a 3D image via transport stream format; paragraph. 0070, page. 5]**.

Regarding claim 57, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)** meets the claim limitations as set forth in claim 56,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 56, wherein an indication of the left and right image data being indicated by signaling information carried directly adjacent a position of the image data **[i.e. a header indicating 2D/3D information adjacent to a payload (image data) in the transport stream format; paragraph. 0012, page. 1, Fig. 3]**.

Regarding claim 58, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)** meets the claim limitations as set forth in claim 55,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data by line interleaving **[i.e. display formats of a 3D image; paragraph. 0061, page. 4, Fig. 5A-5D]**.

Regarding claims 59 , **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** does not explicitly disclose the following claim limitations:

The interface part according to claims 50, wherein the stereoscopic image data components are 2D image data and image depth data **[i.e. a 3D image can be any format, It can include a left image and a right image (stereoscopy) or it can include a 2D image and a depth image (autostereoscopy); paragraph. 0006, page. 1]**.

Regarding claims 60, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)** meets the claim limitations as set forth in claim 59,

Furthermore, **Ha (US 20060279750 A1)** does not explicitly disclose the following claim limitations:

The interface part according to claim 59, wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data **[i.e. a 3D image with stereoscopic or autostereoscopic format may be displayed under a**

disclosed stream structure indicated by the display format information 302c in the header; paragraph 0013, 0014 and 0056, page. 1 and 4, Fig. 3 and 6].

Regarding claim 61, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

A digital display interface **[i.e. operation mode of a display apparatus; paragraph 0013, page 1; Fig. 1]** part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and second audio-visual device, the digital display interface for transmitting uncompressed pixel information the interface part comprising:

an input for receiving formatted image data from the interface **[i.e. receiver; paragraph. 0055, page. 4, Fig. 1 and 3]**;

a processor **[i.e. decoder 110, parameter detector 120, operation mode conversion determining unit 130; paragraph. 0034, page. 2, Fig. 1]** arranged to extract image data **[i.e. decoded transport stream; paragraph. 0034, page. 2, Fig. 3]**, the processor being operable in:

a first mode in which the processor extracts pixel image data for a 2D image from a stream of first data elements **[i.e. 2D detector 122; paragraph. 0034, page. 2, Fig. 1];** and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image **[i.e. 3D detector 122; paragraph. 0036, Fig. 1]**, the interface part arranged to receive signaling information across the interface, the signaling information identifying which mode the formatter is using **[i.e. 3D detector determines whether image data included in the payload of the image signal represents a 3D image to**

display according to image characteristic parameters in the header; paragraph. 0034, page. 2, Fig. 1], and

However, **Ha (US 20060279750 A1** does not explicitly disclose about the encoder receives signal information from a decoder and the size of a 3D image is no greater than the size of a 2D image.

In the same field of endeavor, **Wolf et al. (US 6914637 B1)** meets the claim limitations as follows:

In accordance with capabilities of said second audio-device **[i.e. the transmitter preferably determines what type of encryption to use in response to determining the decryption (or any) capabilities of the receiver; col. 46, ll. 5-15].**

In the same field of endeavor, **Kaye et al. (US 20050146521 A1)** meets the claim limitations as follows:

wherein the second data elements have a capacity that is no greater than the first data elements **[i.e. a 3D image has been scaled down to a smaller number of pixels and/or a smaller color depth size than a 2D image; paragraph. 0063, page. 6].**

It would have been obvious to one with ordinary skill in the art at the time of invention to modify the teachings of **Ha (US 20060279750 A1), Wolf et al. (US 6914637 B1)** with **Kaye et al. (US 20050146521 A1)** in order to create a digital display interface to display a 2D/3D image in different modes based on capabilities of the second device.

Regarding claim 62, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)** meets the claim limitations as set forth in claim 61,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 61, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used **[i.e. the header of the image signal of a transport stream format indicate a 2D/3D mode for displaying; paragraph. 0032, page. 2, Fig. 3]**, the interface part arranged to determine a stereoscopic image format being used **[i.e. a 3D image with stereoscopic or autostereoscopic format may be displayed under a disclosed stream structure indicated by the display format information 302c in the header; paragraph. 0013, 0014 and 0056, page. 1 and 4, Fig. 3 and 6]**.

Regarding claim 63, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)** meets the claim limitations as set forth in claim 61,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 61, wherein the interface is a High Definition Multimedia Interface (HDMI) **[i.e. the system consists of a decoder and an encoder used for providing services with high picture quality; paragraph. 0005, page. 1, Fig. 1 and 6]** and the signaling information is received in a Data Island Packet between image data **[i.e. image signal format; Fig. 3]**.

Regarding claim 64, **Ha (US 20060279750 A1)** in view of **Wolf et al. (US 6914637 B1)** further in view of **Kaye et al. (US 20050146521 A1)** meets the claim limitations as set forth in claim 61,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to 61, wherein the stereoscopic image data components are left eye image data and right eye image data **[i.e. stereo image; paragraph. 0062 and 0066, page. 4 and 5]**.

Regarding claim 65, all claimed limitations are set forth and rejected as per discussion for claim 50.

Regarding claim 66, all claimed limitations are set forth and rejected as per discussion for claim 51.

Regarding claim 67, all claimed limitations are set forth and rejected as per discussion for claim 61.

Conclusion

Any inquiry concerning this communication or earlier communications form the examiner should be directed to Nam Pham, whose can be contacted by phone at (571)270-7352. The examiner can normally be reached on Mon—Thurs.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, CZEKAJ DAVID, can be reached on (571)272-7327.

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/Nam Pham/
Examiner, Art Unit 2487

/Dave Czekaj/
Supervisory Patent Examiner, Art Unit 2487

Notice of References Cited	Application/Control No. 12/808,685	Applicant(s)/Patent Under Reexamination SHEPHERD, NICOLL BURLEIG	
	Examiner NAM PHAM	Art Unit 2487	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2006/0279750	12-2006	Ha, Tae-Hyeun	358/001.2
*	B	US-6,914,637 B1	07-2005	Wolf et al.	348/473
*	C	US-2005/0146521 A1	07-2005	Kaye et al.	345/419
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
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FOREIGN PATENT DOCUMENTS

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12/808,685	06/17/2010	348	2487	2007P01979WOUS

APPLICANTS
Nicoll Burleigh Shepherd, Coulsdon, UNITED KINGDOM;

**** CONTINUING DATA ***************************
This application is a 371 of PCT/IB2008/055305 12/15/2008

**** FOREIGN APPLICATIONS ***************************
EUROPEAN PATENT OFFICE (EPO) 07123461.1 12/18/2007

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Foreign Priority claimed ☑ Yes ☐ No 35 USC 119(a-d) conditions met ☑ Yes ☐ No Verified and Acknowledged /NAM D PHAM/ Examiner's Signature	☐ Met after Allowance /N.P./ Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		UNITED KINGDOM	3	18	4

ADDRESS

PHILIPS INTELLECTUAL PROPERTY & STANDARDS
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BRIARCLIFF MANOR, NY 10510
UNITED STATES

TITLE

TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE

FILING FEE RECEIVED		
1200	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12808685	SHEPHERD, NICOLL BURLEIGH
	Examiner	Art Unit
	NAM PHAM	4184

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	09/05/2012	06/19/2013							
	50	✓	✓							
	51	✓	✓							
	52	✓	✓							
	53	✓	✓							
	54	✓	✓							
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	63	✓	✓							
	64	✓	✓							
	65	✓	✓							
	66	✓	✓							
	67	✓	✓							

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Doc description: Information Disclosure Statement (IDS) Filed

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	12808685
	Filing Date	2010-06-17
	First Named Inventor	Nicoll Burleigh Shepherd
	Art Unit	2621
	Examiner Name	/Nam Pham/
	Attorney Docket Number	009723US1

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	1	20020009137	A1	2002-01-24	NELSON ET AL	
	2	20070139769	A1	2007-06-21	DECUSATIS ET AL	

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	1	2006137006	WO	A2	2006-12-28	FUNKE ET AL		☐
	2	2007069195	WO	A2	2007-06-21	ZUIDEMA ET AL		☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12808685
	Filing Date	2010-06-17
	First Named Inventor	Nicoll Burleigh Shepherd
	Art Unit	2621
	Examiner Name	/Nam Pham/
	Attorney Docket Number	009723US1

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	758	348/46.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/08/29 15:10
S2	688	video adj summary	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/08/29 15:12
S3	39	(video adj summary) SAME signal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/08/29 15:17
S4	3	(video adj summary) SAME (content adj signal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/08/29 15:50
S5	16	(video adj summary) SAME (classif$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/08/29 16:03
S6	751	348/46.ccls.	US-PGPUB; USPAT	OR	ON	2012/08/31 15:17
S7	225	digital adj display adj interface	US-PGPUB; USPAT	OR	ON	2012/08/31 15:23
S8	16	S7 AND (2D OR 3D)	US-PGPUB; USPAT	OR	ON	2012/08/31 15:31
S9	7	S7 AND (stereoscop$3)	US-PGPUB; USPAT	OR	ON	2012/08/31 15:36
S10	131	S7 AND mode	US-PGPUB; USPAT	OR	ON	2012/08/31 15:39
S11	5	interface AND stereocop$3	US-PGPUB; USPAT	OR	ON	2012/08/31 16:00
S12	26078	display adj interface	US-PGPUB; USPAT	OR	ON	2012/08/31 16:02

S13	5401	S12 AND ((transmit OR generate) adj (data OR image))	US-PGPUB; USPAT	OR	ON	2012/08/31 16:03
S14	4631	S13 AND digital	US-PGPUB; USPAT	OR	ON	2012/08/31 16:03
S15	3293	S14 AND format	US-PGPUB; USPAT	OR	ON	2012/08/31 16:04
S16	2364	S15 AND mode	US-PGPUB; USPAT	OR	ON	2012/08/31 16:04
S17	2308	S16 AND first	US-PGPUB; USPAT	OR	ON	2012/08/31 16:04
S18	2234	S17 AND second	US-PGPUB; USPAT	OR	ON	2012/08/31 16:04
S19	442	S18 and (2D OR 3D)	US-PGPUB; USPAT	OR	ON	2012/08/31 16:05
S20	422	S19 AND signal	US-PGPUB; USPAT	OR	ON	2012/08/31 16:05
S21	418	S20 AND information	US-PGPUB; USPAT	OR	ON	2012/08/31 16:06
S22	247	S21 AND pixel	US-PGPUB; USPAT	OR	ON	2012/08/31 16:06
S23	4191	left adj eye adj image	US-PGPUB; USPAT	OR	ON	2012/09/04 07:54
S24	3410	(left adj eye adj image) SAME (right adj eye adj image)	US-PGPUB; USPAT	OR	ON	2012/09/04 07:54
S25	610	(left adj eye adj image) SAME (right adj eye adj image) SAME "2"$1D	US-PGPUB; USPAT	OR	ON	2012/09/04 07:55
S26	461	S25 AND stereoscop$3	US-PGPUB; USPAT	OR	ON	2012/09/04 07:56
S27	451	S26 AND display	US-PGPUB; USPAT	OR	ON	2012/09/04 07:56
S28	228	S27 AND interface	US-PGPUB; USPAT	OR	ON	2012/09/04 07:56
S29	175	S28 AND mode	US-PGPUB; USPAT	OR	ON	2012/09/04 07:57
S31	4	S29 AND (signaling adj information)	US-PGPUB; USPAT	OR	ON	2012/09/04 08:21
S32	37	data adj island adj packet	US-PGPUB; USPAT	OR	ON	2012/09/05 08:56
S33	610	(left adj eye adj image) SAME (right adj eye adj image) SAME "2"$1D	US-PGPUB; USPAT	OR	ON	2012/09/05 09:30
S34	461	S33 AND stereoscop$3	US-PGPUB; USPAT	OR	ON	2012/09/05 09:30
S35	451	S34 AND display	US-PGPUB; USPAT	OR	ON	2012/09/05 09:30
S36	318	S35 AND mode	US-PGPUB; USPAT	OR	ON	2012/09/05 09:30
S37	2	"20090080853"	US-PGPUB; USPAT	OR	ON	2012/09/06 11:32
S38	1	"20020093812"	US-PGPUB; USPAT	OR	ON	2012/09/06 13:31
S39	2	"20080037033"	US-PGPUB; USPAT	OR	ON	2012/09/06 13:35
S40	9	"6320641"	US-PGPUB; USPAT	OR	ON	2012/09/06 13:36

S41	1	"7668382"	US-PGPUB; USPAT	OR	ON	2012/09/06 13:52
S42	2915	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same mode$1 same (transmit$5 or transfer$5)	US-PGPUB; USPAT	OR	ON	2013/06/05 13:33
S43	11	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same mode$1 same (transmit$5 or transfer$5) same un$1compress$3	US-PGPUB; USPAT	OR	ON	2013/06/05 13:35
S44	9	S43 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/05 13:40
S45	1637	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same mode$1 same (transmit$5 or transfer$5 or send$5) same image$1	US-PGPUB; USPAT	OR	ON	2013/06/05 13:57
S46	783	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same mode$1 same (transmit$5 or transfer$5 or send$5) same image$1 same (generat$4 or produc$4)	US-PGPUB; USPAT	OR	ON	2013/06/05 14:02
S47	25	S46 AND HDMI$1	US-PGPUB; USPAT	OR	ON	2013/06/05 14:04
S48	1	S47 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/05 14:04
S49	83	S45 AND HDMI$1	US-PGPUB; USPAT	OR	ON	2013/06/05 14:05
S50	2	S49 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/05 14:05
S51	476	S46 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/05 14:15
S52	14	S51 AND un$1compress$5	US-PGPUB; USPAT	OR	ON	2013/06/05 14:16
S53	154	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same image$1 same HDMI$1	US-PGPUB; USPAT	OR	ON	2013/06/05 14:38
S54	3	S53 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/05 15:09
S55	12611	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same image$1 same mode$1	US-PGPUB; USPAT	OR	ON	2013/06/05 15:13
S56	1179	("3"$1d or three$1dimension$3 or "3"$1demension$3 or steoscop$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same image$1 same mode$1 same interfac$4	US-PGPUB; USPAT	OR	ON	2013/06/05 15:15
S57	286	("3"$1d or three$1dimension$3 or "3"$1demension$3 or steoscop$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same image$1 same mode$1 same interfac$4 same (transfer$4 or transmit$4 or send$4)	US-PGPUB; USPAT	OR	ON	2013/06/05 15:17

S58	175	S57 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/05 15:19
S59	236	("3"$1d or three$1dimension$3 or "3"$1demension$3) same ("2"$1d or two$1dimension$3 or "2"$1demension$3) same signal same capabilit$3 same (sen$4 or receiv$4)	US-PGPUB; USPAT	OR	ON	2013/06/19 08:50
S60	153	S59 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/19 08:52
S61	25	(US-20030231191-$ or US-20040181806-$ or US-20040218599-$ or US-20050184993-$ or US-20100315489-$ or US-20080240152-$ or US-20080008172-$ or US-20070286246-$ or US-20070242068-$ or US-20100027113-$ or US-20030128871-$ or US-20050030301-$ or US-20080013001-$ or US-20070165304-$ or US-20070097024-$ or US-20060279750-$ or US-20070296721-$).did. or (US-8068485-$ or US-5644324-$ or US-6094182-$ or US-6911975-$ or US-7098888-$ or US-7362324-$ or US-6914637-$ or US-7088398-$).did.	US-PGPUB; USPAT	OR	ON	2013/06/19 08:52
S62	11	S61 AND capabilit$4	US-PGPUB; USPAT	OR	ON	2013/06/19 08:53
S63	5443	("3"$1d or three$1dimension$3 or "3"$1demension$3 or stereoscop$3) with ("2"$1d or two$1dimension$3 or "2"$1demension$3) with (size$1 or capabilit$3)	US-PGPUB; USPAT	OR	ON	2013/06/19 09:11
S64	988	("3"$1d or three$1dimension$3 or "3"$1demension$3 or stereoscop$3) with ("2"$1d or two$1dimension$3 or "2"$1demension$3) with (size$1 or capabilit$3) with (great$1 or small$4 or sam$1 or reduc$4)	US-PGPUB; USPAT	OR	ON	2013/06/19 09:14
S65	123	S64 AND (transmitter$1 or encoder$1) and (receiver$1 or decoder$1)	US-PGPUB; USPAT	OR	ON	2013/06/19 09:16
S66	56	S65 AND @ad<"20071218"	US-PGPUB; USPAT	OR	ON	2013/06/19 09:16

6/19/2013 2:50:45 PM
C:\Users\npham\Documents\EAST\Workspaces\12808685.wsp

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12808685	SHEPHERD, NICOLL BURLEIGH
	Examiner	Art Unit
	NAM PHAM	4184

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
348	46	09/05/2012	/N.P./

SEARCH NOTES		
Search Notes	Date	Examiner
Inventor search	06/19/2013	/N.P./
East search		/N.P./

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

PTO/SB/30EFS (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
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 contains a valid OMB control number.

REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	12808685	Filing Date	2010-06-17	Docket Number (if applicable)	2007P01979WOUS	Art Unit	2487
First Named Inventor	Nicoli burleigh Shepherd			Examiner Name	Nam D. Pham		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☒ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

☐ Other _____

☐ Enclosed

☐ Amendment/Reply

☐ Information Disclosure Statement (IDS)

☐ Affidavit(s)/ Declaration(s)

☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

☒ The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 141270

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

☐ Applicant Signature

PTO/SB/30EFS (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
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 contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature	/Michael E. Belk/	Date (YYYY-MM-DD)	2013-05-01
Name	Michael E. Belk	Registration Number	33357

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. 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, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal	
Application Number:	12808685
Filing Date:	17-Jun-2010
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh Shepherd
Filer:	Michael E. Belk/Elissa DeLuccy
Attorney Docket Number:	2007P01979WOUS
Filed as Large Entity	

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Request for Continued Examination	1801	1	1200	1200
		Total in USD ($)		**1200**

Electronic Acknowledgement Receipt	
EFS ID:	15662276
Application Number:	12808685
International Application Number:	
Confirmation Number:	5071
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh Shepherd
Customer Number:	24737
Filer:	Michael E. Belk/Elissa DeLuccy
Filer Authorized By:	Michael E. Belk
Attorney Docket Number:	2007P01979WOUS
Receipt Date:	01-MAY-2013
Filing Date:	17-JUN-2010
Time Stamp:	13:29:32
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1200
RAM confirmation Number	11898
Deposit Account	141270
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. 1.492 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)	
Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Continued Examination (RCE)	2007P01979WOUS_RCE.pdf	697783 233048c96cb5cb1408cf0ba11b57c225f2d2740a	no	3
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30704 321b17c62356101ff8fb6863d532baae7a88f644	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	728487		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number	Filing Date	☐ To be Mailed
12/808,685	06/17/2010	

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	18 minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	4 minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	05/01/2013	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 18	Minus	** 20	=	X $ =	
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/PEGGY YARBOROUGH/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. 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, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/808,685	06/17/2010	Nicoll Burleigh Shepherd	2007P01979WOUS	5071

24737 7590 04/12/2013

PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

EXAMINER	
PHAM, NAM D	

ART UNIT	PAPER NUMBER
2487	

NOTIFICATION DATE	DELIVERY MODE
04/12/2013	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

debbie.henn@philips.com
marianne.fox@philips.com

Advisory Action Before the Filing of an Appeal Brief	**Application No.** 12/808,685	**Applicant(s)** SHEPHERD, NICOLL BURLEIGH
	Examiner NAM PHAM	**Art Unit** 2487

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 01 April 2013 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

NO NOTICE OF APPEAL FILED

1. ☒ The reply was filed after a final rejection. No Notice of Appeal has been filed. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114 if this is a utility or plant application. Note that RCEs are not permitted in design applications. The reply must be filed within one of the following time periods:
   a) ☐ The period for reply expires _____months from the mailing date of the final rejection.
   b) ☒ The period for reply expires on: (1) the mailing date of this Advisory Action; or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.
   c) ☐ A prior Advisory Action was mailed more than 3 months after the mailing date of the final rejection in response to a first after-final reply filed within 2 months of the mailing date of the final rejection. The current period for reply expires months from the mailing date of *the prior Advisory Action* or SIX MONTHS from the mailing date of the final rejection, whichever is earlier.
   Examiner Note: If box 1 is checked, check either box (a), (b) or (c). ONLY CHECK BOX (b) WHEN THIS ADVISORY ACTION IS THE FIRST RESPONSE TO APPLICANT'S FIRST AFTER-FINAL REPLY WHICH WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. ONLY CHECK BOX (c) IN THE LIMITED SITUATION SET FORTH UNDER BOX (c). See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) or (c) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. ☒ The proposed amendments filed after a final rejection, but prior to the date of filing a brief, will not be entered because
   a) ☒ They raise new issues that would require further consideration and/or search (see NOTE below);
   b) ☐ They raise the issue of new matter (see NOTE below);
   c) ☒ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
   d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.
   NOTE: *See Continuation Sheet*. (See 37 CFR 1.116 and 41.33(a)).
4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☐ Applicant's reply has overcome the following rejection(s): _____.
6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
7. ☒ For purposes of appeal, the proposed amendment(s): (a) ☒ will not be entered, or (b) ☐ will be entered, and an explanation of how the new or amended claims would be rejected is provided below or appended.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ The affidavit or other evidence filed after final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
9. ☐ The affidavit or other evidence filed after the date of filing the Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing of good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
10. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

11. ☐ The request for reconsideration has been considered but does NOT place the application in condition for allowance because: _____.
12. ☐ Note the attached Information *Disclosure Statement*(s). (PTO/SB/08) Paper No(s). _____
13. ☐ Other: _____.

STATUS OF CLAIMS

14. The status of the claim(s) is (or will be) as follows:
    Claim(s) allowed: .
    Claim(s) objected to: .
    Claim(s) rejected: 50-67.
    Claim(s) withdrawn from consideration: .

/Dave Czekaj/ Supervisory Patent Examiner, Art Unit 2487	/Nam Pham/

Continuation of 3. NOTE: the proposed amendment changed the scope of the claim and require a further search/consideration.

REPLY UNDER 37 CFR 1.116
EXPEDITED PROCEDURE
TECHNOLOGY CENTER 4184

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	Shepherd, N. B.	Attn. No.:	2007P01979WOUS
SERIAL NO.:	12/808,685	EXAMINER:	Pham, N.D.
FILED:	June 17, 2010	ART UNIT:	4184
		CONFIRMATION No.:	5071

FOR: ***TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE***

Mail Stop: AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

/Nam Pham/

AMENDMENT AFTER FINAL OFFICE ACTION

Dear Sir:

In response to the Office Action dated February 1, 2013, the Applicant hereby submits this paper within two (2) months (until **April 1, 2013**) of the mailing date of the Office Action, and requests amendment of the above-identified application as follows wherein:

Amendments made to the Claims begin on page 2,

Remarks begin on page 7.

As this paper is being filed within two (2) months of the mailing date of the instant Office Action, applicant respectfully requests that the entry of this paper into the record be expedited to allow the Examiner sufficient time to review the arguments presented herein within the statutory time period.

REPLY UNDER 37 CFR 1.116
EXPEDITED PROCEDURE
TECHNOLOGY CENTER 4184

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	Shepherd, N. B.	Attn. No.:	2007P01979WOUS
SERIAL NO.:	12/808,685	EXAMINER:	Pham, N.D.
FILED:	June 17, 2010	ART UNIT:	4184
		CONFIRMATION No.:	5071

FOR: ***TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE***

Mail Stop: AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AFTER FINAL OFFICE ACTION

Dear Sir:

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Amendments made to the Claims begin on page 2,

Remarks begin on page 7.

As this paper is being filed within two (2) months of the mailing date of the instant Office Action, applicant respectfully requests that the entry of this paper into the record be expedited to allow the Examiner sufficient time to review the arguments presented herein within the statutory time period.

IN THE CLAIMS:
Kindly replace the claims of record with the following full set of claims:

1-49. (Canceled)

50. (Currently amended) A digital display interface part, for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter, in accordance with signal information received from the second audio-device, is operable in:

a first mode to generate ~~in which the formatter generates~~ a stream of first data elements, which carry pixel data of a 2D image; and,

a second mode to generate ~~in which the formatter generates~~ a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using, and wherein the second data elements have a capacity that is no greater than the first data elements.

51. (Previously presented) The interface part according to claim 50, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used in the second mode.

52. (Previously presented) The interface part according to claim 51, wherein the signaling information is carried in a horizontal or vertical blanking period.

53. (Previously presented) The interface part according to claim 50, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet between image data.

54. (Currently amended) The interface part according to claim 53, said ~~which is arranged to receive~~ signaling information received across the interface specifies ~~specifying~~ capabilities of the second audio-visual device.

55. (Previously presented) The interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data.

56. (Previously presented) The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data sequentially.

57. (Previously presented) The interface part according to claim 56, wherein an indication of the left and right image data being indicated by signaling information carried directly adjacent a position of the image data.

58. (Previously presented) The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data by line interleaving.

59. (Previously presented) The interface part according to claims 50, wherein the stereoscopic image data components are 2D image data and image depth data.

60. (Previously presented) The interface part according to claim 59, wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data.

61. (Currently amended) A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and a second ~~another~~ audio-visual device, the digital display interface for transmitting uncompressed pixel information the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract image data, the processor being operable, in accordance with capabilities of said second audio device, In:

a first mode in which the processor extracts pixel image data for a 2D

image from a stream of first data elements; and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, the interface part arranged to receive signaling information across the interface, the signaling information identifying which mode the formatter is using and wherein the second data elements have a capacity that is no greater than the first data elements.

62. (Previously presented) The interface part according to claim 61, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used, the interface part arranged to determine a stereoscopic image format being used.

63. (Previously presented) The interface part according to claim 61, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is received in a Data Island Packet between image data.

64. (Previously presented) The interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data.

65. (Currently amended) A method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface

between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information the method comprising:

receiving image data;

formatting the image data for transport over the interface, in accordance with capabilities of the second audio-visual device received in a signaling information, by:

~~in a first mode~~, generating a stream of first data elements which carry pixel data of a 2D image in a first mode; and,

~~in a second mode,~~ generating a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image in a second mode, the second data elements have a capacity that is no greater than the first data elements.

66. (Previously presented) The method according to claim 65, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used.

67. (Currently amended) A method of processing image data at a digital display interface part of an audio-visual device, the digital display interface for transmitting uncompressed pixel information the method comprising:

receiving formatted image data from the interface;

extracting image data in accordance with capabilities of said audiovisual device,

by:

~~in a first mode,~~ extracting pixel image data for a 2D image from a stream of first data elements in a first mode; and,

~~in a second mode,~~ demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image in a second mode, wherein the second data elements have a capacity that is no greater than the first data elements.

REMARKS

Entry of this Amendment and reconsideration are respectfully requested in view of the amendments made to the claims and for the remarks made herein.

Claims 50-67 are pending.

Claims 50-67 stand rejected.

Claims 50, 61, 63 and 67 are independent claims.

Claims 50, 61, 63 and 67 have been amended.

Claims 50-58 and 61-67 stand rejected under 35 USC 103(a) as being unpatentable over Ha (US 20060279750). Claims 59 and 60-stand rejected under 35 USC 103(a) as being unpatentable over Ha.

Prior to comments on the merits of the rejection of the claim, the Office Action states that claims 60, 62-64 and 66 are objected to. However, the Office Action does not provide any reason for objecting to these claims.

Applicant assumes that the objection to claims 60, 62-64 and 66 is incorrect and represents a carry-over from the prior Office Action.

However, if applicant's assumption is deemed incorrect, then applicant respectfully requests that the reasons for the objections to the aforementioned claims be presented and a new period of time for responding to the instant Office Action be set.

Claims 50-58 and 61-67, of which claims 50, 61, 63 and 67 are independent claims, stand rejected under 35 USC 103(a) as being unpatentable over Ha.

In supporting the rejection of the claims, the Office Action refers to Ha for teaching a digital display, an input for receiving image data, a formatter (encoder Fig. 1, para. 0070) arranged to format the data for transport over the interface, wherein the

formatter is operable in: a first mode in which the formatter generates a stream of first data elements, which carry pixel data of a 2D image (para. 0067) and a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image (3D image, para. 0067) wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using and the second data elements have a capacity that is no greater than the first data elements (i.e., the 2D/3D image data obtained from the storage unit 600 and the image characteristic parameter created from the image characteristic parameter generator 610 are converted into a transport stream format while the image data is stored into the payload of the transport stream without concerning the size of 2D/3D image, para. 0070, page 5, fig. 3, 6).

In addition, in reply to the applicant's response to the previous Office Action, the instant Office Action states "On page 9, applicant argues 'the second data elements ... have a capacity that is not greater than the first data elements ..." with respect to claims50, 61, 65 and 67. While the applicant's arguments are understood, the examiner respectfully disagrees. In para. 0070, Ha describes a method/system wherein 2D/3D images are converted into a transport stream format while the image data is stored into the payload of the transport stream without concerning the size of 2D/3D image. In other words, this system is able to transport 2D/3D images without image-size modification. In order to transmit 3D images which have a capacity not greater than 2D images, other components may be modified in the system to reduce the size of 3D images before transporting for example reducing resolution, improving coding efficiency, etc. This requires no more than ordinary skills in the art.

.

Applicant respectfully disagrees with and explicitly traverses the rejection of the claims.

However, in the interest of advancing the prosecution of this matter, the independent claims have been amended to further recite the element of "a formatter arranged to format the data for transport over the interface, wherein the formatter, in accordance with signal information received from the second audio-device." No new matter has been added. Support for the amendment may be found at least on in claim 54.

Although claim 54 has been rejected based upon the teachings of Ha (paragraph 0033; paragraph 0070), applicant submits that Ha fails to teach that the formatter operates in accordance with capabilities of the second audio device. More specifically paragraph 33 states that the decoder 110 decodes a single image according to an encryption specification of the ***image transmitting apparatus***.

Hence, the receiving device operates in accordance with the encoding principles of the transmitting devices. Ha fails to provide any information regarding its specific capabilities with regard to whether a 2-D or 3-D image may be displayable.

In addition, in addition paragraph 070 teaches that the encoder receives the image data obtained by picking up the object from the storage unit 600 and the image characteristic parameter created by the image characteristic parameter generator 610. Also the encoder 630 encodes the image data received from the storage unit 600 and the image characteristic parameter received from the image characteristic parameter generator 610, and converts the received data into a stream at a transport screen stream format. Quotation mark

Hence paragraph 70 fails to disclose that the image is encoded by the encoder based upon any information regarding the capabilities of the receiving audio-visual device.

Hence, while the examiner refers to the encryption technique and decryption technique and the transmission standards disclosed in paragraph 0030 and 0070, Ha

fails to disclose that the encoding device uses any information regarding capabilities of the receiving audiovisual device in determining a mode in which to encode the data. Accordingly the independent claims include subject matter not disclosed by Ha.

A claim is anticipated if each and every element recited in the claim is found in a single prior art reference.

Ha cannot be said to anticipate the subject matter recited in the independent claims as Ha fails to disclose the element of "a formatter arranged to format the data for transport over the interface, wherein the formatter, in accordance with signal information received from the second audio-device,."

Applicant submits that the independent claims, and the claims dependent therefrom, are not anticipated by Ha, as Ha fails to disclose a material element recited in the claims.

With regard to the rejection of the remaining claims, these claims depend from claim 1, which has been shown to include subject matter not disclosed by Ha. The remaining references fail to provide any teaching regarding the element of "a formatter arranged to format the data for transport over the interface, wherein the formatter, in accordance with signal information received from the second audio-device."

Accordingly, the remaining claims are also not rendered unpatentable as the combination of Ha and the other cited references fails to disclose all the elements recited in the claims.

For the amendments made to the claims and for the arguments presented herein, applicant submits that the objections and rejections of the claims have been overcome

and respectfully requests that the objections and rejections be withdrawn and that a Notice of Allowance be issued.

Applicant denies any statement, position or averment stated in the Office Action that is not specifically addressed by the foregoing. Any rejection and/or points of argument not addressed are moot in view of the presented arguments and no arguments are waived and none of the statements and/or assertions made in the Office Action is conceded.

Applicant makes no statement regarding the patentability of the subject matter recited in the claims prior to this Amendment and has amended the claims solely to facilitate expeditious prosecution of this patent application. Applicant respectfully reserves the right to pursue claims, including the subject matter encompassed by the originally filed claims, as presented prior to this Amendment, and any additional claims in one or more continuing applications during the pendency of the instant application.

In order to advance the prosecution of the matter, applicant respectively requests that any errors in form that do not alter the substantive nature of the arguments presented herein be transmitted telephonically to the applicant's representative so that such errors may be quickly resolved or pursuant to MPEP 714.03 be entered into the record to avoid continued delay of the prosecution of this matter any further.

MPEP 714.03 affords the Examiner the discretion, pursuant to 37 CFR 1.135 (c), to enter into the record a bona fide attempt to advance the application that includes minor errors in form.

"[a]n Examiner may treat an amendment not fully responsive to a non-final Office Action by: (A) accepting the amendment as an adequate reply to the non-final Office action to avoid abandonment ... (B) notifying the applicant that the reply must be completed... (C) setting a new time period for applicant to complete the reply ...

The treatment to be given to the amendment depends upon:

(A) whether the amendment is bona fide; (B) whether there is sufficient time for applicant's reply ... (C) the nature of the deficiency.

Where an amendment substantially responds to the rejections, objections or requirements in a non-final Office action (and is bona fide attempt to advance the application to final action) but contains a minor deficiency (e.g., fails to treat every rejection, objection or requirement), the examiner may simply act on the amendment and issue a new (non-final or final) Office action. The new Office action may simply reiterate the rejection, objection or requirement not addressed by the amendment (or otherwise indicate that such rejection, objection or requirement is no longer applicable).

This course of action would not be appropriate in instances in which an amendment contains a serious deficiency (e.g., the amendment is unsigned or does not appear to have been filed in reply to the non-final Office action)..."

However, if the Examiner believes that such minor errors in form cannot be entered into the record or that the disposition of any issues arising from this response may be best resolved by a telephone call, then the Examiner is invited to contact applicant's representative at the telephone number listed below to resolve such minor errors or issues.

No fees are believed necessary for filing this paper.

Respectfully submitted,

Michael E. Belk, reg. no. 33,357

Date: March 29, 2012

/Carl A. Giordano/

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Electronic Acknowledgement Receipt	
EFS ID:	15401144
Application Number:	12808685
International Application Number:	
Confirmation Number:	5071
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh Shepherd
Customer Number:	24737
Filer:	Michael E. Belk/Elissa DeLuccy
Filer Authorized By:	Michael E. Belk
Attorney Docket Number:	2007P01979WOUS
Receipt Date:	01-APR-2013
Filing Date:	17-JUN-2010
Time Stamp:	15:50:49
Application Type:	U.S. National Stage under 35 USC 371

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Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2007P01979WOUS_116Amd.pdf	147412 37e4e0dd1fcd49d09f212d28d2569440627 30243	yes	14

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment After Final	1	1
	Claims	2	7
	Applicant Arguments/Remarks Made in an Amendment	8	14
Warnings:			
Information:			
	Total Files Size (in bytes):	147412	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/808,685	Filing Date 06/17/2010	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT **04/01/2013**

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0	X $80 =	0
Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $420 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	0

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/DEBORAH NASH/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. 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, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/808,685	06/17/2010	Nicoll Burleigh Shepherd	2007P01979WOUS	5071

24737 7590 02/01/2013

PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

EXAMINER	
PHAM, NAM D	
ART UNIT	PAPER NUMBER
2487	

NOTIFICATION DATE	DELIVERY MODE
02/01/2013	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

debbie.henn@philips.com
marianne.fox@philips.com

Office Action Summary	Application No.	Applicant(s)	
	12/808,685	SHEPHERD, NICOLL BURLEIGH	
	Examiner	Art Unit	
	NAM PHAM	2487	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 June 2010*.

2a)☒ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *50-67* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *50-67* is/are rejected.

8)☒ Claim(s) *60,62-64 and 66* is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *17 June 2010* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *20101102*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Summary

1. This office action for US Patent application 12/808685 is responsive to communications filed on June 17, 2010. Currently, claims 50-67 are pending are presented for examination.

Response to Arguments

2. On pages 9, applicant argues "the second data elements (3D images) have a capacity that is not greater than the first data elements (2D images)" with respect to claims 50, 61, 65 and 67. While the applicant's arguments are understood, the examiner respectfully disagrees. In paragraph 0070 (page. 5, Fig. 3 and 6) Ha describes a method/system wherein 2D/3D images are converted into a transport stream format while the image data is stored into the payload of the transport stream without concerning the size of 2D/3D image. In other words, this system is able to transport 2D/3D images without image-size modification. In order to transmit 3D images which have a capacity not greater than 2D images, other components may be modified in the system to reduce the size of 3D images before transporting for example reducing resolution, improving encoding efficiency, etc. This requires no more than ordinary skills in the art.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. **Claims 50-58 and 61-67** is/are rejected under 35 U.S.C §102 (e) as being anticipated by **Ha (US 20060279750 A1)**.

Regarding claim 50, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

A digital display interface part **[i.e. an image transmitting apparatus; paragraph 0064, page 4, Fig. 6]**, for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information, the interface part comprising:

an input for receiving image data **[i.e. storage unit, image characteristic parameter generator; Fig. 6]**;

a formatter **[i.e. encoder Fig.1; see paragraph 0070, page 5]** arranged to format the data for transport over the interface, wherein the formatter is operable in:

a first mode in which the formatter generates a stream of first data elements, which carry pixel data of a 2D image **[i.e. 2D image signal; paragraph 0067, page 5]**; and,

a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image **[i.e. 3D image signal; paragraph 0067, page 5]**, wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using and the second data elements have a capacity that is no greater than the first data elements **[i.e. the 2D/3D image data obtained from the storage unit 600 and the image characteristic parameter created from the image characteristic parameter generator 610 are converted into a transport stream format while the image data is stored into the payload of the transport stream without concerning the size of 2D/3D image; paragraph 0070, page. 5, Fig. 3, 6]**.

Regarding claim 51, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 50, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used in the second mode **[i.e. 2D/3D identification information; paragraph 0056, page 4; Fig. 3]**.

Regarding claim 52, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 51,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 51, wherein the signaling information is carried in a horizontal or vertical blanking period **[i.e. image signal format; Fig. 3]**.

Regarding claim 53, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 50, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet between image data **[i.e. image signal format; Fig. 3]**.

Regarding claim 54, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 53,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 53, which is arranged to receive signaling information **[i.e. notification signal; paragraph 0084, page6; paragraph 0090, page 6; Fig. 11]** across the interface specifying capabilities of the second audio-visual device **[i.e. encryption technique, decryption technique, transmission standard; paragraph 0033, page 2; paragraph 0070, page 5].**

Regarding claim 55, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data **[i.e. stereo images; paragraph 0062, page 4; paragraph 0066, page 5]**.

Regarding claim 56, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 55,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

> The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data sequentially **[i.e. transport stream format; paragraph 0070, page 5]**.

Regarding claim 57, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 56,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

The interface part according to claim 56, wherein an indication of the left and right image data being indicated by signaling information **[i.e. image characteristic parameter; paragraph 0012, page 1]** carried directly adjacent a position of the image data **[i.e. header of the image signal; Fig. 3]**.

Regarding claim 58, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 55,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data by line interleaving **[i.e. display formats for a 3D image; paragraph 0061, page 4; Fig. 5A-5D]**.

Regarding claim 61, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

A digital display interface **[i.e. operation mode of a display apparatus; paragraph 0013, page 1; Fig. 1]** part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the digital display interface for transmitting uncompressed pixel information the interface part comprising:

an input for receiving formatted image data from the interface **[i.e. receiver; paragraph 0055, page 4; Fig. 1, 3]**;

a processor **[i.e. decoder 110, parameter detector 120, operation mode conversion determining unit 130; paragraph 0034, page 2; Fig. 1]** arranged to extract image data **[i.e. decoded transport stream; see paragraph 0034, page 2; Fig. 3]**, the processor being operable in:

a first mode in which the processor extracts pixel image data for a 2D image from a stream of first data elements **[i.e. 2D detector 122; paragraph 0034, page 2; Fig. 1];** and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, the interface part arranged to receive signaling information across the interface, the signaling information identifying which mode the formatter is using **[i.e. 3D detector; see paragraph 0034, page 2; Fig. 1]** and the second elements have a capacity that is no greater than the first data elements **[i.e. the 2D/3D image data obtained from the storage unit 600 and the image characteristic parameter created from the image characteristic parameter generator 610 are converted into a transport stream format while the image data is stored into the payload of the transport stream without concerning the size of 2D/3D image; paragraph 0070, page. 5, Fig. 3, 6]**.

Regarding claim 62, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 61,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

The interface part according to claim 61, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used **[i.e. header of the image signal; paragraph 0032, page 2; Fig. 3]**, the interface part arranged to determine a stereoscopic image format being used.

Regarding claim 63, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 61,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

The interface part according to claim 61, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is received in a Data Island Packet between image data **[i.e. image signal format; Fig. 3]**.

Regarding claim 64, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 61,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

The interface part according to 61, wherein the stereoscopic image data components are left eye image data and right eye image data **[i.e. stereo image; paragraph 0062, page 4; paragraph 0066, page 5]**.

Regarding claim 65, all claimed limitations are set forth and rejected as per discussion for claim 50.

Regarding claim 66, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 65,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations which are set forth and rejected as per discussion for claim 51.

Regarding claim 67, all claimed limitations are set forth and rejected as per discussion for claim 61.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.
>
> The factual inquiries set forth in Graham v. John Deere Co., 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:
> 1. Determining the scope and contents of the prior art.
> 2. Ascertaining the differences between the prior art and the claims at issue.
> 3. Resolving the level of ordinary skill in the pertinent art.
> 4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

10. **Claims 59 and 60** is/are rejected under 35 U.S.C § 103(a) as being unpatentable over **Ha (US 20060279750 A1)**

Regarding claims 59 and60, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 50,

Ha (US 20060279750 A1) does not explicitly disclose the following claim limitations:

The interface part according to claims 50, wherein the stereoscopic image data components are 2D image data and image depth data.

The interface part according to claim 59, wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data.

However, **Ha (US 20060279750 A1)** teaches us the device can transmit the stereoscopic image data (3D) which is generated from 2D image data and image depth data with a disclosed transmitting mechanism **[paragraph 0013, page 1; paragraph 0014, page 1; and paragraph 0063, page 4; Fig. 3, 6]**.

It would have been obvious to one with ordinary skill in the art at the time of invention to modify the teachings of **Ha (US 20060279750 A1)** to create an interface and a mechanism of transmitting stereoscopic image data, the motivation being to form a digital display interface which is able to transmit 3D images to another auto-visual device.

New Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications form the examiner should be directed to Nam Pham, whose can be contacted by phone at (571)270-7352. The examiner can normally be reached on Mon—Thurs.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, CZEKAJ DAVID, can be reached on (571)272-7327.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) AT 866-217-9197 (too free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Nam Pham/
Examiner, Art Unit 2487

/Dave Czekaj/
Supervisory Patent Examiner, Art Unit 2487

Notice of References Cited	Application/Control No. 12/808,685	Applicant(s)/Patent Under Reexamination SHEPHERD, NICOLL BURLEIG	
	Examiner NAM PHAM	Art Unit 2487	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2006/0279750	12-2006	Ha, Tae-Hyeun	358/001.2
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

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	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	12808685
	Filing Date	2010-06-17
	First Named Inventor	Nicoll Burleigh Shepherd
	Art Unit	2621
	Examiner Name	/Nam Pham/
	Attorney Docket Number	009723US1

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20020009137	A1	2002-01-24	NELSON ET AL	
	2	20070139769	A1	2007-06-21	DECUSATIS ET AL	

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	1	2006137006	WO	A2	2006-12-28	FUNKE ET AL		☐
	2	2007069195	WO	A2	2007-06-21	ZUIDEMA ET AL		☐

EFS Web 2.1.17

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /N.P./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12808685
	Filing Date	2010-06-17
	First Named Inventor	Nicoll Burleigh Shepherd
	Art Unit	2621
	Examiner Name	/Nam Pham/
	Attorney Docket Number	009723US1

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EXAMINER SIGNATURE

Examiner Signature	/Nam Pham/	Date Considered	01/28/2013

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /N.P./

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12808685	SHEPHERD, NICOLL BURLEIGH
	Examiner	Art Unit
	NAM PHAM	4184

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	09/05/2012								
	50	✓								
	51	✓								
	52	✓								
	53	✓								
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	63	✓								
	64	✓								
	65	✓								
	66	✓								
	67	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12808685	SHEPHERD, NICOLL BURLEIGH
	Examiner	Art Unit
	NAM PHAM	4184

SEARCHED			
Class	Subclass	Date	Examiner
348	46	09/05/2012	/N.P./
Inventor search		09/05/2012	/N.P./
East search		09/05/2012	/N.P./

SEARCH NOTES		
Search Notes	Date	Examiner

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	Shepherd, N. B.	Attn. No.:	2007P01979WOUS
SERIAL NO.:	12/808,685	EXAMINER:	Pham, N.D.
FILED:	June 17, 2010	ART UNIT:	4184
		CONFIRMATION No.:	5071

FOR: ***TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE***

Mail Stop: Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT

Dear Sir:

In response to the Office Action dated October 1, 2012, the Applicant hereby submits this paper within three (3) months (until **January 1, 2013, which is a Federal Holiday and may be timely filed on January 2, 2013**) of the mailing date of the Office Action, and requests amendment of the above-identified application as follows wherein:

Amendments made to the Claims begin on page 2,

Remarks begin on page 8.

IN THE CLAIMS:
Kindly replace the claims of record with the following full set of claims:

1-49. (Canceled)

50. (Currently amended) A digital display interface part, for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable in:

a first mode in which the formatter generates a stream of first data elements, which carry pixel data of a 2D image; and,

a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using and the second data elements have a capacity that is no greater than the first data elements.

51. (Currently amended) [[An]] The interface part according to claim 50, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used in the second mode.

52. (Currently amended) [[An]]The interface part according to claim 51, wherein the signaling information is carried in a horizontal or vertical blanking period.

53. (Currently amended) [[An]]The interface part according to claim 50, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet between image data.

54. (Currently amended) [[An]]The interface part according to claim 53, which is arranged to receive signaling information across the interface specifying capabilities of the second audio-visual device.

55. (Currently amended) [[An]] The interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data.

56. (Currently amended) [[An]] The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data sequentially.

57. (Currently amended) [[An]] The interface part according to claim 56, wherein an indication of the left and right image data being indicated by signaling information carried directly adjacent a position of the image data.

58. (Currently amended) [[An]]The interface part according to claim 55 arranged for sending the left eye image data and the right eye image data by line interleaving.

59. (Currently amended) [[An]]The interface part according to claims 50, wherein the stereoscopic image data components are 2D image data and image depth data.

60. (Currently amended) [[An]]The interface part according to claim [[58]] 59, wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data.

61. (Currently amended) A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the digital display interface for transmitting uncompressed pixel information the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract image data, the processor being operable in:

a first mode in which the processor extracts pixel image data for a 2D

image from a stream of first data elements; and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, the interface part arranged to receive signaling information across the interface, the signaling information identifying which mode the formatter is using and the second data elements have a capacity that is no greater than the first data elements.

62. (Currently amended) [[An]] The interface part according to claim [[50]] 61, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used, the interface part arranged to determine a stereoscopic image format being used.

63. (Currently amended) [[An]]The interface part according to claim [[50]] 61, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is received in a Data Island Packet between image data.

64. (Currently amended) [[An]] The interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data.

65. (Currently amended) A method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information the method comprising:

receiving image data;

formatting the image data for transport over the interface by:

in a first mode, generating a stream of first data elements which carry pixel data of a 2D image; and,

in a second mode, generating a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, the second data elements have a capacity that is no greater than the first data elements.

66. (Currently amended) The method ~~An interface part~~ according to claim [[50]] 65, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used.

67. (Currently amended) A method of processing image data at a digital display interface part of an audio-visual device, the digital display interface for transmitting uncompressed pixel information the method comprising:

receiving formatted image data from the interface;

extracting image data by:

in a first mode, extracting pixel image data for a 2D image from a stream of first data elements; and,

in a second mode, demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, wherein the second data elements have a capacity that is no greater than the first data elements.

REMARKS

Entry of this Amendment and reconsideration are respectfully requested in view of the amendments made to the claims and for the remarks made herein.

Claims 50-67 are pending.

Claims 50-67 stand rejected.

Claims 50, 61, 63 and 67 are independent claims.

Claims 50-67 have been amended.

Claims 60, 62, 63, 64 and 66 are objected to. Claims 50-58 and 61-67 stand rejected under 35 USC 102(e) as being anticipate by Ha (US 20060279750). Claims 59 and 60-stand rejected under 35 USC 103(a) as being unpatentable over Ha.

With regard to the objection to the claims, applicant thanks the Examiner for his observation and has amended the claims to correct the errors noted.

Applicant submits that for the amendments made to the claims, the reason for the objection is no longer applicable.

Claims 50-58 and 61-67, of which claims 50, 61, 63 and 67 are independent claims, stand rejected under 35 USC 102(e) as being anticipate by Ha.

In supporting the rejection of the claims, the Office Action refers to Ha for teaching a digital display, an input for receiving image data, a formatter arranged to format the data for transport over the interface, wherein the formatter is operable in: a first mode in which the formatter generates a stream of first data elements, which carry pixel data of a 2D image (para. 0067) and a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image (3D image, para. 0067) wherein the interface part

is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using.

Applicant respectfully disagrees with and explicitly traverses the rejection of the claims.

However, in the interest of advancing the prosecution of this matter, the independent claims have been amended to further recite the element of "wherein the second data elements have a capacity that is no greater than the first data elements." No new matter has been added. Support for the amendment may be found at least on page 3, lines 3-5 ("Advantageously, the second data elements have a capacity which is no greater than, and preferably the same as, the first data elements. This allows the stereoscopic data to be carried with minimal modification to the standards defining the interface.").

Ha, as read by the applicant, teaches an image detector for detecting an image characteristic parameter that includes information regarding whether associated image data represents a 2D image or a 3D image. Ha further discloses a display format detector that detects information regarding a display format if the image data is associated with a 3D image.

However, Ha fails to provide any teaching regarding the capabilities of a 3D image having same capabilities of a 2D image ("and the second data elements have a capacity that is no greater than the first data elements.").

A claim is anticipated if each and every element recited in the claim is found in a single prior art reference.

Ha cannot be said to anticipate the subject matter recited in the independent claims as Ha fails to disclose the element of "and the second data elements have a capacity that is no greater than the first data elements."

Applicant submits that the independent claims, and the claims dependent therefrom, are not anticipated by Ha, as Ha fails to disclose a material element recited in the claims.

With regard to the rejection of the remaining claims, these claims depend from claim 1, which has been shown to include subject matter not disclosed by Ha. The remaining references fail to provide any teaching regarding the element of "and the second data elements have a capacity that is no greater than the first data elements."

Accordingly, the remaining claims are also not rendered unpatentable as the combination of Ha and the other cited references fails to disclose all the elements recited in the claims.

For the amendments made to the claims and for the arguments presented herein, applicant submits that the objections and rejections of the claims have been overcome and respectfully requests that the objections and rejections be withdrawn and that a Notice of Allowance be issued.

Applicant denies any statement, position or averment stated in the Office Action that is not specifically addressed by the foregoing. Any rejection and/or points of argument not addressed are moot in view of the presented arguments and no arguments are waived and none of the statements and/or assertions made in the Office Action is conceded.

Applicant makes no statement regarding the patentability of the subject matter recited in the claims prior to this Amendment and has amended the claims solely to facilitate expeditious prosecution of this patent application. Applicant respectfully reserves the right to pursue claims, including the subject matter encompassed by the originally filed claims, as presented prior to this Amendment, and any additional claims in one or more continuing applications during the pendency of the instant application.

In order to advance the prosecution of the matter, applicant respectively requests that any errors in form that do not alter the substantive nature of the arguments presented herein be transmitted telephonically to the applicant's representative so that such errors may be quickly resolved or pursuant to MPEP 714.03 be entered into the record to avoid continued delay of the prosecution of this matter any further.

MPEP 714.03 affords the Examiner the discretion, pursuant to 37 CFR 1.135 (c), to enter into the record a bona fide attempt to advance the application that includes minor errors in form.

"[a]n Examiner may treat an amendment not fully responsive to a non-final Office Action by: (A) accepting the amendment as an adequate reply to the non-final Office action to avoid abandonment ... (B) notifying the applicant that the reply must be completed... (C) setting a new time period for applicant to complete the reply ...

The treatment to be given to the amendment depends upon:

(A) whether the amendment is bona fide; (B) whether there is sufficient time for applicant's reply ... (C) the nature of the deficiency.

Where an amendment substantially responds to the rejections, objections or requirements in a non-final Office action (and is bona fide attempt to advance the application to final action) but contains a minor deficiency (e.g., fails to treat every rejection, objection or requirement), the examiner may simply act on the amendment and issue a new (non-final or final) Office action. The new Office action may simply reiterate the rejection, objection or requirement not addressed by the amendment (or otherwise indicate that such rejection, objection or requirement is no longer applicable).

This course of action would not be appropriate in instances in which an amendment contains a serious deficiency (e.g., the amendment is unsigned or does not appear to have been filed in reply to the non-final Office action)..."

However, if the Examiner believes that such minor errors in form cannot be entered into the record or that the disposition of any issues arising from this response may be best resolved by a telephone call, then the Examiner is invited to contact applicant's representative at the telephone number listed below to resolve such minor errors or issues.

No fees are believed necessary for filing this paper.

Respectfully submitted,

Michael E. Belk, reg. no. 33,357

Date: December 19, 2012

/Carl A. Giordano/

By: Carl A. Giordano
Attorney for Applicant
Registration No. 41,780
(914) 391 8104

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P.O. Box 3001
Briarcliff Manor, NY 10510-8001
Phone: (914) 333-9643
Fax: (914) 332-0615

Electronic Acknowledgement Receipt	
EFS ID:	14522410
Application Number:	12808685
International Application Number:	
Confirmation Number:	5071
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh Shepherd
Customer Number:	24737
Filer:	Michael E. Belk/Elissa DeLuccy
Filer Authorized By:	Michael E. Belk
Attorney Docket Number:	2007P01979WOUS
Receipt Date:	20-DEC-2012
Filing Date:	17-JUN-2010
Time Stamp:	10:02:08
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2007P01979WOUS_Amd.pdf	137622 d7e7baf4577dfb8855f1453fc023cb7feddcd8d	yes	12

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	Claims	2	7
	Applicant Arguments/Remarks Made in an Amendment	8	12
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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (07-06)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/808,685	Filing Date 06/17/2010	☐ To be Mailed

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☐		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT 12/20/2012	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0	X $ =		OR	X $62=	0
Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $ =		OR	X $250=	0
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	**0**

AMENDMENT	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)	OR	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/HELENA PAYTON/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. 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, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/808,685	06/17/2010	Nicoll Burleigh Shepherd	009723 US1	5071

24737 7590 10/01/2012

PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

EXAMINER	
PHAM, NAM D	
ART UNIT	PAPER NUMBER
4184	

NOTIFICATION DATE	DELIVERY MODE
10/01/2012	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

vera.kublanov@philips.com
debbie.henn@philips.com
marianne.fox@philips.com

Office Action Summary	Application No.	Applicant(s)	
	12/808,685	SHEPHERD, NICOLL BURLEIGH	
	Examiner	Art Unit	
	NAM PHAM	4184	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 June 2010*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *50-67* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *50-67* is/are rejected.

8)☒ Claim(s) *60,62-64 and 66* is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *17 June 2010* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *20101102*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Summary

1. This office action for US Patent application 12/808685 is responsive to communications filed on June 17, 2010. Currently, claims 50-67 are pending are presented for examination.

Claim Objections

2. **Claim 60** is objected because it should be a dependent claim of claim 59 instead of 58.
3. **Claim 62** is objected to because it should be a dependent claim of claim 61 instead of 50.
4. **Claim 63** is objected to because it should be a dependent claim of claim 61 instead of 50.
5. **Claim 64** is objected to because it should be a dependent claim of claim 61 instead of 50.
6. **Claim 66** is objected to because it should be a dependent claim of claim 65 instead of 50.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

   A person shall be entitled to a patent unless –

   (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

   (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

8. **Claims 50-58 and 61-67** is/are rejected under 35 U.S.C §102 (e) as being anticipated by **Ha (US 20060279750 A1)**.

Regarding claim 50, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

A digital display interface part **[i.e. an image transmitting apparatus; paragraph 0064, page 4, Fig. 6]**, for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information, the interface part comprising:

an input for receiving image data **[i.e. storage unit, image characteristic parameter generator; Fig. 6]**;

a formatter **[i.e. encoder Fig.1; see paragraph 0070, page 5]** arranged to format the data for transport over the interface, wherein the formatter is operable in:

a first mode in which the formatter generates a stream of first data elements, which carry pixel data of a 2D image **[i.e. 2D image signal; paragraph 0067, page 5]**; and,

a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image **[i.e. 3D image signal; paragraph 0067, page 5]**, wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using.

Regarding claim 51, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

An interface part according to claim 50, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used in the second mode **[i.e. 2D/3D identification information; paragraph 0056, page 4; Fig. 3]**.

Regarding claim 52, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 51,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

An interface part according to claim 51, wherein the signaling information is carried in a horizontal or vertical blanking period **[i.e. image signal format; Fig. 3]**.

Regarding claim 53, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

An interface part according to claim 50, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet between image data **[i.e. image signal format; Fig. 3]**.

Regarding claim 54, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 53,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

An interface part according to claim 53, which is arranged to receive signaling information **[i.e. notification signal; paragraph 0084, page6; paragraph 0090, page 6; Fig. 11]** across the interface specifying capabilities of the second audio-visual device **[i.e. encryption technique, decryption technique, transmission standard; paragraph 0033, page 2; paragraph 0070, page 5].**

Regarding claim 55, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 50,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

An interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data **[i.e. stereo images; paragraph 0062, page 4; paragraph 0066, page 5]**.

Regarding claim 56, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 55,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

An interface part according to claim 55 arranged for sending the left eye image data and the right eye image data sequentially **[i.e. transport stream format; paragraph 0070, page 5]**.

Regarding claim 57, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 56,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

An interface part according to claim 56, wherein an indication of the left and right image data being indicated by signaling information **[i.e. image characteristic parameter; paragraph 0012, page 1]** carried directly adjacent a position of the image data **[i.e. header of the image signal; Fig. 3]**.

Regarding claim 58, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 55,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

An interface part according to claim 55 arranged for sending the left eye image data and the right eye image data by line interleaving **[i.e. display formats for a 3D image; paragraph 0061, page 4; Fig. 5A-5D]**.

Regarding claim 61, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

A digital display interface **[i.e. operation mode of a display apparatus; paragraph 0013, page 1; Fig. 1]** part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the digital display interface for transmitting uncompressed pixel information the interface part comprising:

an input for receiving formatted image data from the interface **[i.e. receiver; paragraph 0055, page 4; Fig. 1, 3]**;

a processor **[i.e. decoder 110, parameter detector 120, operation mode conversion determining unit 130; paragraph 0034, page 2; Fig. 1]** arranged to extract image data **[i.e. decoded transport stream; see paragraph 0034, page 2; Fig. 3]**, the processor being operable in:

a first mode in which the processor extracts pixel image data for a 2D image from a stream of first data elements **[i.e. 2D detector 122; paragraph 0034, page 2; Fig. 1];** and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, the interface part arranged to receive signaling information across the interface, the signaling

information identifying which mode the formatter is using **[i.e. 3D detector; see paragraph 0034, page 2; Fig. 1].**

Regarding claim 62, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 61,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

An interface part according to claim 61 (*original 50*), wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used **[i.e. header of the image signal; paragraph 0032, page 2; Fig. 3]**, the interface part arranged to determine a stereoscopic image format being used.

Regarding claim 63, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 61,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

An interface part according to claim 61 (*original 50*), wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is received in a Data Island Packet between image data **[i.e. image signal format; Fig. 3]**.

Regarding claim 64, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 61,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations, as follows:

An interface part according to 61 (*original 50*), wherein the stereoscopic image data components are left eye image data and right eye image data **[i.e. stereo image; paragraph 0062, page 4; paragraph 0066, page 5]**.

Regarding claim 65, all claimed limitations are set forth and rejected as per discussion for claim 50.

Regarding claim 66, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 65,

Furthermore, **Ha (US 20060279750 A1)** meets the claim limitations which are set forth and rejected as per discussion for claim 51.

Regarding claim 67, all claimed limitations are set forth and rejected as per discussion for claim 61.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.
>
> The factual inquiries set forth in Graham v. John Deere Co., 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:
> 1. Determining the scope and contents of the prior art.
> 2. Ascertaining the differences between the prior art and the claims at issue.
> 3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

10. **Claims 59 and 60** is/are rejected under 35 U.S.C § 103(a) as being unpatentable over **Ha (US 20060279750 A1)**

Regarding claims 59 and60, **Ha (US 20060279750 A1)** meets the claim limitations as set forth in claim 50,

Ha (US 20060279750 A1) does not explicitly disclose the following claim limitations:

An interface part according to claims 50, wherein the stereoscopic image data components are 2D image data and image depth data.

An interface part according to claim 58, wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data.

However, **Ha (US 20060279750 A1)** teaches us the device can transmit the stereoscopic image data (3D) which is generated from 2D image data and image depth data with a disclosed transmitting mechanism **[paragraph 0013, page 1; paragraph 0014, page 1; and paragraph 0063, page 4; Fig. 3, 6]**.

It would have been obvious to one with ordinary skill in the art at the time of invention to modify the teachings of **Ha (US 20060279750 A1)** to create an interface and a mechanism of transmitting stereoscopic image data, the motivation being to form a digital display interface which is able to transmit 3D images to another auto-visual device.

Conclusion

Any inquiry concerning this communication or earlier communications form the examiner should be directed to Nam Pham, whose can be contacted by phone at (571)270-7352. The examiner can normally be reached on Mon—Thurs.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, SATH PERUNGAVOOR, can be reached on (571)272-7455.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) AT 866-217-9197 (too free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Nam Pham/
Examiner, Art Unit 2487

/SATH V PERUNGAVOOR/

Supervisory Patent Examiner, Art Unit 2488

Notice of References Cited	Application/Control No. 12/808,685	Applicant(s)/Patent Under Reexamination SHEPHERD, NICOLL BURLEIG	
	Examiner NAM PHAM	Art Unit 4184	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2006/0279750	12-2006	Ha, Tae-Hyeun	358/001.2
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12808685	SHEPHERD, NICOLL BURLEIGH
	Examiner	Art Unit
	NAM PHAM	4184

SEARCHED			
Class	Subclass	Date	Examiner
348	46	09/05/2012	/N.P./
Inventor search		09/05/2012	/N.P./
East search		09/05/2012	/N.P./

SEARCH NOTES		
Search Notes	Date	Examiner

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	12808685
	Filing Date	2010-06-17
	First Named Inventor	Nicoll Burleigh Shepherd
	Art Unit	2621
	Examiner Name	
	Attorney Docket Number	009723US1

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20020009137	A1	2002-01-24	NELSON ET AL	
	2	20070139769	A1	2007-06-21	DECUSATIS ET AL	

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	1	2006137006	WO	A2	2006-12-28	FUNKE ET AL		☐
	2	2007069195	WO	A2	2007-06-21	ZUIDEMA ET AL		☐

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /N.P./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12808685
	Filing Date	2010-06-17
	First Named Inventor	Nicoll Burleigh Shepherd
	Art Unit	2621
	Examiner Name	
	Attorney Docket Number	009723US1

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EXAMINER SIGNATURE			
Examiner Signature	/Nam Pham/	Date Considered	09/05/2012

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	758	348/46.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/08/29 15:10
S19	442	S18 and (2D OR 3D)	US-PGPUB; USPAT	OR	ON	2012/08/31 16:05
S23	4191	left adj eye adj image	US-PGPUB; USPAT	OR	ON	2012/09/04 07:54
S24	3410	(left adj eye adj image) SAME (right adj eye adj image)	US-PGPUB; USPAT	OR	ON	2012/09/04 07:54
S25	610	(left adj eye adj image) SAME (right adj eye adj image) SAME "2"$1D	US-PGPUB; USPAT	OR	ON	2012/09/04 07:55
S26	461	S25 AND stereoscop$3	US-PGPUB; USPAT	OR	ON	2012/09/04 07:56
S27	451	S26 AND display	US-PGPUB; USPAT	OR	ON	2012/09/04 07:56
S28	228	S27 AND interface	US-PGPUB; USPAT	OR	ON	2012/09/04 07:56
S29	175	S28 AND mode	US-PGPUB; USPAT	OR	ON	2012/09/04 07:57
S31	4	S29 AND (signaling adj information)	US-PGPUB; USPAT	OR	ON	2012/09/04 08:21
S32	37	data adj island adj packet	US-PGPUB; USPAT	OR	ON	2012/09/05 08:56
S33	610	(left adj eye adj image) SAME (right adj eye adj image) SAME "2"$1D	US-PGPUB; USPAT	OR	ON	2012/09/05 09:30
S34	461	S33 AND stereoscop$3	US-PGPUB; USPAT	OR	ON	2012/09/05 09:30
S35	451	S34 AND display	US-PGPUB; USPAT	OR	ON	2012/09/05 09:30
S36	318	S35 AND mode	US-PGPUB; USPAT	OR	ON	2012/09/05 09:30

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CONFIRMATION NO. 5071

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12/808,685	06/17/2010	348	4184	009723 US1

APPLICANTS
Nicoll Burleigh Shepherd, Coulsdon, UNITED KINGDOM;

**** CONTINUING DATA ***************************
This application is a 371 of PCT/IB2008/055305 12/15/2008

**** FOREIGN APPLICATIONS ***************************
EUROPEAN PATENT OFFICE (EPO) 07123461.1 12/18/2007

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		UNITED KINGDOM	3	18	4

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UNITED STATES

TITLE

TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE

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	Examiner	**Art Unit**
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	1	2006137006	WO	A2	2006-12-28	FUNKE ET AL		☐
	2	2007069195	WO	A2	2007-06-21	ZUIDEMA ET AL		☐

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	Art Unit	2621
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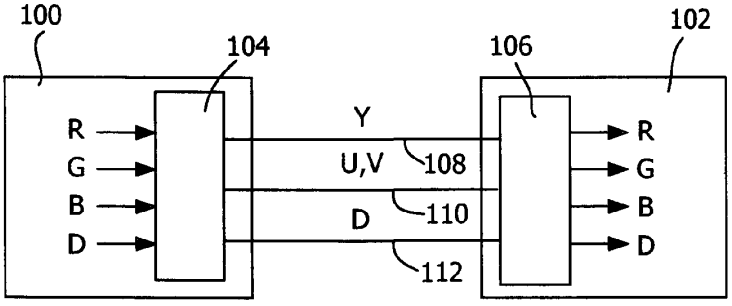
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(54) Title COMBINED EXCHANGE OF IMAGE AND RELATED DEPTH DATA



(57) Abstract A method of combined exchange of image data and related depth data is disclosed The method comprises converting an input image signal, representing the image data comprising a predetermined number of input color components (R G,B) into an output image signal comprising a luminance component and a chrominance component combining the output signal with the related depth data into a combined signal, comprising the luminance component, the chrominance component and a depth component (D) which is based on the depth data, and transmission of the combined signal over a number of channels (108 112) which is equal to the predetermined number of input color components (R G B)

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Combined exchange of image and related depth data

The invention relates to methods of combined exchange of image data and related depth data

The invention further relates to a transmitting unit for combined exchange of image data and related depth data

The invention further relates to an image processing apparatus comprising such a transmitting unit

The invention further relates to a receiving unit for combined exchange of image data and related depth data

The invention further relates to a multi-view display device comprising such a receiving unit

Since the introduction of display devices, a realistic 3-D display device has been a dream for many Many principles that should lead to such a display device have been investigated Some principles try to create a realistic 3-D object in a certain volume For instance, in the display device as disclosed in the article " Solid-state Multi-planar Volumetric Display", by A Sullivan in proceedings of SID'03, 1531-1533, 2003, visual data is displaced at an array of planes by means of a fast projector Each plane is a switchable diffuser If the number of planes is sufficiently high the human brain integrates the picture and observes a realistic 3-D object This principle allows a viewer to look around the object within some extent In this display device all objects are (semi-)transparent

Many others try to create a 3-D display device based on binocular disparity only In these systems the left and right eye of the viewer perceives another image and consequently, the viewer perceives a 3-D image An overview of these concepts can be found in the book "Stereo Computer Graphics and Other True 3-D Technologies", by D F McAllister (Ed), Princeton University Press, 1993 A first principle uses shutter glasses in combination with for instance a CRT If the odd frame is displayed, light is blocked for the left eye and if the even frame is displayed light is blocked for the right eye

Display devices that show 3-D without the need for additional appliances are called auto-stereoscopic display devices

A first glasses-free display device comprises a barrier to create cones of light aimed at the left and right eye of the viewer The cones correspond for instance to the odd and even sub-pixel columns By addressing these columns with the appropriate information, the viewer obtains different images in his left and right eye if he is positioned at the correct spot, and is able to perceive a 3-D picture

A second glasses-free display device comprises an array of lenses to image the light of odd and even sub-pixel columns to the viewer's left and right eye

The disadvantage of the above mentioned glasses-free display devices is that the viewer has to remain at a fixed position To guide the viewer, indicators have been proposed to show the viewer that he is at the right position See for instance United States patent US5986804 where a barrier plate is combined with a red and green led In case the viewer is well positioned he sees a green light, and a red light otherwise

To relieve the viewer of sitting at a fixed position, multi-view auto-stereoscopic display devices have been proposed See for instance United States patents US60064424 and US20000912 In the display devices as disclosed in US60064424 and US20000912 a slanted lenticular is used, whereby the width of the lenticular is larger than two sub-pixels In this way there are several images next to each other and the viewer has some freedom to move to the left and right

In order to generate a 3-D impression on a multi-view display device, images from different virtual viewpoints have to be rendered This requires either multiple input views or some 3-D or depth information to be present This depth information can be recorded, generated from multi-view camera systems or generated from conventional 2-D video material For generating depth information from 2-D video several types of depth cues can be applied such as structure from motion, focus information, geometric shapes and dynamic occlusion The aim is to generate a dense depth map, i e per pixel a depth value This depth map is subsequently used in rendering a multi-view image to give the viewer a depth impression In the article "Synthesis of multi viewpoint images at non-intermediate positions" by P A Redert, E A Hendriks, and J Biemond, in Proceedings of International Conference on Acoustics, Speech, and Signal Processing, Vol IV, ISBN 0-8186-7919-0, pages 2749-2752, IEEE Computer Society, Los Alamitos, California, 1997 a method of extracting depth information and of rendering a multi-view image on basis of the input image and the depth map are disclosed The multi-view image is a set of images, to be displayed by

a multi-view display device to create a 3-D impression Typically, the images of the set are created on basis of an input image Creating one of these images is done by shifting the pixels of the input image with respective amounts of shift These amounts of shifts are called disparities So, typically for each pixel there is a corresponding disparity value, together forming a disparity map Disparity values and depth values are typically inversely related, i e

$$S = \frac{\alpha}{D} \qquad (1)$$

with S being disparity, α a constant value and D being depth Creating a depth map is considered to be equivalent with creating a disparity map In this specification disparity values and depth values are both covered by the term depth related data elements

The video data, i e the image signal and the corresponding depth data have to be exchanged between various image processing units and eventually to a display device, in particular a multi-view display device Typically video data is exchanged by means of an RGB link That means that three correlated but separated streams of data are transferred by means of three channels Examples of standards which are based on such a RGB link are DVI (digital visual interface) and LVDS (low-voltage differential signaling) However in the case of 3-D, along with the video data, the depth related data has to be exchanged too

It is an object of the invention to provide a method of the kind described in the opening paragraph which is adapted to existing video interfaces

This object of the invention is achieved in that the method comprises

- converting an input image signal, representing the image data, comprising a predetermined number of input color components into an output image signal comprising a luminance component and a chrominance component,
- combining the output signal with the related depth data into a combined signal, comprising the luminance component, the chrominance component and a depth component which is based on the depth data, and
- transmission of the combined signal over a number of channels which is equal to the predetermined number of input color components

By converting the input image signal comprising a predetermined number of input color components into an output image signal having at least one component less than the input image signal has, room is created for the exchange of the depth data

Typically, the input color components comprise a red component (R) a green component (G) and a blue component (B)

Preferably, the luminance component is transmitted over a first one of the channels, the chrominance component is transmitted over a second one of the channels and the depth component is transmitted over a third one of the channels

Each of the channels as a bandwidth, i e maximum amount of information which can be exchanged per time unit Preferably the combined exchange of image and related depth data is such that the applied bandwidth for the number of channels is substantially mutually equal That means that per unit of time substantially the same amount of information is exchanged over the respective channels To achieve that it is preferred that the chrominance component comprises a further number of output color components which are computed on basis of spatially subsampling the input image signal and that the further number of output components are transmitted over the second one of the channels by means of multiplexing

Exchange of information comprises sending and receiving The method as described and discussed above is related to the sending part of the exchange of data It is another object of the invention to provide a corresponding method which is related to the receiving part of the exchange of data and which is also adapted to existing video interfaces

This object of the invention is achieved in that the corresponding method comprises

- reception of a combined signal, comprising a luminance component and a chrominance component representing the image data and comprising a depth component which is based on the depth data, the combined signal being transmitted over a number of channels,
- extracting the luminance component and the chrominance component from the combined signal, and
- converting the luminance component and the chrominance component into an image signal, representing the image data, the image signal comprising a predetermined number of input color components whereby the predetermined number of input color components is equal to the number of channels

It is a further object of the invention to provide a transmitting unit of the kind described in the opening paragraph which is adapted to existing video interfaces

This object of the invention is achieved in that the transmitting unit comprises

- converting means for converting an input image signal, representing the image data, comprising a predetermined number of input color components into an output image signal comprising a luminance component and a chrominance component,
- combining means for combining the output signal with the related depth data into a combined signal, comprising the luminance component, the chrominance component and a depth component which is based on the depth data, and
- outputting means for outputting the combined signal over a number of channels which is equal to the predetermined number of input color components

It is a further object of the invention to provide a receiving unit of the kind described in the opening paragraph which is adapted to existing video interfaces

This object of the invention is achieved in that the receiving unit comprises

- reception means for reception of a combined signal, comprising a luminance component and a chrominance component representing the image data and comprising a depth component which is based on the depth data, the combined signal being transmitted over a number of channels,
- extracting means for extracting the luminance component and the chrominance component from the combined signal,
- converting means for converting the luminance component and the chrominance component into an image signal, representing the image data, the image signal comprising a predetermined number of input color components whereby the predetermined number of input color components is equal to the number of channels

It is a further object of the invention to provide an image processing apparatus of the kind described in the opening paragraph which is adapted to existing video interfaces

This object of the invention is achieved in that the image processing apparatus comprises the transmitting unit as described above

It is a further object of the invention to provide a multi-view display device of the kind described in the opening paragraph which is adapted to existing video interfaces

This object of the invention is achieved in that the multi-view display device comprises the receiving unit as described above

Modifications of the transmitting unit, the receiving unit, and variations thereof may correspond to modifications and variations thereof of the image processing apparatus, the multi-view display device and the methods being described

These and other aspects of the transmitting unit, the receiving unit, the image processing apparatus, the multi-view display device and the methods according to the invention will become apparent from and will be elucidated with respect to the implementations and embodiments described hereinafter and with reference to the accompanying drawings, wherein

Fig 1 schematically shows a first processing device connected to a second processing device,

Fig 2 schematically shows an embodiment of the transmitting unit according to the invention,

Fig 3 schematically shows an embodiment of the receiving unit according to the invention, and

Fig 4 schematically shows an image processing apparatus comprising a multi-view display device, both according to the invention

Same reference numerals are used to denote similar parts throughout the Figures

Fig 1 schematically shows a first processing device 100 connected to a second processing device 102 The first processing device 100 and the second processing device may be integrated circuits (IC) like an image processor and a display driver, respectively Alternatively, the first processing device 100 is a more complex apparatus like a PC and the second processing device 102 is a multi-view display device, e g a monitor The first 100 and second processing device 102 are connected by means of a physical connection The physical connection is e g based on a twisted-pair or on a twisted-pair plus ground for serial transport of data It should be noted that parallel transport of data is also possible

On top of the physical connection three logical connections are realized Each logical connection corresponds to a channel 108-112 for transport of data between the first processing device 100 and the second processing device 102 Examples of connections are based on standards like DVI or LVDS

The data format being applied within the context of the first processing device 100 is based on four components There are three the input color components R,G,B which together represent image data and there is a fourth component D which corresponds to depth related data Typically, the data is stored in two-dimensional matrices comprising for each pixel P_i an R_i sample, a G_i sample, a B_i sample and a D_i sample

The data format being applied within the context of the second processing device 102 is equal to the data format being applied within the context of the first processing device 100 and hence is based on the four components too

As said above, there are only three logical connections between the first 100 and second processing device 102 In order to exchange the image data in combination with the corresponding depth data the first processing device 100 comprises a transmitting unit 104 according to the invention and the second processing device 102 comprises a receiving unit 106 according to the invention The combination of the transmitting unit 104, the physical connection between the first 100 and second 102 processing device and the receiving unit 106 makes data exchange between the first 100 and second 102 processing device possible Basically, the exchange is based on a first conversion of the image data into intermediate data, combining the intermediate data with the depth data, transmission, separating the depth data from the intermediate data and a second conversion of the intermediate data into the image data

Fig 2 schematically shows an embodiment of the transmitting unit 104 according to the invention The transmitting unit 104 is arranged to combine image data and related depth data in order to exchange the combined data The transmitting unit 104 comprises

- a converting unit 202 for converting an input image signal, representing the image data, comprising a predetermined number of input color components R,G,B into an output image signal comprising a luminance component Y and a chrominance component C,
- a combining unit 204 for combining the output signal with the related depth data D into a combined signal, comprising the luminance component Y, the chrominance C component and a depth component D which is based on the depth data, and
- an outputting unit 206 for outputting the combined signal over a number of channels which is equal to the predetermined number of input color components

The converting unit 202, the combining unit 204 and the outputting unit 206 may be implemented using one processor Normally, these functions are performed under control of a software program product During execution, normally the software program product is loaded into a memory, like a RAM, and executed from there The program may be loaded from a background memory, like a ROM, hard disk, or magnetically and/or optical storage, or may be loaded via a network like Internet Optionally an application specific integrated circuit provides the disclosed functionality

Preferably the chrominance component C comprises two output color components U and V The converting unit 202 is arranged to compute samples of the luminance component and the two output color components on basis of the three input color components R,G,B, as specified in Equations 2-4

$$Y = R * 0\,299 + G * 0\,587 + B * 0\,114 \quad (2)$$

$$U = R * -0\,147 + G * -0\,289 + B * 0\,437 \quad (3)$$

$$V = R * 0\,615 + G * -0\,515 + B * -0\,1 \quad (4)$$

Preferably, spatial sub-sampling is applied to reduce the number of U and V samples with a factor of two The result is that the number of Y_i samples is twice the number of U_i samples and twice the number of V_i samples Before subsampling takes place preferably low pass filtering is applied

The combining unit 204 is arranged to combine the corresponding samples of the luminance component Y, the first output color component U, the second output color component V and the depth component D to a sequence of triplets of samples, e g

$$(Y_1,U_1,D_1),(Y_2,V_1,D_2),(Y_3,U_3,D_3),(Y_4,V_3,D_4),(Y_5,U_5,D_5),(Y_6,V_5,D_6)$$

Notice that the triplets alternately include a sample of the first output color component U and of the second output color component V

The outputting unit 206 is arranged to output the triplets of samples to logical connections, i e channels In the table below it is indicated to which of the channels the samples are mapped

First channel	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8	Y_9
Second channel	U_1	V_1	U_3	V_3	U_5	V_5	U_7	V_7	U_9
Third channel	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9

Preferably, the outputting unit 206 comprises a serializer Typically, the samples are represented with a number of bits, which ranges from 8 to 12 The data on the

physical connection is preferably exchanged by means of serial transport For that reason the bits representing the consecutive samples are put in a time sequential series

Fig 3 schematically shows an embodiment of the receiving unit 106 according to the invention The receiving unit 106 is arranged to receive combined data comprising image data and related depth data and is arranged to decompose the combined data The transmitting unit 106 comprises

- a reception unit 306 for reception of the combined signal, comprising a luminance component and a chrominance component representing the image data and comprising a depth component which is based on the depth data, the combined signal being transmitted over a number of channels,
- an extraction unit 304 for extracting the luminance component and the chrominance component from the combined signal, and
- a converting unit 302 for converting the luminance component and the chrominance component into an image signal, representing the image data, the image signal comprising a predetermined number of input color components whereby the predetermined number of input color components is equal to the number of channels

The reception unit 306, the extraction unit 304 and the converting unit 302 may be implemented using one processor Normally, these functions are performed under control of a software program product During execution, normally the software program product is loaded into a memory, like a RAM, and executed from there The program may be loaded from a background memory, like a ROM, hard disk, or magnetically and/or optical storage, or may be loaded via a network like Internet Optionally an application specific integrated circuit provides the disclosed functionality

Preferably, the reception unit 306 comprises a de-serializer The data on the physical connection, via which the combined signal is provided to the receiving unit 106, is preferably exchanged by means of serial transport However, typically the data format within the context of the receiving unit 106 is such that direct access to all bits of the samples is more convenient, i e parallel data access

The extraction unit 304 is arranged to extract the luminance component Y and the chrominance C component from the combined signal as received by the reception unit 306 of receiving unit 106 The chrominance component C comprises two output color components U and V The extraction unit 306 is also arranged to extract the depth samples from the combined signal

The converting unit 202 is arranged to compute samples of the three input color components R,G,B on basis of the samples of the luminance component Y and the two output color components U and V, as specified in the Equations 5-7

$$R = Y * 1 + U * 0 + V * 1\ 14 \quad (5)$$

$$G = Y * 1 + U * -0\ 39 + V * -0\ 58 \quad (6)$$

$$B = Y * 1 + U * 2\ 03 + V * 0 \quad (7)$$

It should be noted that, an alternative model of color components may be applied instead of the YUV color model, e g YIQ, YCbCr, PhotoYCC

Fig 4 schematically shows an image processing apparatus 400 comprising a multi-view display device 406, both according to the invention The image processing apparatus 400 comprises

- a receiver 402 for receiving a video signal representing input images,

an image analysis unit 404 for extracting depth related data from the input images, and

- a multi-view display device 406 for displaying multi-view images which are rendered by the multi-view display device on basis of the provided image data and related depth data

The image data and related depth data are exchanged between the image analysis unit 404 and the multi-view display device 406, by means of a combined signal as described in connection with Figs 2 and 3 The image analysis unit 404 comprises a transmitting unit 104 as described in connection with Fig 2 The multi-view display device 406 comprises a receiving unit 106 as described in connection with Fig 3

The video signal may be a broadcast signal received via an antenna or cable but may also be a signal from a storage device like a VCR (Video Cassette Recorder) or Digital Versatile Disk (DVD) The signal is provided at the input connector 410 The image processing apparatus 400 might e g be a TV Alternatively the image processing apparatus 400 does not comprise the optional display device but provides the output images to an apparatus that does comprise a display device 406 Then the image processing apparatus 400 might be e g a set top box, a satellite-tuner, a VCR player, a DVD player or recorder Optionally the image processing apparatus 400 comprises storage means, like a hard disk or

means for storage on removable media, e g optical disks The image processing apparatus 500 might also be a system being applied by a film-studio or broadcaster

The multi-view display device 406 comprises a rendering unit 408, which is arranged to generate a sequence of multi-view images on basis of the received combined signal The rendering unit 408 is arranged to provide (at least) two correlated streams of video images to the multi-view display device which is arranged to visualize a first series of views on basis of the first one of the correlated streams of video images and to visualize a second series of views on basis of the second one of the correlated streams of video images If a user, i e viewer, observes the first series of views by his left eye and the second series of views by his right eye he notices a 3-D impression It might be that the first one of the correlated streams of video images corresponds to the sequence of video images as received by means of the combined signal and that the second one of the correlated streams of video images is rendered by appropriate shifting on basis of the provided depth data Preferably, both streams of video images are rendered on basis of the sequence of video images as received.

In the article "Synthesis of multi viewpoint images at non-intermediate positions" by P A Redert, E A Hendriks, and J Biemond, in Proceedings of International Conference on Acoustics, Speech, and Signal Processing, Vol IV, ISBN 0-8186-7919-0, pages 2749-2752, IEEE Computer Society, Los Alamitos, California, 1997 a method of extracting depth information and of rendering a multi-view image on basis of the input image and the depth map are disclosed The image analysis unit 404 is an implementation for the disclosed method of extracting depth information The rendering unit 408 is an implementation of the method of rendering disclosed in the article

It should be noted that the above-mentioned embodiments illustrate rather than limit the invention and that those skilled in the art will be able to design alternative embodiments without departing from the scope of the appended claims In the claims, any reference signs placed between parentheses shall not be constructed as limiting the claim The word 'comprising' does not exclude the presence of elements or steps not listed in a claim The word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements The invention can be implemented by means of hardware comprising several distinct elements and by means of a suitable programmed computer In the unit claims enumerating several means, several of these means can be embodied by one and the same item of hardware or software The usage of the words first, second and third, etcetera do not indicate any ordering These words are to be interpreted as names

CLAIMS

1 A method of combined exchange of image data and related depth data, comprising

- converting an input image signal, representing the image data, comprising a predetermined number of input color components (R,G,B) into an output image signal comprising a luminance component and a chrominance component,
- combining the output signal with the related depth data into a combined signal, comprising the luminance component, the chrominance component and a depth component (D) which is based on the depth data, and
- transmission of the combined signal over a number of channels (108-112) which is equal to the predetermined number of input color components (R,G,B)

2 A method as claimed in claim 1, whereby the input color components comprise a red component a green component and a blue component

3 A method as claimed in claim 1 or 2, whereby the luminance component is transmitted over a first one of the channels, the chrominance component is transmitted over a second one of the channels and the depth component is transmitted over a third one of the channels

4 A method as claimed in any of the claims above, whereby the available bandwidth for the number of channels is substantially mutually equal

5 A method as claimed in any of the claims above, whereby the chrominance component comprises a further number of output color components which are computed on basis of spatially subsampling the input image signal

6 A method as claimed in claim 5, whereby the further number of output components are transmitted over the second one of the channels by means of multiplexing

7 A transmitting unit (104) for combined exchange of image data and related depth data, the transmitting unit comprising

- converting means (202) for converting an input image signal, representing the image data, comprising a predetermined number of input color components into an output image signal comprising a luminance component and a chrominance component,
- combining means (204) for combining the output signal with the related depth data into a combined signal, comprising the luminance component, the chrominance component and a depth component which is based on the depth data, and
- outputting means (206) for outputting the combined signal over a number of channels which is equal to the predetermined number of input color components

8 An image processing apparatus (400) comprising the transmitting unit as claimed in claim 7

9 A method of combined exchange of image data and related depth data, comprising

- reception of a combined signal, comprising a luminance component and a chrominance component representing the image data and comprising a depth component which is based on the depth data, the combined signal being transmitted over a number of channels,
- extracting the luminance component and the chrominance component from the combined signal, and
- converting the luminance component and the chrominance component into an image signal, representing the image data, the image signal comprising a predetermined number of input color components whereby the predetermined number of input color components is equal to the number of channels

10 A receiving unit (106) for combined exchange of image data and related depth data, comprising

- reception means (306) for reception of a combined signal, comprising a luminance component and a chrominance component representing the image data and comprising a depth component which is based on the depth data, the combined signal being transmitted over a number of channels,
- extracting means (304) for extracting the luminance component and the

chrominance component from the combined signal, and

- converting means (302) for converting the luminance component and the chrominance component into an image signal, representing the image data, the image signal comprising a predetermined number of input color components whereby the predetermined number of input color components is equal to the number of channels (108-112)

11 A multi-view display device (408) comprising the receiving unit (106) as claimed in claim 10

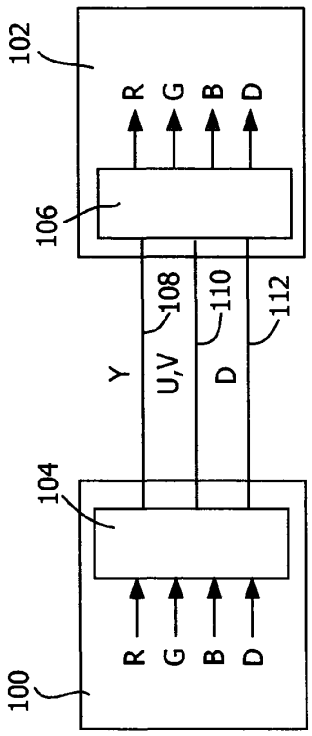


FIG. 1

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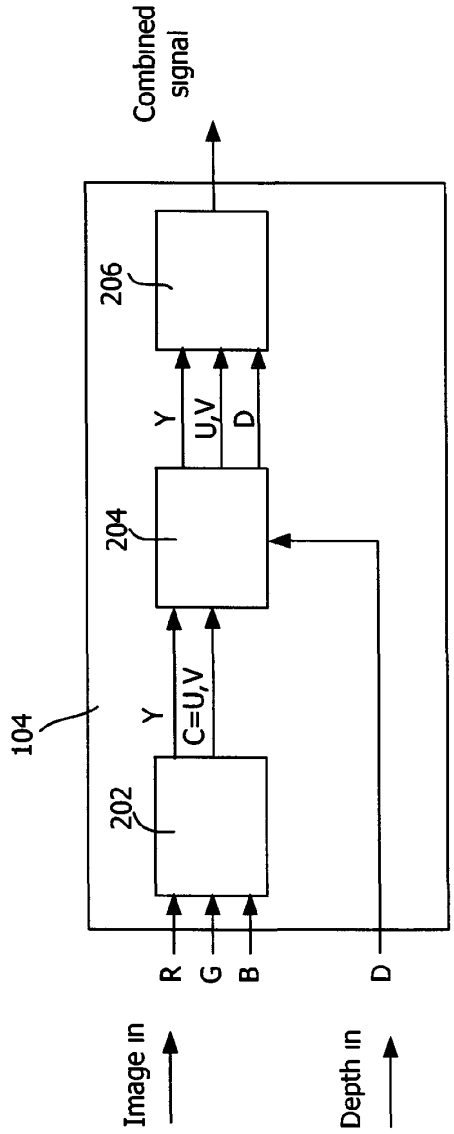


FIG. 2

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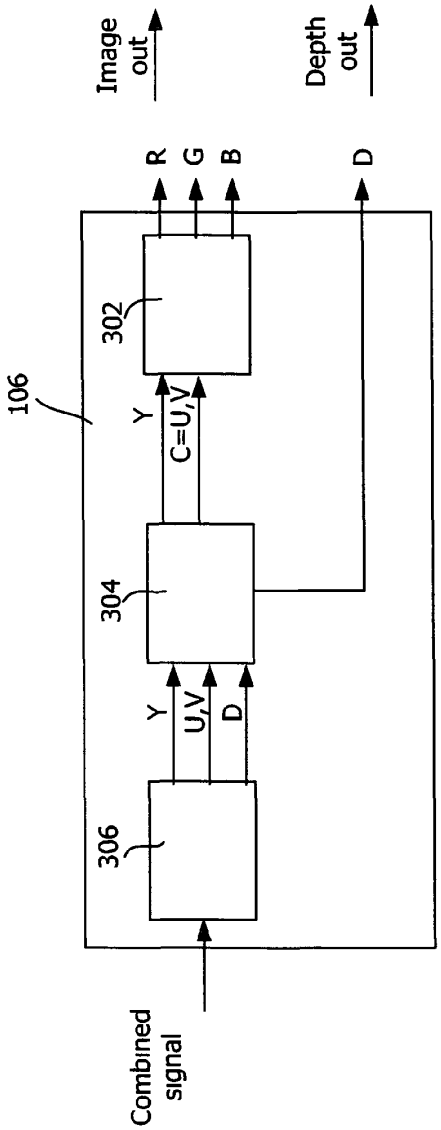

Image out
Depth out
R
G
B
D
302
106
Y
C=U,V
304
Y
U,V
D
306
Combined signal

FIG. 3

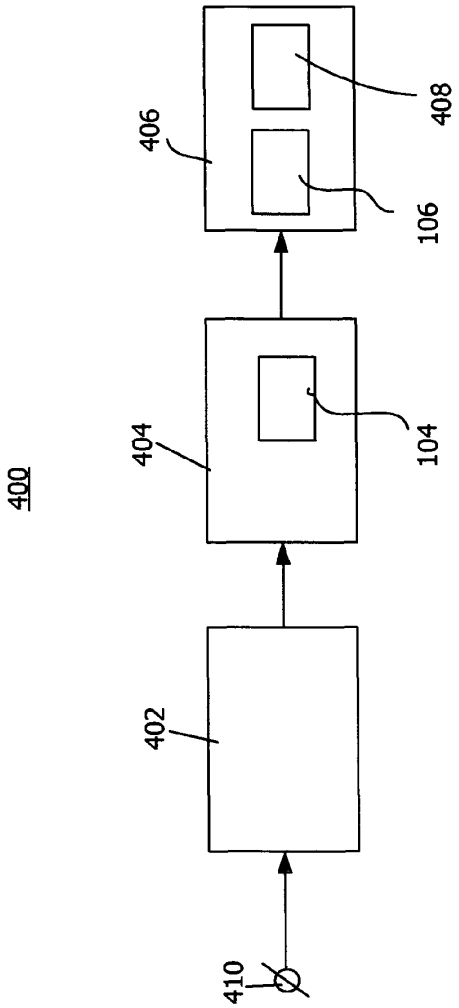


FIG. 4

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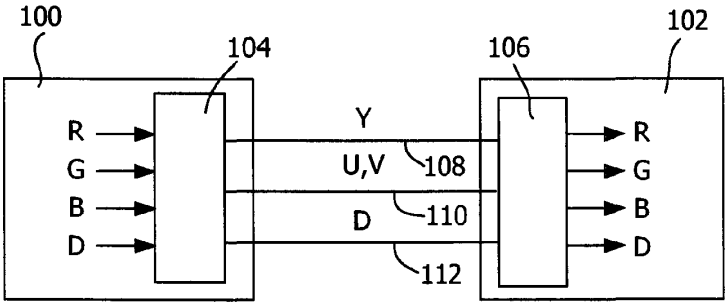
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— *as to applicant s entitlement to apply for and be granted a patent (Rule 4 17(ii))*

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For two letter codes and other abbreviations refer to the Guidance Notes on Codes and Abbreviations appearing at the beginning of each regular issue of the PCT Gazette

(54) Title TRANSMISSION OF 3D IMAGE USING 2D IMAGE AND DEPTH DATA



(57) Abstract A method of combined exchange of image data and related depth data is disclosed The method comprises converting an input image signal representing the image data, comprising a predetermined number of input color components (R G B) into an output image signal comprising a luminance component and a chrominance component combining the output signal with the related depth data into a combined signal, comprising the luminance component the chrominance component and a depth component (D) which is based on the depth data, and transmission of the combined signal over a number of channels (108 112) which is equal to the predetermined number of input color components (R G B)

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B FIELDS SEARCHED

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Electronic data base consulted during the international search (name of data base and where practical search terms used)
EPO-Internal

C DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 2003/146883 A1 (ZELITT SHELDON S [CA]) 7 August 2003 (2003-08-07)	1-10
Y	abstract paragraphs [0057], [0059] paragraphs [0068] - [0070] paragraphs [0081] - [0083], figures 11,12 claims 32,33,36	11
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[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

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Date of the actual completion of the international search	Date of mailing of the international search report
29 January 2007	08/02/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office P B 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel (+31–70) 340–2040 Tx 31 651 epo nl Fax (+31–70) 340–3016	Mao, Pauline

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C(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document with indication where appropriate of the relevant passages	Relevant to claim No
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Information on patent family members

International application No
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(74) Agents: **ROLFES, Johannes, G., A.** et al.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

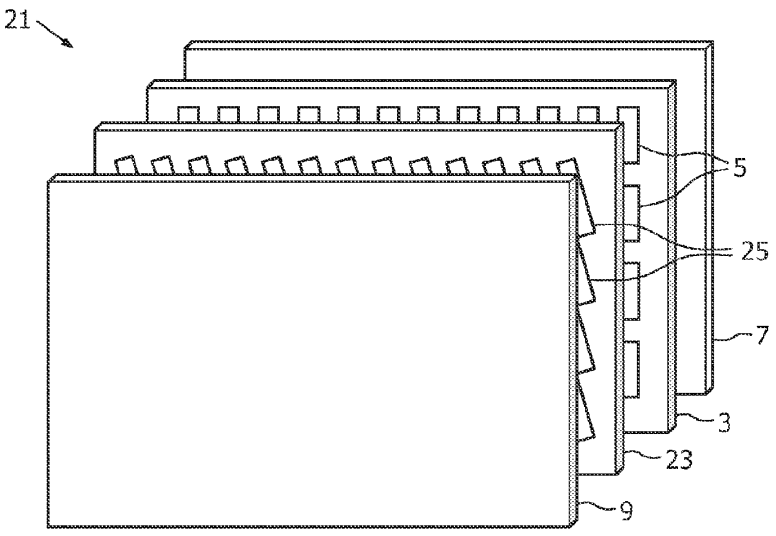
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(54) Title: DISPLAY DEVICE



(57) Abstract: An autostereoscopic display device comprises a display panel having an array of display pixels for producing a display. The display pixels are arranged in orthogonal rows and columns. The device also comprises an array of parallel lenticular elements positioned over the display panel. The lenticular elements have optical focal axes that are slanted at an angle to the display pixel columns. Display areas of the display pixels have edges that are substantially parallel to the lenticular element axes. The light intensity output also varies across each pixel display area in a direction perpendicular to the lenticular element axes.

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Display device

This invention relates to an autostereoscopic display device comprising a display panel having an array of display pixels for producing a display, and a plurality of lenticular elements arranged over the display panel and through which the display pixels are viewed.

A known autostereoscopic display device is described in GB 2196166 A. This known device comprises a two dimensional liquid crystal display panel having a row and column array of display pixels acting as a spatial light modulator to produce the display. An array of elongate lenticular elements extending parallel to one another overlies the display pixel array, and the display pixels are observed through these lenticular elements.

The lenticular elements are provided as a sheet of elements, each of which comprises an elongate semi-cylindrical lens element. The lenticular elements extend in the column direction of the display panel, with each lenticular element overlying a respective group of two or more adjacent columns of display pixels.

In an arrangement in which, for example, each lenticule is associated with two columns of display pixels, the display pixels in each column provide a vertical slice of a respective two dimensional sub-image. The lenticular sheet directs these two slices and corresponding slices from the display pixel columns associated with the other lenticules, to the left and right eyes of a user positioned in front of the sheet, so that the user observes a single stereoscopic image.

In other arrangements, each lenticule is associated with a group of four or more adjacent display pixels in the row direction. Corresponding columns of display pixels in each group are arranged appropriately to provide a vertical slice from a respective two dimensional sub-image. As a user's head is moved from left to right a series of successive, different, stereoscopic views are perceived creating, for example, a look-around impression.

The above described device provides an effective three dimensional display. However, it will be appreciated that, in order to provide stereoscopic views, there is a necessary sacrifice in the horizontal resolution of the device. For example, a display panel

having an array of 600 rows and 800 columns of display pixels may provide a four-view autostereoscopic display in which each view comprises an array of 600 rows and 200 pixels. This substantial difference between vertical and horizontal resolution is undesirable.

US patent No. 6,064,424 discloses an autostereoscopic display device similar to that described above, except that the elongate lenticular elements are slanted at an angle to the column direction of the display panel. By slanting the lenticular elements, some of the reduction in horizontal resolution, which would otherwise be required, is transferred to the vertical resolution. It thus becomes possible to "consume" both vertical and horizontal resolution to increase the number views displayed by the device.

The device disclosed in the above mentioned US patent overcomes the problem associated with a reduction in horizontal resolution. However, by slanting the lenticular elements at an angle to the columns of display pixels, other problems are introduced. In particular, as a user's head is moved from left to right, variations in light intensity are observed. These intensity variations are caused by the lenticular elements imaging varying amounts of the opaque black mask that defines the pixel areas of the display panel. The variations are observed by the user as moiré interference.

The problem of light intensity variations may be addressed by altering the focal axes of the lenticular elements, so that broader bands of the display panel are imaged. However, cross talk between the different views is then introduced, which is also undesirable.

According to the invention, there is provided an autostereoscopic display device comprising: a display panel having an array of display pixels for producing a display, the display pixels being arranged in rows and columns; and an array of parallel lenticular elements positioned over the display panel, the lenticular elements having optical focal axes that are slanted at an angle to the display pixel columns, wherein display areas of the display pixels have edges that are substantially parallel to the lenticular element axes.

By providing a device having pixel display areas with edges that are parallel to the lenticular element axes, the problems of light intensity variations and cross talk between views are reduced or eliminated. The lenticular element axes, however, remain slanted at an angle to the display pixel columns, and so it is still possible to "consume" both vertical and horizontal resolution to increase the number views displayed by the device.

The display panel may comprise a first mask arrangement for providing pixel display areas having edges that are substantially parallel to the display pixel columns. Such display panels are entirely conventional, and the invention may therefore be based on mass produced units. The autostereoscopic display device then also comprises a second mask

arrangement, positioned over the first mask arrangement, and arranged to modify the pixel display areas to have edges that are substantially parallel to the lenticular element axes.

Alternatively, the display panel may comprise a mask arrangement arranged to provide pixel display areas having edges that are substantially parallel to the lenticular element axes. Such display panels are not conventional, and specially designed pixel layouts may therefore be required. Such non-conventional display panels do, however, allow for a larger pixel display area for a given pixel pitch. These pixel display areas may have a rectangular shape.

The mask arrangement may be integrated into the red, green and blue filters of a colour display panel.

Each lenticular element may overlie a plurality of display pixels in the row direction and/or the column direction. There may be a single row of lenticular elements overlying the display panel.

The ratio between the pitch of the pixel display areas and the width of the pixel display areas, in a direction perpendicular to the lenticular element axes, may be greater than or equal to 2:1.

The width of the pixel display areas may be equal to the width of a gap (for example, provided by a mask) between the pixel display areas, in a direction perpendicular to the lenticular element axes.

The rows and columns of display pixels may be orthogonal. A display pixel may be provided at every intersection of the display pixel rows and columns.

The display panel may be a liquid crystal display panel. Such display panels are particularly suitable for use in autostereoscopic display devices.

The light intensity output across each pixel display area may vary in a direction perpendicular to the lenticular element axes, preferably across edge portions of the pixel display area. In particular, the light intensity output of each display pixel may be greater at the centre of the pixel display area than it is at the edges of the pixel display area. This may be achieved by adapting the mask arrangements so that the light transmitting portions that define the pixel display areas have a light attenuating function. In this way, the transition between adjacent views may be smoother, further reducing light intensity variations.

Embodiments of the invention will now be described, purely by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic perspective view of a known autostereoscopic display device;

Fig. 2 is a schematic plan view of the display device shown in Fig. 1;

Fig. 3 is a schematic perspective view of a first embodiment of the invention;

Fig. 4 is a schematic plan view of the display device shown in Fig. 3;

Fig. 5 is a schematic perspective view of a second embodiment of the invention; and

Fig. 6 is a schematic plan view of the display device shown in Fig. 5.

The invention provides an autostereoscopic display device in which the lenticular element axes and the edges of the pixel display areas are both slanted at a common angle to the display pixel columns. By providing pixel display areas with edges that are parallel to the lenticular element axes, light intensity variations and cross talk between views can be reduced or eliminated.

Fig. 1 is a schematic perspective view of a known direct view autostereoscopic display device 1. The known device 1 comprises a liquid crystal display panel 3 of the active matrix type that acts as a spatial light modulator to produce the display.

The display panel 3 has an orthogonal array of display pixels 5 arranged in rows and columns. For the sake of clarity, only a small number of display pixels 5 are shown in the Figure. In practice, the display panel 3 might comprise about one thousand rows and several thousand columns of display pixels 5.

The structure of the liquid crystal display panel 3 is entirely conventional. In particular, the panel 3 comprises a pair of spaced transparent glass substrates, between which an aligned twisted nematic or other liquid crystal material is provided. The substrates carry patterns of transparent indium tin oxide (ITO) electrodes on their facing surfaces. Polarising layers are also provided on the outer surfaces of the substrates.

Each display pixel 5 comprises opposing electrodes on the substrates, with the intervening liquid crystal material therebetween. The shape and layout of the display pixels 5 are determined by the shape and layout of the electrodes. The display pixels 5 are regularly spaced from one another by gaps.

Each display pixel 5 is associated with a switching element, such as a thin film transistor (TFT) or thin film diode (TFD). The display pixels are operated to produce the

display by providing addressing signals to the switching elements, and suitable addressing schemes will be known to those skilled in the art.

The gaps between the display pixels 5 are covered by an opaque black mask. The mask is provided in the form of a grid of light absorbing material. The mask covers the switching elements and defines the individual display pixel areas.

The display panel 3 is illuminated by a light source 7 comprising, in this case, a planar backlight extending over the area of the display pixel array. Light from the light source 7 is directed through the display panel 3, with the individual display pixels 5 being driven to modulate the light and produce the display.

The display device 1 also comprises a lenticular sheet 9 arranged over the display side of the display panel 3. The lenticular sheet 9 comprises a row of lenticular elements extending parallel to one another.

The arrangement of the display pixels 5 and lenticular elements 11 are shown more clearly in Fig. 2, which is a schematic plan view of the display device 1 shown in Fig. 1. Again, only a small number of the display pixels 5 a are shown for the sake of clarity.

As can be seen from Fig. 2, the lenticular elements 11, of which only one is shown, are slanted at an angle to the column direction of the display pixels 5, i.e. their longitudinal axis defines an acute angle with the column direction of the display pixels 5.

The lenticular elements 11 are in the form of convex cylindrical lenses, and they act as an optical director means to provide different images, or views, from the display panel 3 to the eyes of a user positioned in front of the display device 1. The lenticular elements 11 also provide a number of different images, or views, to the eyes of the user as the user's head moves from left to right in front of the display device 1.

The autostereoscopic display device 1 shown in Figs. 1 and 2 is capable of providing nine different views. In particular, for each group of eighteen display pixels 5 overlaid by a lenticular element 11, the lenticular element 11 projects two pixels 5 in each of nine different directions, so as to form the nine different views. The display pixels 5 in Fig. 2 are labelled from "1" to "9" to indicate to which of the views they correspond.

As well as the display pixels 5, the lenticular element 11 also projects portions of the black mask 13 provided between the display pixels 5.

For example, the lenticular element 11 shown in Fig. 2 overlies a group of eighteen display pixels 5. The dashed line 15 indicates a portion of the display panel 3 that is projected by the lenticular element 11 in one particular direction to produce one of the nine different views. As can be seen, two display pixels for view "4" are projected, as is a

significant amount of the black mask 13. Small amounts of display pixels for the neighbouring views "3" and "5" are also projected, and this is observed as cross talk between the views.

It will be appreciated that, as the user's head moves from left to right, his/her eyes will receive several different ones of the nine views, in turn. As the user's head moves in this way, the proportion of the black mask 13 received by the user's eyes also varies, thereby causing light intensity variations. These undesirable light intensity variations are observed as a moiré pattern.

The problems associated with the known autostereoscopic display device 1 described above are addressed by autostereoscopic display devices according to the invention. Figs. 3 and 4 show schematic perspective and plan views respectively of a first autostereoscopic display device 21 according to the invention.

The display device 21 shown in Figs. 3 and 4 is similar in many ways to the device shown in Figs. 1 and 2, and like numerals indicate like features. In particular, the display device 21 comprises a display panel 3, a light source 7 and a lenticular sheet 9 that are identical to those described above with reference to Fig. 1. Referring to Fig. 4, it can be seen that the lenticular sheet 9 comprises a row of slanted lenticular elements 11, although for the sake of clarity only one element 11 is shown.

The display device 21 shown in Figs. 3 and 4 additionally comprises a mask arrangement 23 positioned between the display panel 3 and the lenticular sheet 9. This mask arrangement 23 is in addition to the mask arrangement that is provided as part of the display panel 3 and that defines the normally rectangular pixels of the display panel 3.

The function of the additional mask arrangement 23 is to modify the shape of the rectangular pixels 5 of the display panel 3 to provide specifically shaped pixel display areas.

Referring to Fig. 4, it can be seen that the additional mask arrangement 23 comprises an array of slanted, rectangular opaque areas 25. The opaque areas 25 are slanted at an angle so that their longer sides are parallel to the optical focal axes of the lenticular elements 11. The opaque areas 25 are positioned so as to cover the areas between the display pixels 5 of the display panel 3. However, because the opaque areas 25 are slanted, they also cover parts of the adjacent display pixels 5 themselves, thereby providing the modified pixel display areas.

The opaque areas 25 of the additional mask arrangement 23 may be provided on a carrier sheet, in the form of a black, light absorbing material similar to that used in the mask arrangement of the display panel 3.

The effect of the additional mask arrangement 23 is therefore that the pixel display areas of the device 21 are modified so that portions of their edges are parallel to the lenticular element axes, as shown in Fig. 4.

In common with the device 1 described with reference to Figs. 1 and 2, the device 21 shown in Figs. 3 and 4 is capable of providing nine different views. In particular, for each group of eighteen display pixels 5 overlaid by a lenticular element 11, the lenticular element 11 projects two pixels 5 in each of nine different directions, so as to form the nine different views. The display pixels 5 in Fig. 4 are labelled from "1" to "9" to indicate to which of the views they correspond.

As well as the display pixels 5, the lenticular element 11 also projects portions of the black mask 13 provided between the display pixels 5. For example, the lenticular element 11 shown in Fig. 4 overlies a group of eighteen display pixels 5. The dashed line 15 indicates a portion of the display panel 3 that is projected by the lenticular element 11 in one particular direction to produce one of the nine different views.

As can be seen, two display pixels for view "4" are projected, as is a significant amount of the black mask 13. However, because the pixel display areas have been modified by the additional mask arrangement 23, no portions of display pixels for the neighbouring views "3" and "5" are projected. Accordingly, undesirable cross talk between the different views is prevented.

The modification of the pixel display areas also causes undesirable light intensity variations, which are otherwise observed as the viewing angle changes, to be reduced. In particular, the relative amounts of display pixel and black mask received by the user's eyes, as his/her head moves from left to right, vary to a lesser degree.

Figs. 5 and 6 show schematic perspective and plan views respectively of a second autostereoscopic display device 31 according to the invention.

The display device 31 shown in Figs. 5 and 6 is similar to the device shown in Figs. 1 and 2, and like numerals indicate like features. In particular, the display device 31 comprises a light source 7 and a lenticular sheet 9 that are identical to those described above with reference to Figs. 1 and 2. Referring to Fig. 6, it can be seen that the lenticular sheet 9 comprises a row of slanted lenticular elements, although for the sake of clarity only one element 11 is shown.

The display device 31 shown in Figs. 5 and 6 also comprises a display panel 3 positioned between the light source 7 and the lenticular sheet 9. The display panel 3 is identical to that described with reference to Figs. 1 and 2, except that the rectangular display pixels 5 are slanted at an angle to the display pixel columns. In particular, the display pixels 5 are slanted so that the longer edges of the display pixels 5 are parallel with the lenticular element axes.

Thus, whereas the device 21 shown in Figs. 3 and 4 employed an additional mask arrangement 23 to modify the conventional pixel display areas of the display panel, the device 31 shown in Figs. 5 and 6 employs a non-convention display panel 3 already having slanted display pixels 5.

The slanted shape of the display pixels 5 in the device 31 shown in Figs. 5 and 6 is defined by the mask arrangement within the display panel 3 itself. However, the entire structure of the display pixels 5, including the electrode patterns and liquid crystal material, may be modified, so as to provide a device 31 that has larger pixel display areas than those of the device 21 shown in Figs. 3 and 4. In this way, brightness of the display device 31 is be increased.

Operation of the device shown in Figs. 5 and 6 is exactly the same as operation of the device shown in Figs. 3 and 4, and for this reason a detailed description will be omitted. It is sufficient to note that the effect of the modified mask arrangement of the display panel 3 is the same as that of the additional mask arrangement 23 shown in Figs. 3 and 4, i.e. the edges of the pixel display areas are provided parallel to the lenticular element axes, and this effectively prevents cross talk between the different views. Light intensity variations, as the user's head moves from left to right, are also reduced. In fact, because the slanted pixel display areas are rectangular in shape, a constant amount of the pixel display areas is projected by the lenticular elements 11. The light intensity thus remains almost constant as the user's head moves from left to right.

Specific examples of the invention have been described. However, it will be apparent to those skilled in the art that various changes and modifications may be made to these embodiments, without departing from the scope of the invention.

For example, arrangements in which nine views are provided have been described. However, it will be apparent to those skilled in the art that a different number of views may be provided by an arrangement having wider and/or longer lenticular elements. The same number of views could also be provided by arrangements having different lenticular element configurations.

The specific examples described above employ liquid crystal display panels having, for example, a display pixel pitch in the range 50μm to 1000 μm. However, it will be apparent to those skilled in the art that alternative types of display panel may be employed, such as organic light emitting diode (OLED) or cathode ray tube (CRT) display devices.

In the second example described above, the entire structure of the pixels of the display panel is modified to provide slanted pixel display areas. However, in other embodiments, the modifications could be limited to the mask arrangement of the display panel. In certain colour display device embodiments, the mask arrangement of the display panel could be integrated with the colour filters of the display pixels.

In the embodiments described above, there is a relatively sudden transition between the various views, as the viewing angle changes. Accurate positioning of the pixel display areas is therefore required in order to avoid momentary, but large, light intensity variations during the transition between views. The additional mask arrangement and/or the mask arrangement of the display panel may, however, be modified so that the light transmitting portions that define the pixel display areas have a light attenuating function. In particular, the light output of the display pixels can be arranged to fade gradually towards the edges of the pixel display areas, so as to smooth the transition between the views.

Throughout this disclosure the term "pixel" has been used. This term is intended to refer to independently switchable display elements, and therefore includes sub-pixels in a colour display.

CLAIMS:

1. An autostereoscopic display device comprising:

- a display panel having an array of display pixels for producing a display, the display pixels being arranged in rows and columns; and

- an array of parallel lenticular elements positioned over the display panel, the lenticular elements having optical focal axes that are slanted at an angle to the display pixel columns,

wherein display areas of the display pixels have edges that are substantially parallel to the lenticular element axes.

2. An autostereoscopic display device according to claim 1, wherein the display panel comprises a first mask arrangement for providing pixel display areas having edges that are substantially parallel to the display pixel columns, and wherein the autostereoscopic display device further comprises a second mask arrangement, positioned over the first mask arrangement, arranged to modify the pixel display areas to have edges that are substantially parallel to the lenticular element axes.

3. An autostereoscopic display device according to claim 1, wherein the display panel comprises a mask arrangement arranged to provide pixel display areas having edges that are substantially parallel to the lenticular element axes.

4. An autostereoscopic display device according to claim 3, wherein the pixel display areas have a rectangular shape.

5. An autostereoscopic display device according to claim 3 or 4, wherein the mask arrangement comprises colour filters.

6. An autostereoscopic display device according to any preceding claim, wherein each lenticular element overlies a plurality of display pixels in the row direction.

7. An autostereoscopic display device according to any preceding claim, wherein each lenticular element overlies a plurality of display pixels in the column direction.

8. An autostereoscopic display device according to any preceding claim, wherein the ratio between the pitch of the pixel display areas and the width of the pixel display areas, in a direction perpendicular to the lenticular element axes, is greater than or equal to 2:1.

9. An autostereoscopic display device according to any preceding claim, wherein the width of the pixel display areas is equal to the width of a gap between the pixel display areas, in a direction perpendicular to the lenticular element axes.

10. An autostereoscopic display device according to any preceding claim, wherein the rows and columns of display pixels are orthogonal.

11. An autostereoscopic display device according to any preceding claim, wherein a display pixel is provided at every intersection of the display pixel rows and columns.

12. An autostereoscopic display device according to any preceding claim, wherein the display panel is a liquid crystal display panel.

13. An autostereoscopic display device according to any preceding claim, wherein the light intensity output across each pixel display area varies in a direction perpendicular to the lenticular element axes.

14. An autostereoscopic display device according to claim 13, wherein the light intensity output of each display pixel is greater at the centre of the pixel display area than at the edges of the pixel display area.

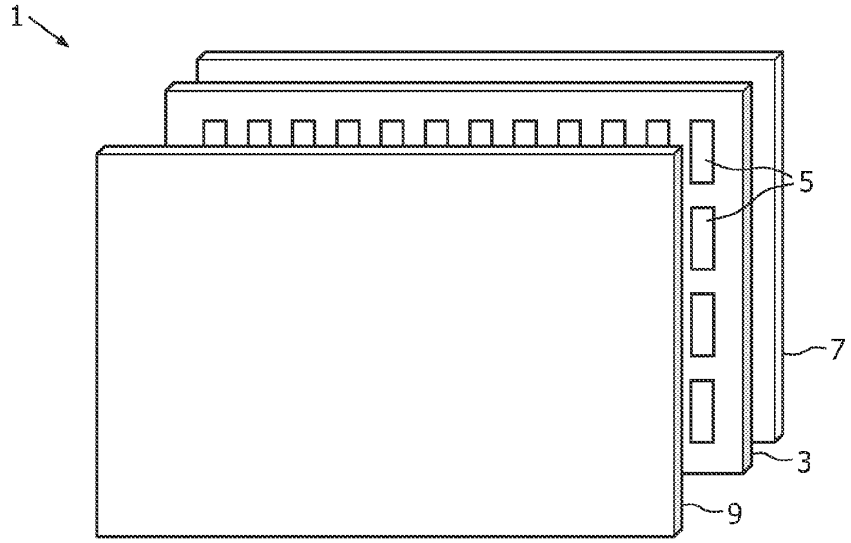

1
5
7
3
9

FIG. 1

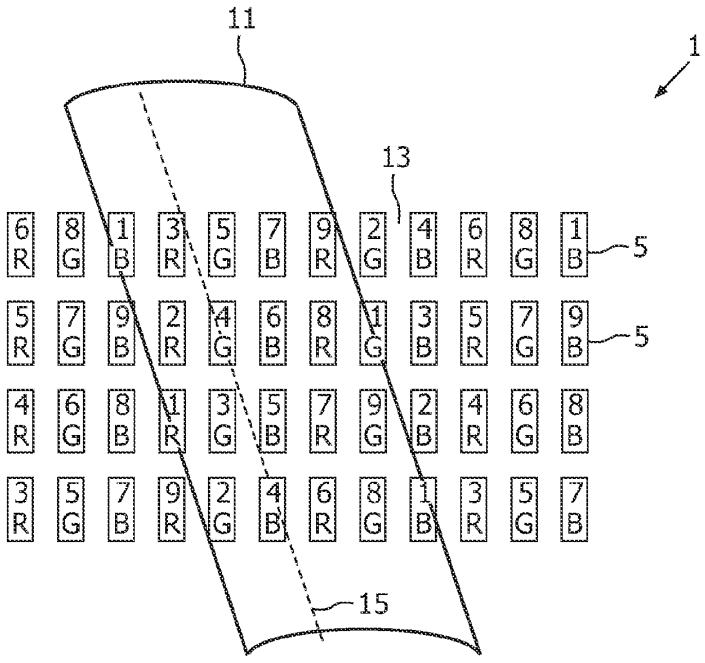

11
1
13
6 R
8 G
1 B
3 R
5 G
7 B
9 R
2 G
4 B
6 R
8 G
1 B
5
5 R
7 G
9 B
2 R
4 G
6 B
8 R
1 G
3 B
5 R
7 G
9 B
5
4 R
6 G
8 B
1 R
3 G
5 B
7 R
9 G
2 B
4 R
6 G
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5 G
7 B
15

FIG. 2

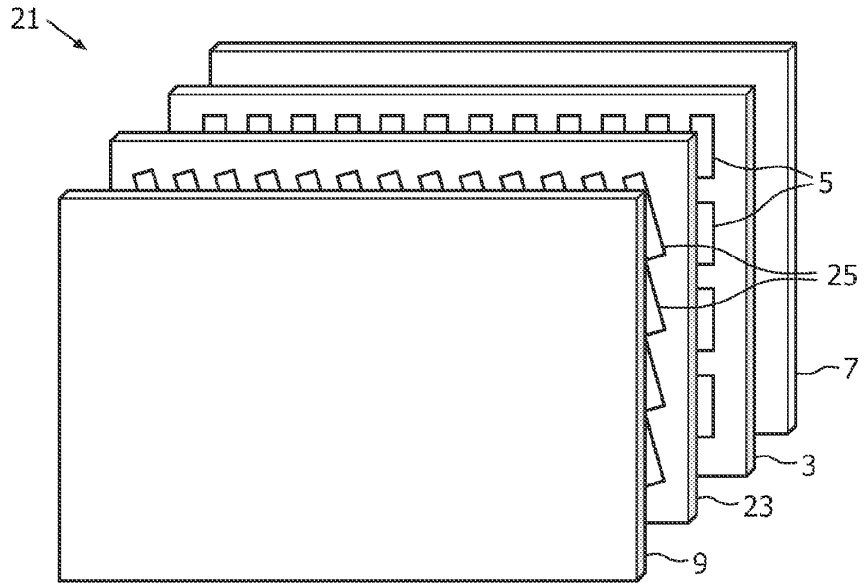


FIG. 3

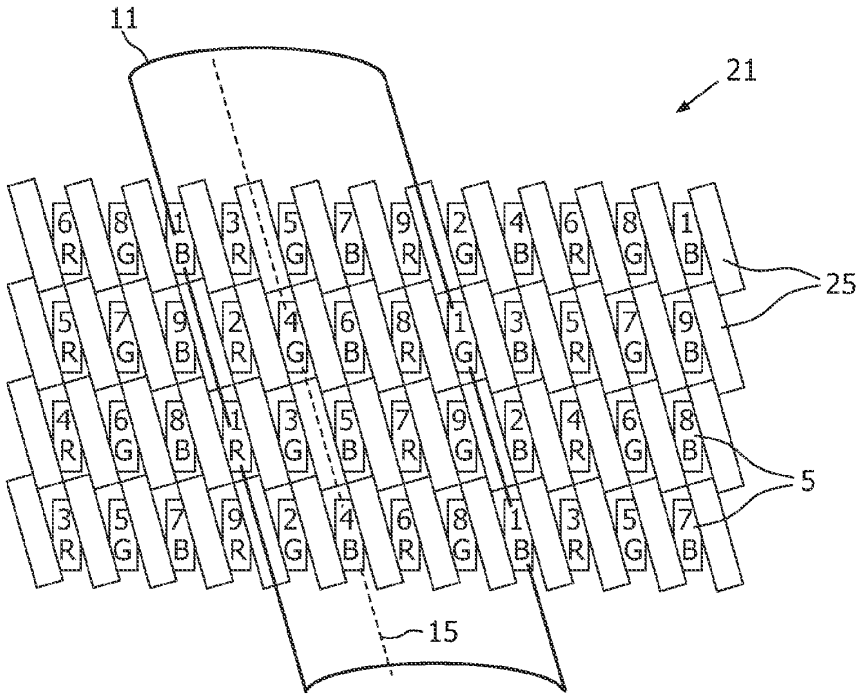


FIG. 4

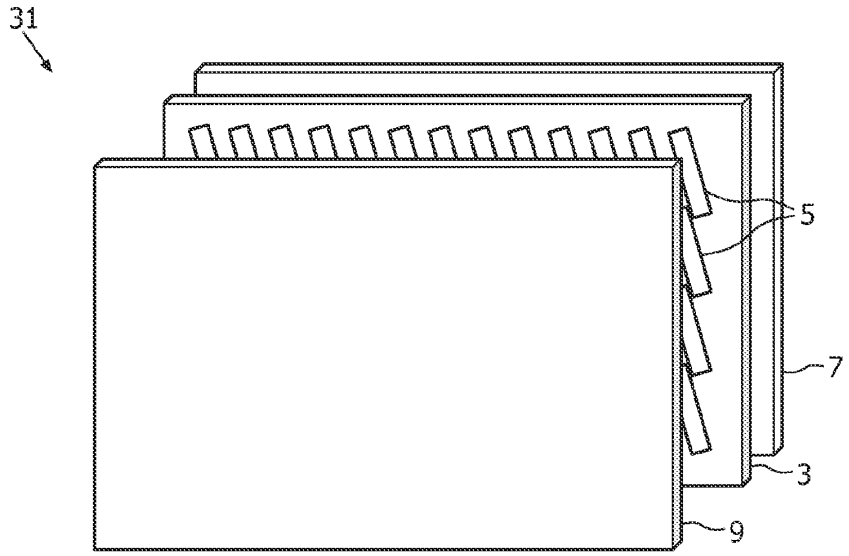


FIG. 5

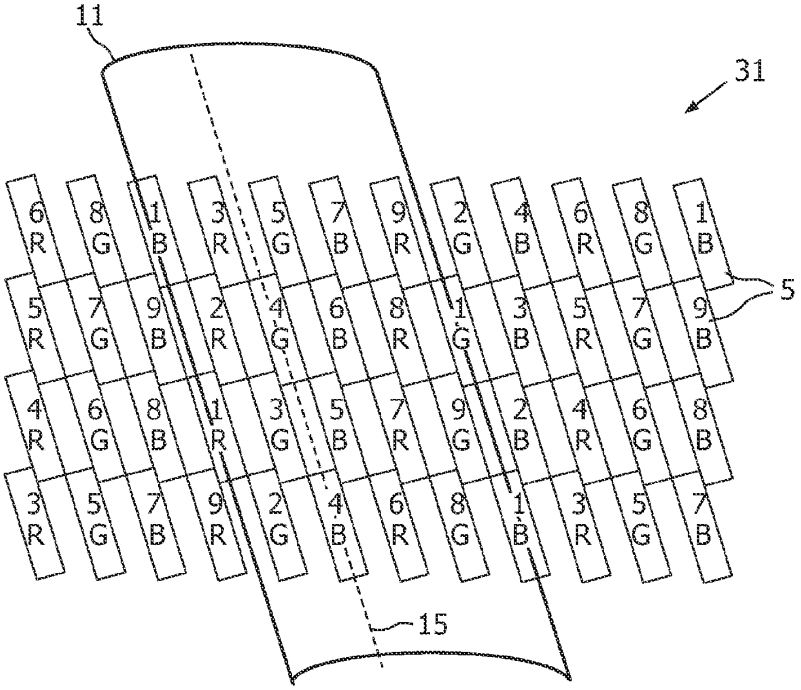


FIG. 6

Electronic Acknowledgement Receipt	
EFS ID:	8753475
Application Number:	12808685
International Application Number:	
Confirmation Number:	5071
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh Shepherd
Customer Number:	24737
Filer:	Michael E. Belk/Elissa DeLuccy
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Filed (SB/08)	009723US1_IDS_2010_Nov_2.pdf	612073 ccb73dc59d565dc47102ad7dc40aa7ed39fb1536	no	4
Warnings:					
Information:					

2	Foreign Reference	WO2006137006A2.pdf	980159 3353c378487b0ec9b65cb971c411ec2a678f863e	no	23
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3	Foreign Reference	WO2007069195A2.pdf	795056 6111caf5a3ba6f7eca172409ad85d52eae457e73	no	15
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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
12/808,685	Nicoll Burleigh Shepherd	009723 US1

24737
PHILIPS INTELLECTUAL PROPERTY & STANDARDS
P.O. BOX 3001
BRIARCLIFF MANOR, NY 10510

INTERNATIONAL APPLICATION NO.	
PCT/IB2008/055305	
I.A. FILING DATE	PRIORITY DATE
12/15/2008	12/18/2007

CONFIRMATION NO. 5071
371 ACCEPTANCE LETTER

OC000000043325721

Date Mailed: 09/03/2010

NOTICE OF ACCEPTANCE OF APPLICATION UNDER 35 U.S.C 371 AND 37 CFR 1.495

The applicant is hereby advised that the United States Patent and Trademark Office in its capacity as a Designated / Elected Office (37 CFR 1.495), has determined that the above identified international application has met the requirements of 35 U.S.C. 371, and is ACCEPTED for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above and the relevant dates are:

06/17/2010	06/18/2010
DATE OF RECEIPT OF 35 U.S.C. 371(c)(1), (c)(2) and (c)(4) REQUIREMENTS	DATE OF COMPLETION OF ALL 35 U.S.C. 371 REQUIREMENTS

A Filing Receipt (PTO-103X) will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE " FILING DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1), (c)(2) and (c)(4) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN ABOVE.** *The filing date of the above identified application is the international filing date of the international application (Article 11(3) and 35 U.S.C. 363).* Once the Filing Receipt has been received, send all correspondence to the Group Art Unit designated thereon.

The following items have been received:

- Copy of the International Application filed on 06/17/2010
- Copy of the International Search Report filed on 06/17/2010
- Preliminary Amendments filed on 06/17/2010
- Oath or Declaration filed on 06/17/2010
- U.S. Basic National Fees filed on 06/17/2010
- Priority Documents filed on 06/17/2010

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

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FORM PCT/DO/EO/903 (371 Acceptance Notice)

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/808,685	06/17/2010		1200	009723 US1	18	4

CONFIRMATION NO. 5071

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FILING RECEIPT



Date Mailed: 09/03/2010

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Nicoll Burleigh Shepherd, Coulsdon, UNITED KINGDOM;

Assignment For Published Patent Application

Koninklijke Philips Electronics N.V., Eindhoven, NL

Power of Attorney: The patent practitioners associated with Customer Number 24737

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/IB2008/055305 12/15/2008

Foreign Applications

EUROPEAN PATENT OFFICE (EPO) 07123461.1 12/18/2007

If Required, Foreign Filing License Granted: 09/01/2010

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/808,685**

Projected Publication Date: 12/16/2010

Non-Publication Request: No

Early Publication Request: No

Title

TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE

Preliminary Class

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier

license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	Atty. Docket
SHEPHERD	009723 US1
Serial No.	Group Art Unit
Filed: CONCURRENTLY	Ex.

TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE

Commissioner for Patents
Alexandria, VA 22313-1450

PRELIMINARY AMENDMENT

Sir:

Prior to calculation of the filing fee and examination, please amend the above-identified application as follows:

REMARKS

This is a preliminary amendment. Please cancel claims 1-49 without prejudice or disclaimer. Please add claims 50-67. No new matter is added.

Applicant(s) reserve(s) the right to continue prosecution of any subject matter canceled, or not claimed, in this, a divisional, or other continuing application.

Examination of the application is now respectfully requested. If any points remain in issue that may best be resolved through a personal or telephonic interview, the Examiner is respectfully requested to contact the undersigned at the telephone number listed below.

Respectfully submitted,

By /Paul Im/
Paul Im, Reg. No. 50,418
Attorney
(914) 333-9627

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh SHEPHERD
Filer:	Paul Im./Jeanne Rusciano
Attorney Docket Number:	009723 US1

Filed as Large Entity

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
National Stage Fee	1631	1	330	330
Natl Stage Search Fee - Report provided	1642	1	430	430
National Stage Exam - all other cases	1633	1	220	220
Pages:				
Claims:				
Independent claims in excess of 3	1614	1	220	220
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1200**

Electronic Acknowledgement Receipt	
EFS ID:	7831652
Application Number:	12808685
International Application Number:	PCT/IB08/55305
Confirmation Number:	5071
Title of Invention:	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE
First Named Inventor/Applicant Name:	Nicoll Burleigh SHEPHERD
Customer Number:	24737
Filer:	Paul Im./Jeanne Rusciano
Filer Authorized By:	Paul Im.
Attorney Docket Number:	009723 US1
Receipt Date:	17-JUN-2010
Filing Date:	
Time Stamp:	07:53:26
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1200
RAM confirmation Number	8463
Deposit Account	141270
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. 1.492 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	009723-ADS.pdf	967425 fe10bdb2bf6c0c5263cc0a354f7c855ff46b5f73	no	4
Warnings:					
Information:					
2	Oath or Declaration filed	009723-Dec.pdf	208864 b44a7e5abc9b64f6755b0aecbb15441e19a7e739	no	2
Warnings:					
Information:					
3	Documents submitted with 371 Applications	WO_2009077969_A2.pdf	1306284 e069976d61c8d8250c6fed1fec6e9ce859189b23	no	26
Warnings:					
Information:					
4	Documents submitted with 371 Applications	WO_2009077969_R4A3.pdf	209327 7568e7720e241900db24fb16337da00c66477698	no	6
Warnings:					
Information:					
5		-009723-PRELIM.pdf	770743 1fb76572a121a48c614d481c2ddf4a364a9b30c3	yes	7

Multipart Description/PDF files in .zip description

Document Description	Start	End
Preliminary Amendment	1	1
Claims	2	6
Applicant Arguments/Remarks Made in an Amendment	7	7

Warnings:					
Information:					
6	Fee Worksheet (PTO-875)	fee-info.pdf	36677 2c94befc9c449946b2164f12605f7f0c0cf3671d	no	2
Warnings:					
Information:					

Total Files Size (in bytes):	3499320

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/14 (07-07)
Approved for use through 06/30/2010. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	009723 US1
	Application Number	
Title of Invention	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Applicant Information:

Applicant 1 Remove

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Nicoll	Burleigh	SHEPHERD	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	COULSDON	Country Of Residence[i]	GB
Citizenship under 37 CFR 1.41(b) [i]	GB		

Mailing Address of Applicant:

Address 1	166 CHALDON WAY		
Address 2			
City	COULSDON	State/Province	
Postal Code	CR5 1DF	Country[i]	GB

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	24737		
Email Address	jeanne.rusciano@philips.com	Add Email	Remove Email

Application Information:

Title of the Invention	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE		
Attorney Docket Number	009723 US1	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter			
Suggested Class (if any)		Sub Class (if any)	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)		Suggested Figure for Publication (if any)	

PTO/SB/14 (07-07)
Approved for use through 06/30/2010. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	009723 US1
	Application Number	
Title of Invention	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE	

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S. C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Enter either Customer Number or complete the Representative Name section below. If both sections are completed the Customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	24737		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	a 371 of international	PCT/IB2008/055305	2008-12-15

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).

Remove

Application Number	Country [i]	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
07123461.1	EP	2007-12-18	◉ Yes ○ No

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Assignee Information:

Providing this information in the application data sheet does not substitute for compliance with any requirement of part 3 of Title 37 of the CFR to have an assignment recorded in the Office.

Assignee 1 Remove

PTO/SB/14 (07-07)
Approved for use through 06/30/2010. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	009723 US1
	Application Number	
Title of Invention	TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE	

If the Assignee is an Organization check here. ☒			
Organization Name	KONINKLIJKE PHILIPS ELECTRONICS N.V.		
Mailing Address Information:			
Address 1	HIGH TECH CAMPUS 44		
Address 2			
City	EINDHOVEN	**State/Province**	
Country [i]	NL	Postal Code	5656 AE
Phone Number		Fax Number	
Email Address			
Additional Assignee Data may be generated within this form by selecting the **Add** button.		Add	

Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.					
Signature	/Paul Im/			Date (YYYY-MM-DD)	2010-06-16
First Name	PAUL	Last Name	IM	Registration Number	50418

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. 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, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	ATTORNEY'S DOCKET NUMBER PH009723US1

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention the specification of which (check only one item below):

☐ entitled:

☐ is attached hereto.

☐ was filed as United States application

Serial No

on

and was amended

on

☒ was filed as PCT international application

Number PCT/IB2008/055306

On 16-Dec-2008

and was amended under PCT Article 19

on (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C.119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or of any PCT international application having a filing date before that of the application of which priority is claimed.

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY	APPLICATION NUMBER	DATE OF FILING DAY, MONTH, YEAR	PRIORITY CLAIMED UNDER 35 USC 119
EP	07123461.1	18-Dec-2007	YES

Combined Declaration For Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications)	Attorney's Docket Number PH009723US1

POWER OF ATTORNEY: I hereby appoint practitioners associated with Customer Number 24737 as my attorney(s) and/or agent(s) to prosecute this application and transact all business in the U.S. Patent and Trademark Office connected therewith. Please direct all correspondence for this application to the address associated with the above-mentioned Customer Number.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
		SHEPHERD	Nicoll	Burleigh
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
		Coulsdon	United Kingdom	United Kingdom
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
		166 Chaldon Way	CR5 1DF Coulsdon	United Kingdom
SIGNATURE				DATE
				16 DEC 2008

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 June 2009 (25.06.2009)

PCT

(10) International Publication Number
WO 2009/077969 A2

(51) International Patent Classification:
H04N 13/00 (2006.01)

(21) International Application Number:
PCT/IB2008/055305

(22) International Filing Date:
15 December 2008 (15.12.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
07123461.1 18 December 2007 (18.12.2007) EP

(71) Applicant *(for all designated States except US)*: **KONINKLIJKE PHILIPS ELECTRONICS N.V.** [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **SHEPHERD, Nicoll, B.** [GB/GB]; c/o High Tech Campus 44, NL-5656 AE Eindhoven (NL).

(74) Agents: **UITTENBOGAARD, Frank** et al.; c/o High Tech Campus 44, NL-5656 AE Eindhoven (NL).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

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(54) Title: TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE

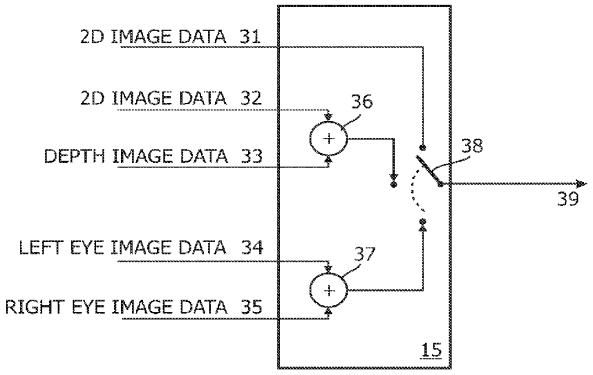


FIG. 2

(57) Abstract: A digital display interface (40) connects a first audio-visual device (10) to a second audio-visual device (20). Stereoscopic image data is transmitter over the display interface (40). Components of stereoscopic image data are multiplexed and inserted into an image data carrying element. An existing deep color mode can be re-used for this purpose. Signaling information to help identify or decode the stereoscopic image data is carried in auxiliary data carrying elements. Stereoscopic image data can be distributed between image data carrying data elements and auxiliary data carrying data elements. Auxiliary data carrying elements can be transmitted in horizontal or vertical blanking periods, and can comprise HDMI Data Island Packets. Stereoscopic image data can be sent over an auxiliary data channel. The auxiliary data channel can form part of the same cable as is used to carry a primary channel of the display interface, a separate cable, or a wireless link.

WO 2009/077969 A2

Transport of stereoscopic image data over a display interface

FIELD OF THE INVENTION

This invention relates to transport of image data for the display of stereoscopic images.

BACKGROUND TO THE INVENTION

Various schemes for displaying three dimensional images (static, or moving images) are known. One well-known scheme simultaneously displays two images which are encoded for the left eye and right eye by means of different optical polarizations, or colors (e.g. red and green). A viewer wears a pair of special glasses which have lenses in front of the left and right eyes. The lenses are arranged to pass only the image intended for that eye, i.e. a left eye sees only the image intended for that eye. Another stereoscopic display technique sequentially presents an image intended for the left eye, and an image intended for the right eye. A user wears a special pair of glasses which are shuttered in synchronism with the displayed images, such that the left eye shutter is open during the period when the left eye image is displayed, and the right eye shutter is open during the period when the right eye image is displayed.

Auto stereoscopic display techniques remove the need for a viewer to wear special glasses. One known scheme uses a flat panel display with multisided slanted ventricular lenses mounted in front of display elements. An example of this kind of display is described in WO07/069195 A2.

Historically, 3D displays have been limited to specialized applications (e.g. medical imaging) or feature film presentation where it is possible to provide bespoke, high cost, display apparatus. There is now considerable interest in delivering stereoscopic content to a much wider audience, including the consumer electronics market. However, an issue with delivering stereoscopic images in a consumer electronics environment is that conventional displays, and display interfaces which connect displays or projectors to media players, have been designed specifically for the display of conventional 2D images.

Schemes for conveying stereoscopic image data within the confines of existing display interfaces have tended to sacrifice part of the active portion of an image to carry

additional data necessary to render a stereoscopic image. The WOWvx format developed by Koninklijke Philips Electronics N.V. divides the overall display frame into a number of separate regions where different data can be carried. The overall frame is divided into two sub-frames, arranged side-by-side: a first of the sub-frames carries 2D image data and a second of the sub-frames carries depth information. A header is added to the beginning of the upper left-hand corner of the frame. The image data is carried in a normal manner across a display interface. A display extracts depth data from the second sub-frame and creates a 3D image having a resolution of the first sub-frame. This 3D image can then be 'stretched' to occupy the full visible area of the display.

Digital displays and media players are increasingly being equipped with digital display interfaces such as the High Definition Multimedia Interface (HDMI). The present invention seeks to provide an alternative way of delivering stereoscopic image data over a digital display interface.

SUMMARY OF THE INVENTION

A first aspect of the present invention provides a digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable in:

a first mode in which the formatter generates a stream of first data elements which carry pixel data of a 2D image;

a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

An advantage of this arrangement is that the stereoscopic image data can be carried across a digital display interface using the existing capacity of the interface. Advantageously, where the display interface supports various color depths of image data, such as 48-bit color as well as conventional 24-bit color, the higher capacity transport modes which are intended to transport higher color depth data can be re-used to carry the multiplexed stereoscopic image data. Therefore, no additional capacity is required from the interface to carry the stereoscopic data, while still allowing good color depth for the stereoscopic content. It also has the benefit that little or no changes are required to an existing standard defining the display interface. It also allows stereoscopic image content to be sent

with a resolution which is significantly higher than schemes which sacrifice part of the active image area to carry the stereo image data.

Advantageously, the second data elements have a capacity which is no greater than, and preferably the same as, the first data elements. This allows the stereoscopic data to be carried with minimal modification to the standards defining the interface.

The term "stereoscopic image data components" is intended to include any scheme which sends data to construct a stereoscopic (or autostereoscopic) display to a user, and includes: schemes which send left eye image data and right eye image data; schemes which send 2D image data and image depth data; schemes which send 2D image data and image depth data and occlusion information, indicating which objects in the picture are occluded by other objects.

In the case of a stereoscopic image which uses left eye and right eye image data, the formatter can use a portion of the second data element to carry the left eye image data and another portion of the second data element to carry the right eye image data.

In the case of a stereoscopic image which uses 2D + depth data, the formatter can use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data. The depth data may additionally be carried in other parts of a signal, such as periods within horizontal or vertical blanking periods. In HDMI, Data Island Packets are carried within these periods, and certain Data Island Packets can be identified as carrying depth data.

Advantageously, signaling information is sent across the interface identifying which mode the formatter is using and further signaling information can allow the second audio-visual device (e.g. a display or projector) to indicate whether it has the capability to render stereoscopic data sent in that formatting mode.

In a High Definition Multimedia Interface (HDMI), signaling can be carried by packets carried within the Data Islands between image data. The capability of a sink device to handle stereoscopic data can be signaled between interface parts using the HDMI Display Data Channel (DDC) channel, with capability data being stored in an Extended Display Identification Data (EDID) ROM at a sink.

A related aspect of the present invention provides a digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract image data, the processor being operable in:

a first mode in which the processor extracts pixel image data for a 2D image from a stream of first data elements; and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

A related aspect of the present invention provides a method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface between the first audio-visual device and a second audio-visual device, the method comprising:

receiving image data;

formatting the image data for transport over the interface by:

in a first mode, generating a stream of first data elements which carry pixel data of a 2D image; and,

in a second mode, generating a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

A related aspect of the present invention provides a method of processing image data at a digital display interface part of an audio-visual device, the method comprising:

receiving formatted image data from the interface;

extracting image data by:

in a first mode, extracting pixel image data for a 2D image from a stream of first data elements; and,

in a second mode, demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

A further aspect of the invention provides a digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable to send a portion of the stereoscopic image data over a primary image data transport channel of the interface and another portion of the stereoscopic image data over an auxiliary data channel.

The interface part can send signaling information across the interface identifying how stereoscopic data is distributed between the primary data channel and the auxiliary data channel.

Advantageously, the stereoscopic image data comprises 2D image data and image depth data and the formatter is arranged to send depth data across the auxiliary data channel.

The auxiliary data channel can comprise a separate line, or lines, within the same cable as the primary channel; a second cable which is separate from a first cable carrying the primary channel; or a wireless link.

A related aspect of the present invention provides a digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for connecting to a primary image data transport channel of the interface and an auxiliary data channel;

a processor arranged to extract a portion of the stereoscopic image data from the primary image data transport channel of the interface and another portion of the stereoscopic image data from the auxiliary data channel.

A related aspect of the present invention provides a method of sending stereoscopic image data over a digital display interface between a first audio-visual device and a second audio-visual device, comprising, at the first audio-visual device:

receiving stereoscopic image data for transport over the interface;

sending a portion of the stereoscopic image data over a primary image data transport channel of the interface and another portion of the stereoscopic image data over an auxiliary data channel.

A related aspect of the present invention provides a method of processing stereoscopic image data at an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the method comprising:

extracting a portion of the stereoscopic image data from a primary image data transport channel of the interface and another portion of the stereoscopic image data from an auxiliary data channel.

A further aspect of the invention provides a digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data;

a formatter arranged to generate a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein signaling information for use in decoding the stereoscopic image data is carried in at least one of the auxiliary data elements.

Where the stereoscopic image data comprises left eye image data and right eye image data, the signaling information can specify what data elements carry the left eye image data and what data elements carry the right eye image data. Where the left eye images and right eye images are interleaved on a line-by-line basis, the signaling information can be sent as often as once for each pair of interleaved lines, although it can be sent much less frequently, such as once per field or frame.

Where the stereoscopic image data comprises 2D image data and depth information, the signaling information can specify at least one of: the transmission location, quantity of the depth information.

Advantageously, where the stereoscopic image data has a plurality of different possible formats, the signaling information specifies the format. One of the formats for the stereoscopic image data can be a scheme which encodes the stereoscopic image data within a conventional 2D image format.

Advantageously, the signaling information is carried in a horizontal or vertical blanking period and for a High Definition Multimedia Interface (HDMI) the signaling information can be sent in a Data Island Packet.

A related aspect of the present invention provides a digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream;

using signaling information carried in at least one of the auxiliary data elements to decode the stereoscopic image data.

A related aspect of the present invention provides a method of sending stereoscopic image data over a digital display interface between a first audio-visual device and a second audio-visual device comprising, at the first audio-visual device:

receiving stereoscopic image data;

generating a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein signaling information for use in decoding the stereoscopic image data is carried in at least one of the auxiliary data elements.

A related aspect of the present invention provides a method of processing stereoscopic image data at a digital display interface part of an audio-visual device, the method comprising:

receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream;

using signaling information carried in at least one of the auxiliary data elements to decode the stereoscopic image data.

A further aspect of the invention provides a digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data components;

a formatter arranged to generate a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein the stereoscopic image data is distributed between the image data carrying data elements and the auxiliary data carrying data elements.

Advantageously, the stereoscopic image data components are 2D image data and image depth data and wherein the depth data is carried in the auxiliary data carrying data elements. Advantageously, the stream further comprises signaling information, carried within auxiliary data carrying data elements, specifying which part of an image the depth information relates to.

The auxiliary data carrying data elements are sent in a horizontal or vertical blanking period, such as HDMI Data Island Packets.

A related aspect of the present invention provides a digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements;

a processor arranged to extract stereoscopic image data from the image data carrying data elements and at least part of the stereoscopic image data from the auxiliary data carrying data elements.

A related aspect of the present invention provides a method of sending stereoscopic data across a digital display interface between a first audio-visual device and a second audio-visual device, the method comprising, at the first audio-visual device:

receiving stereoscopic image data components;

generating a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and distributing the stereoscopic image data between the image data carrying data elements and the auxiliary data carrying data elements.

A related aspect of the present invention provides a method of processing stereoscopic image data at a digital display interface part of an audio-visual device, the method comprising:

receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements;

extracting stereoscopic image data from the image data carrying data elements and at least part of the stereoscopic image data from the auxiliary data carrying data elements.

The functionality described here can be implemented in software, hardware or a combination of these. The invention can be implemented by means of hardware comprising several distinct elements, and by means of a suitably programmed computer. Accordingly, further aspects of the invention provide software for implementing any of the methods. The software may be stored on an electronic memory device, hard disk, optical disk or other machine-readable storage medium. The software may be delivered as a computer program product on a machine-readable carrier or it may be downloaded to the AV device via a network connection.

The invention also extends to signals, for transmission over the display interface, which result from any of the methods.

Features of the various aspects of the invention can be combined.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 shows a display interface for carrying image data between two AV devise;

Fig. 2 shows a formatting function at one end of the interface;

Fig. 3 shows a conventional way of sending 2D image data across a display interface;

Figs. 4 and 5 show ways of sending stereoscopic image data across a display interface;

Fig. 6 shows format of an HDMI video frame; and,

Fig. 7 shows a display interface which includes an auxiliary data channel.

DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 shows an example scenario in which the invention can be used. In Figure 1, an AV device 10 which is capable of providing a source of digital AV content is connected to a display (or video projector) 20 via a digital display interface (DDI) 40. Interface parts 12, 22 in devices 10, 20 support the interface 40, and provide functions such as formatting signals into the form required by standards defining the interface 40. The source device 10 can be a device which can retrieve digital AV content from a store 11, such as a hard disk, a solid state memory or an optical disc or any other fixed or removable storage medium or device. Examples of device 10 include a personal video recorder (PVR), an optical disc player such as a DVD player, an HD-DVD player or a Blu-ray player. Alternatively, device 10 can take the form of a set-top box which receives content from a distribution channel (such as a broadcast channel or broadband network or other type of network (e.g. home network)).

There are a variety of methods for displaying stereoscopic (3D) images. The two main methods for transferring 3D image data across an interface are: to transmit two complete, separate, stereoscopic images representing the left and right views as seen by human eyes; and a normal 2D image with associated depth information that can be used to generate the stereoscopic images within the display. The first method generally requires a significantly higher bandwidth (up to twice that needed for a 2D image) over the interface, but needs little processing in the display, while the second method can require a smaller increase in bandwidth, but at the expense of some fast real-time processing in the display to process the depth information.

Current digital display interfaces, such as HDMI, offer a very high bandwidth. These interfaces transfer uncompressed pixel information, unlike other transport mechanisms (such as Ethernet, USB, IEEE1394) which have to transfer compressed images because of their bandwidth limitations. Originally, images transferred by HDMI were limited to 8 bits per color per pixel, so-called “24-bit color”. Improvements to HDMI from version 1.3 have allowed HDMI to carry more bits per pixel, with the options of carrying 10, 12 and 16 bits per color per pixel, i.e. up to 48-bit color. HDMI describes Deep Color Pixel Packing modes (HDMI 1.3a, section 6.5.3) which allow the higher color depths just described.

According to one embodiment of the present invention, the deep color modes are used to transport stereoscopic image data. The stereoscopic image data can be left image

data + right image data or 2D + depth information. Figure 2 shows a formatting function 15 used within an interface part 12. The formatter 15 can selectively operate in one of a number of different modes. This is shown schematically by formatter selecting one of the sets of inputs: 2D image data 31; 2D + depth image data 32, 33; or left eye and right eye image data 34, 35 for processing and selectively connecting 38 to an interface output 39. Formatter 15 can receive conventional 2D image data 31, such as 24-bit color image data 31. Typically this is received in an RGB or component video (Y,Cr,Cb) format. When receiving stereoscopic image data, formatter 15 multiplexes 36, 37 the image data components. For left eye/right eye image data, the left eye data and right eye data will typically be taken from the same pixel in the left eye/right eye frames or fields of the images, although other algorithms for combining pixels are also within the scope of the present invention. For 2D image + depth information, the 2D image data will typically correspond to a single pixel (e.g. RGB or component video format) and the depth information can take a different form, and may correspond to a different region of the image to the pixel of the 2D image. The formatter 15 may only support one of the 3D formats (i.e. just L+R, or just 2D+depth) or both types of 3D format.

Figures 3 to 5 show a range of different ways in which the image data can be multiplexed. Figure 3 shows conventional image data. In HDMI, the three color components (R,G,B or Y,Cr,Cb) are sent simultaneously on three Transition Minimised Differential Signaling (TMDS) channels 41. TMDS refers to line-level coding applied to the data to maintain an approximate DC balance as well as a reduction in the number of transitions in the data stream. Each color component can be sent using a standard color depth (e.g. 8 bits per color per pixel) or an enhanced color depth, such as 16 bits per color per pixel. Figure 4 shows a way in which stereoscopic left eye/right eye data can be multiplexed. The components of the left eye data (R,G,B or Y,Cr,Cb) are sent in a first portion of each data-carrying element, and then immediately followed by the components of the right eye data (R,G,B or Y,Cr,Cb). Both left eye and right eye are either sent within the same packet, consecutive image data packets, or parts of consecutive image data packets. As an example, where a 16-bit per color per pixel mode is used, bits 0-7 can carry the left image Y data and bits 8-15 carry the right image Y data. HDMI 1.3a currently allows a color depth of up to 16-bits per color per pixel (48-bit color). Figure 4 shows how two 24-bit color images can be carried within the existing 48-bit color mode with no additional capacity required from the interface. It will be appreciated that future revisions of HDMI (and other) specifications may

extend the bandwidth to permit a larger color depth, which will allow each of the left eye and right eye images to use more bits per pixel, so allowing richer 3D images.

Figure 5 shows a scheme for sending 2D image data + depth information where the 2D data is sent first, followed by the depth data. Each color component (R,G,B or Y,Cr,Cb) follows the same format. In Figure 6 the capacity of the packet is divided equally between the 2D data and depth information, although any other division is possible. It may be possible to send significantly less depth data than 2D data, which can allow the 2D image to use a wide color palette and/or high resolution. It is also possible to send some – or all – of the depth information in a different part of the transmitted data stream, such as within specific HDMI Data Island Packets carried within the horizontal and vertical line blanking intervals. This is particularly useful for depth data that is not attached directly to a specific pixel, for instance, it applies to a region of the image.

Interface part 12 sends signaling 42 which indicates the format of the image data, e.g. indicating whether the image data is 2D, stereo (L+R) or stereo (2D+depth). The signaling can also indicate further details of the multiplexing scheme, such as which color depth mode is being used to carry the multiplexed data, the number of bits per data element that are allocated to 2D data and the number of bits per data element that are allocated to depth data. This signaling allows flexibility in how the stereo data is allocated to data carrying elements sent across the interface 40 and allows for the amount of Depth information to be changed dynamically, according to the requirements of the content which is to be displayed. In HDMI, Data Island Packets are sent in horizontal and vertical line blanking periods. The signaling information can conveniently be carried within a Data Island Packet. Figure 6 shows the layout of an HDMI video frame, showing a region 61 where pixel data is sent across TMDS channels, a horizontal blanking period 63 and a vertical blanking period. Data Island Packets 64 are sent within Data Island periods positioned within the horizontal and vertical blanking periods 62, 63. The signaling data can be carried in a General Control Packet, an Auxiliary Video InfoFrame (AVI) packet or an InfoFrame Packet specifically designated for this purpose. If depth data is carried both within the pixel data carrying data elements and other places of the stream, the signaling can indicate where the depth data is to be found. The amount of depth data and the location(s) of the depth data can vary on a dynamic basis during an image, or sequence of images, depending on the required color depth, resolution or complexity of the image (e.g. the amount of depth information within an image).

AV device 20 includes a processor 21 applies suitable processing to the data to render a 3D image. In the case of stereoscopic display, where a user is simultaneously or sequentially presented with separate left and right eye images, processor 21 constructs the separate left eye/right eye images and outputs them 24 at the required time. For sequential stereoscopic displays, a further output 23 is provided to synchronize operation of shuttered glasses. In the case of an autostereoscopic display, such as a display using a ventricular screen, processor 21 constructs the image data which is required to be output 24 to the display elements to generate the autostereoscopic display. Interface part 22 and processor 21 use the signaling information sent across the interface to:

determine if stereoscopic image data is being sent; determine what general stereoscopic image format is being used (e.g. left+right image; 2D+depth; stereo encoded within active image data);

determine more detail of how the image data is being encoded on the interface, and therefore what decoding scheme should be used at the receiver. This may include information about which deep color mode is being used, bit allocation between 2D and depth data, transmission location of depth data (e.g. specific Data Island Packets or auxiliary channel locations).

Further signaling between the AV devices 10, 20 allows the sink device 20 to indicate it's capabilities to receive and process image data. The capability information may indicate the maximum allowed bandwidth for each mode of sending 2D and stereo image data. In HDMI, the capability of a sink device can use the Display Data Channel (DDC) channel, with capability data being stored in an Extended Display Identification Data (EDID) ROM at a sink.

The interface may support other schemes for sending stereoscopic data. A first alternative is to send two separate complete images, carried sequentially (such as a complete left image followed by a complete right image). The indication of the left and right image can be indicated by signaling information carried directly adjacent the position of the image data, such as an HDMI Data Island Packet.

A second alternative is to send two separate images, but with the lines of the two images interleaved. For example, the first line of the left image is sent first, followed by the first line of the right image, and so on.

A third alternative is to send a 2D image in a conventional manner, and to carry depth information in specific Data Island Packets dedicated to carrying depth information.

In each of these alternatives, signaling information carried directly adjacent the position of the image data, such as an HDMI Data Island Packet, can indicate what the image data corresponds to. For the third alternative, the signaling information can specify which part of the image the depth data relates to. As noted above, the HDMI Data Island Packets can be a General Control Packet, an Auxiliary Video InfoFrame (AVI) packet or an InfoFrame Packet specifically designated for this purpose. The information in these packets can identify:

the current stereoscopic method (field, line or byte) being used (see above);

whether a Deep Color Pixel Packing mode is being used to carry 3D information or a Deep Color Mode 2D image;

the mapping of left and right images to the current field, line or byte;

how many of the Data Island Packet packets/sub-packets are being uses to carry Depth information;

the location of other stereoscopic image data components.

The embodiments above show how the separate stereoscopic image components can be carried over a display interface. For some applications, especially those intended for display on a ventricular screen, the picture received at the interface part 12 may already be encoded with stereoscopic content. As an example, a WOWvx encoded image as described in the background section, comprises a 2D image, depth information and/or occlusion information already embedded into separate regions of a conventional image. In one embodiment, the 2D image is carried in one quarter of the image pixels (e.g. in half a line for half the total lines in the picture). The associated depth and/or occlusion information is carried in the other three-quarters of the presented picture. In this case, the lines of the picture are transported across the HDMI link as thought they were a single 2D image occupying all of each line, for all the available lines. In order to identify such a 3D image, an HDMI Data Island Packet (typically a General Control Packet, Auxiliary Video InfoFrame (AVI) packet or specifically designated InfoFrame Packet) indicates this method. The information in this Packet identifies:

- the current stereoscopic method (e.g. 2D+Depth) being used;
- any information pertaining to this method which is required by the display.

The sink identifies the transmitted picture as using this method and processes the picture accordingly. The sink also carries information in the EDID indicating that it supports this method.

In the above description, stereoscopic image data is carried over a channel of an interface (e.g. an HDMI Transport Stream) either by multiplexing the stereoscopic image data within normal data carrying elements of the channels, or by carrying at least part of the stereoscopic image data within other packets (e.g. Data Island Packets) carried over the same channel. A further embodiment of the invention carries at least some of the stereoscopic image data over an associated high speed auxiliary data link such as Gigabit Ethernet, IEEE 1394 or a high-speed wireless link. Signaling information identifies which information is carried by the primary channels of the interface and which is carried by the associated auxiliary link. In HDMI, the signaling information can be carried in Data Island Packets. Similar, or complementary, identification information may also be carried on the associated high speed auxiliary link. The sink uses the received Data Island Packets to identify which information is carried on which link and combines the two streams of data in the necessary format for presentation or processing. Depending on the characteristics of the HDMI and associated auxiliary link, it may be necessary to buffer the data contained in the two streams in order to maintain synchronicity between them. In one embodiment using the above embodiment, the associated wires for the auxiliary link are carried within the HDMI cable; this option is shown in Figure 7 by additional line 50 connecting modules 51, 52 in interface parts 12, 22. In other embodiments, the associated auxiliary link is carried in a separate cable connecting the devices 10, 20, or by a high-speed wireless link.

Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

1. A digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable in:

a first mode in which the formatter generates a stream of first data elements, which carry pixel data of a 2D image; and,

a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

2. An interface part according to claim 1 wherein the second data elements have a capacity which is no greater than the first data elements.

3. An interface part according to claim 1 or 2 wherein the stereoscopic image data components are left eye image data and right eye image data.

4. An interface part according to claim 3 wherein the formatter is arranged to use a portion of the second data element to carry the left eye image data and another portion of the second data element to carry the right eye image data.

5. An interface part according to claim 4 wherein the formatter is arranged to multiplex a corresponding pixel of the left eye image data and the right eye image data into the second data element.

6. An interface part according to claim 1 or 2 wherein the stereoscopic image data components are 2D image data and image depth data.

7. An interface part according to claim 6 wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data.

8. An interface part according to claim 7 wherein the formatter is arranged to multiplex a pixel of the 2D image with depth data from a different part of the image.

9. An interface part according to any one of the preceding claims wherein the formatter is operable in a third mode in which the formatter generates third data elements carrying per pixel data, the third data elements having a capacity which is smaller than each of the first data elements and the second data elements.

10. An interface part according to any one of the preceding claims which is arranged to send signaling information across the interface identifying which mode the formatter is using.

11. An interface part according to any one of the preceding claims which is arranged to receive signaling information across the interface specifying capabilities of the second audio-visual device.

12. An interface part according to claim 10 wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet between image data.

13. An interface part according to any one of the preceding claims wherein the interface is a High Definition Multimedia Interface (HDMI) and the first mode and the second mode are Deep Color Modes having a capacity of greater than 24-bits of color data per pixel.

14. A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract image data, the processor being operable in:

a first mode in which the processor extracts pixel image data for a 2D image from a stream of first data elements; and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

15. A method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface between the first audio-visual device and a second audio-visual device, the method comprising:

receiving image data;

formatting the image data for transport over the interface by:

in a first mode, generating a stream of first data elements which carry pixel data of a 2D image; and,

in a second mode, generating a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

16. A method of processing image data at a digital display interface part of an audio-visual device, the method comprising:

receiving formatted image data from the interface;

extracting image data by:

in a first mode, extracting pixel image data for a 2D image from a stream of first data elements; and,

in a second mode, demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

17. Software for performing the method of claim 15 or 16.

18. A signal resulting from the method of claim 15.

19. A digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable to send a portion of the stereoscopic image data over a primary image data transport channel of the interface and another portion of the stereoscopic image data over an auxiliary data channel.

20. An interface part according to claim 19 which is arranged to send signaling information across the interface identifying how stereoscopic data is distributed between the primary data channel and the auxiliary data channel.

21. An interface part according to claim 19 or 20 wherein the stereoscopic image data comprises 2D image data and image depth data and the formatter is arranged to send depth data across the auxiliary data channel.

22. An interface part according to any of claims 19 to 21 wherein the interface comprises a set of lines within a cable and the auxiliary data channel comprises a separate line, or lines, within the same cable.

23. An interface part according to any of claims 19 to 21 wherein the interface comprises a first cable and the auxiliary data channel is carried by a second cable.

24. An interface part according to any of claims 19 to 21 wherein the auxiliary data channel is carried by a wireless connection.

25. A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for connecting to a primary image data transport channel of the interface and an auxiliary data channel;

a processor arranged to extract a portion of the stereoscopic image data from the primary image data transport channel of the interface and another portion of the stereoscopic image data from the auxiliary data channel.

26. A method of sending stereoscopic image data over a digital display interface between a first audio-visual device and a second audio-visual device, comprising, at the first

audio-visual device:

receiving stereoscopic image data for transport over the interface;

sending a portion of the stereoscopic image data over a primary image data transport channel of the interface and another portion of the stereoscopic image data over an auxiliary data channel.

27. A method of processing stereoscopic image data at an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the method comprising:

extracting a portion of the stereoscopic image data from a primary image data transport channel of the interface and another portion of the stereoscopic image data from an auxiliary data channel.

28. A digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data;

a formatter arranged to generate a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein signaling information for use in decoding the stereoscopic image data is carried in at least one of the auxiliary data elements.

29. An interface part according to claim 28 wherein the stereoscopic image data comprises left eye image data and right eye image data and the signaling information specifies what data elements carry the left eye image data and what data elements carry the right eye image data.

30. An interface part according to claim 28 wherein the stereoscopic image data comprises 2D image data and depth information and the signaling information specifies at least one of: the transmission location, quantity of the depth information.

31. An interface part according to any one of claims 28 to 30 wherein the stereoscopic image data has a plurality of different formats and the signaling information specifies the format.

32. An interface part according to claim 31 wherein one of the formats for the stereoscopic image data is encoding the stereoscopic image data within a conventional 2D image format.

33. An interface part according to any one of claims 28 to 32 wherein the signaling information is carried in a horizontal or vertical blanking period.

34. An interface part according to claim 33 wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet.

35. A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream;

using signaling information carried in at least one of the auxiliary data elements to decode the stereoscopic image data.

36. A method of sending stereoscopic image data over a digital display interface between a first audio-visual device and a second audio-visual device comprising, at the first audio-visual device:

receiving stereoscopic image data;

generating a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein signaling information for use in decoding the stereoscopic image data is carried in at least one of the auxiliary data elements.

37. A method of processing stereoscopic image data at a digital display interface part of an audio-visual device, the method comprising:

receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream;

using signaling information carried in at least one of the auxiliary data elements to decode the stereoscopic image data.

38. Software for performing the method of claim 36 or 37.

39. A signal resulting from the method of claim 36.

40. A digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data components;

a formatter arranged to generate a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein the stereoscopic image data is distributed between the image data carrying data elements and the auxiliary data carrying data elements.

41. An interface part according to claim 40 wherein the stereoscopic image data components are 2D image data and image depth data and wherein the depth data is carried in the auxiliary data carrying data elements.

42. An interface part according to claim 41 further comprising carrying signaling information within auxiliary data carrying data elements specifying which part of an image the depth information relates to.

43. An interface part according to any one of claims 40 to 42 wherein the auxiliary data carrying data elements are sent in a horizontal or vertical blanking period.

44. An interface part according to claim 43 wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet.

45. A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements;

a processor arranged to extract stereoscopic image data from the image data carrying data elements and at least part of the stereoscopic image data from the auxiliary data carrying data elements.

46. A method of sending stereoscopic data across a digital display interface between a first audio-visual device and a second audio-visual device, the method comprising, at the first audio-visual device:

receiving stereoscopic image data components;

generating a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and distributing the stereoscopic image data between the image data carrying data elements and the auxiliary data carrying data elements.

47. A method of processing stereoscopic image data at a digital display interface part of an audio-visual device, the method comprising:

receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements;

extracting stereoscopic image data from the image data carrying data elements and at least part of the stereoscopic image data from the auxiliary data carrying data elements.

48. Software for performing the method of claim 46 or 47.

49. A signal resulting from the method of claim 46.

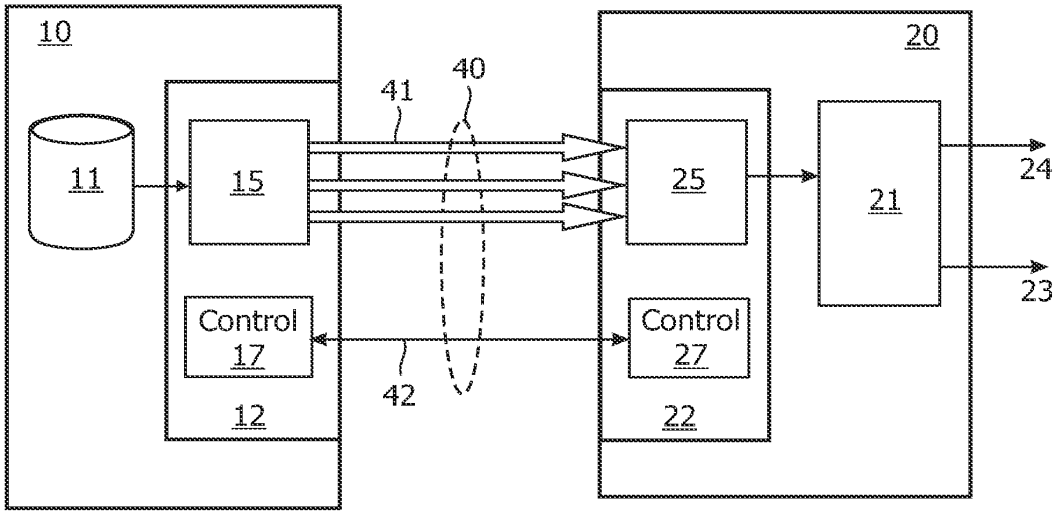

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FIG. 1

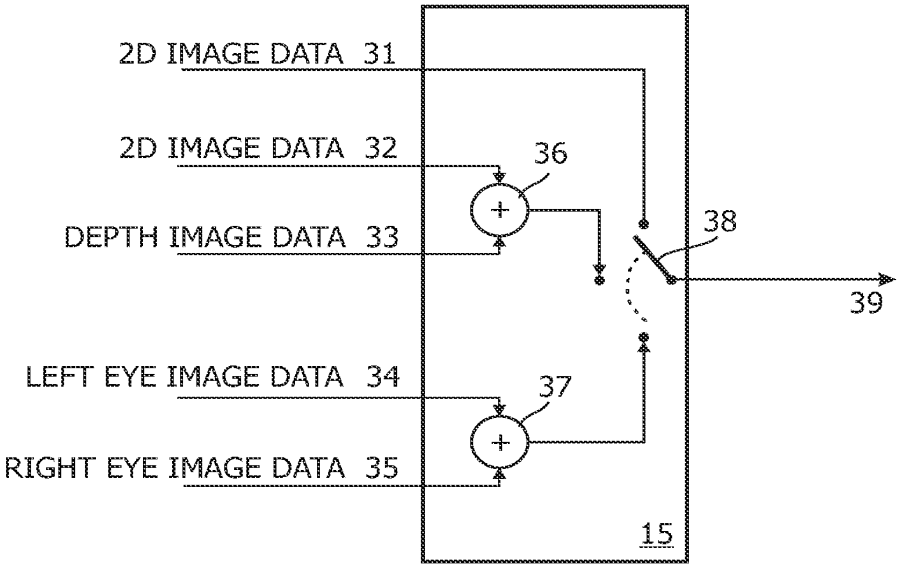

2D IMAGE DATA 31
2D IMAGE DATA 32
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DEPTH IMAGE DATA 33
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LEFT EYE IMAGE DATA 34
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RIGHT EYE IMAGE DATA 35
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FIG. 2

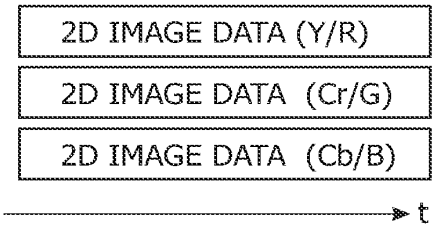


FIG. 3

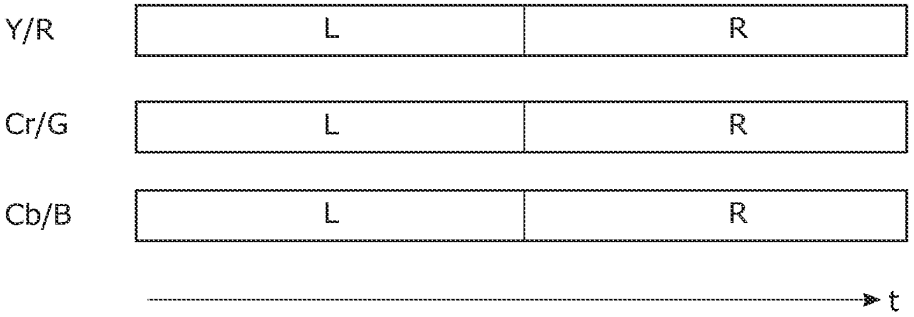


FIG. 4

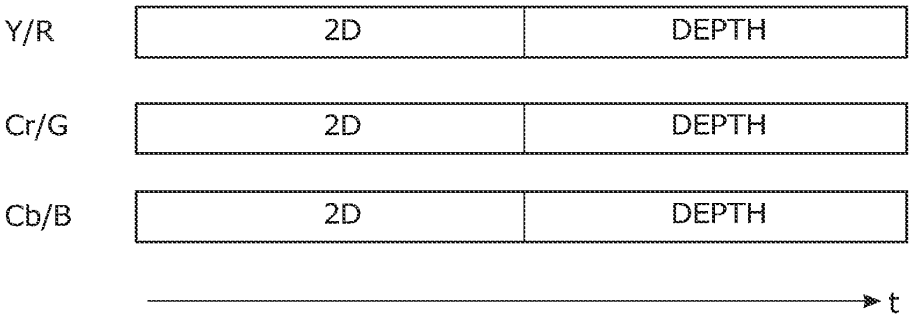


FIG. 5

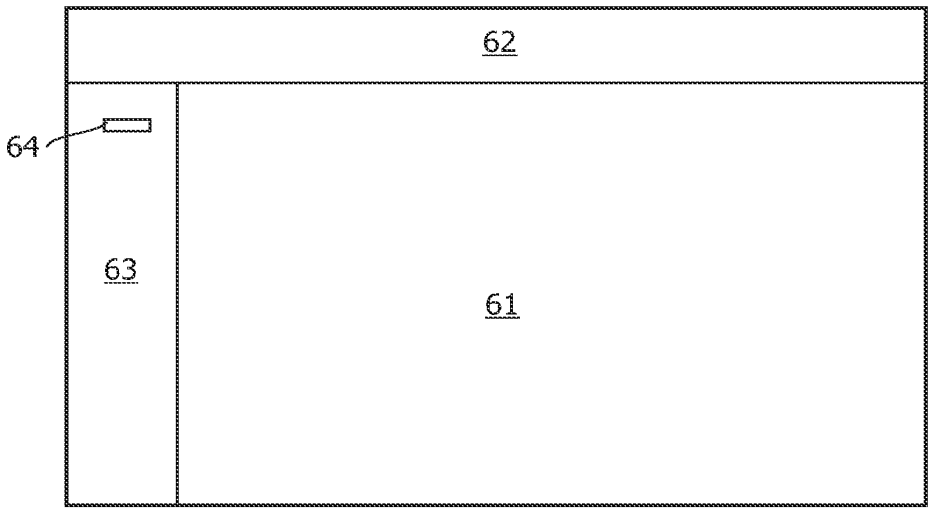

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FIG. 6

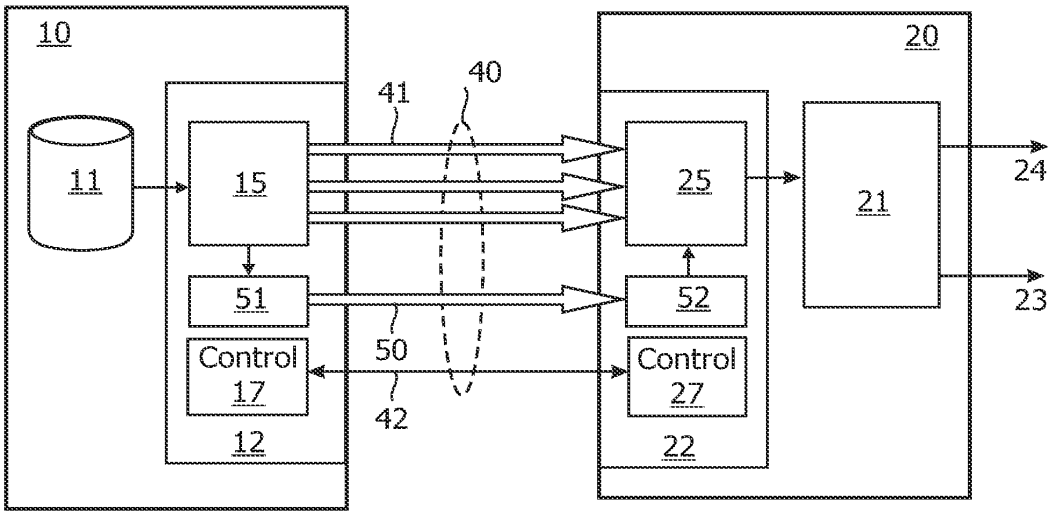

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FIG. 7

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(71) Applicant *(for all designated States except US)*: **KONINKLIJKE PHILIPS ELECTRONICS N.V.** [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

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(74) Agents: **UITTENBOGAARD, Frank** et al.; c/o High Tech Campus 44, NL-5656 AE Eindhoven (NL).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

[Continued on next page]

(54) **Title**: TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE

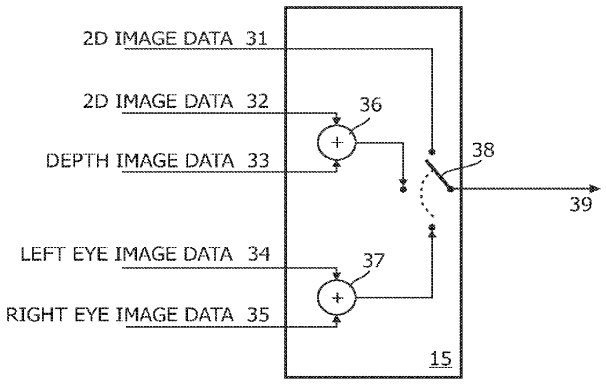


FIG. 2

(57) **Abstract**: A digital display interface (40) connects a first audio-visual device (10) to a second audio-visual device (20). Stereoscopic image data is transmitter over the display interface (40). Components of stereoscopic image data are multiplexed and inserted into an image data carrying element. An existing deep color mode can be re-used for this purpose. Signaling information to help identify or decode the stereoscopic image data is carried in auxiliary data carrying elements. Stereoscopic image data can be distributed between image data carrying data elements and auxiliary data carrying data elements. Auxiliary data carrying elements can be transmitted in horizontal or vertical blanking periods, and can comprise HDMI Data Island Packets. Stereoscopic image data can be sent over an auxiliary data channel. The auxiliary data channel can form part of the same cable as is used to carry a primary channel of the display interface, a separate cable, or a wireless link.

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(88) Date of publication of the international search report:
13 August 2009

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2008/055305

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04N13/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/009137 A1 (NELSON JOHN E [US] ET AL) 24 January 2002 (2002-01-24)	1-5, 14-19, 25-27, 45,47
Y	page 1, paragraphs 6-8, page 2, paragraphs 34-36, page 3, paragraph 39-42,	6-8,12, 13,20-23
Y	WO 2006/137006 A (KONINKL PHILIPS ELECTRONICS NV [NL]; FUNKE ERIC P [NL]; BEEKERS HENRIC) 28 December 2006 (2006-12-28) pages 3,5,7, paragraph 5-30	6-8, 20-23
Y	US 2007/139769 A1 (DECUSATIS CASIMER M [US] ET AL) 21 June 2007 (2007-06-21) page 5, paragraph 69	12,13

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 April 2009	17/06/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Dinov, Vassil

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2008/055305

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search reportcovers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

see extra sheet

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-27, 45,47

   An apparatus and method for transmission of stereoscopic images between first audio-video device and a display comprising a formatter which arrange the image data in two transport channels or data streams - primary and auxiliary.

   ---

2. claims: 28-44,46,48-49

   An apparatus for transmission of stereoscopic images comprising a formatter which generates a stream of image data and a stream of additional data at intervals in the stream.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2008/055305

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002009137 A1	24-01-2002	NONE	
WO 2006137006 A	28-12-2006	CN 101204097 A	18-06-2008
		JP 2008544681 T	04-12-2008
US 2007139769 A1	21-06-2007	CN 1988676 A	27-06-2007

Form PCT/ISA/210 (patent family annex) (April 2005)

IN THE CLAIMS

Please amend the claims as follows:

1-49. (Canceled)

50. (New) A digital display interface part, for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable in:

a first mode in which the formatter generates a stream of first data elements, which carry pixel data of a 2D image; and,

a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, wherein the interface part is arranged to send signaling information across the interface, the signaling information identifying which mode the formatter is using.

51. (New) An interface part according to claim 50, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used in the second mode.

52. (New) An interface part according to claim 51, wherein the signaling information is carried in a horizontal or vertical blanking period.

53. (New) An interface part according to claim 50, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet between image data.

54. (New) An interface part according to claim 53, which is arranged to receive signaling information across the interface specifying capabilities of the second audio-visual device.

55. (New) An interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data.

56. (New) An interface part according to claim 55 arranged for sending the left eye image data and the right eye image data sequentially.

57. (New) An interface part according to claim 56, wherein an indication of the left and right image data being indicated by signaling information carried directly adjacent a position of the image data.

58. (New) An interface part according to claim 55 arranged for sending the left eye image data and the right eye image data by line interleaving.

59. (New) An interface part according to claims 50, wherein the stereoscopic image data components are 2D image data and image depth data.

60. (New) An interface part according to claim 58, wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data.

61. (New) A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the digital display interface for transmitting uncompressed pixel information the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract image data, the processor being operable in:

a first mode in which the processor extracts pixel image data for a 2D image from a

stream of first data elements; and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image, the interface part arranged to receive signaling information across the interface, the signaling information identifying which mode the formatter is using.

62. (New) An interface part according to claim 50, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used, the interface part arranged to determine a stereoscopic image format being used.

63. (New) An interface part according to claim 50, wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is received in a Data Island Packet between image data.

64. (New) An interface part according to claim 50, wherein the stereoscopic image data components are left eye image data and right eye image data.

65. (New) A method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface between the first audio-visual device and a second audio-visual device, the digital display interface for transmitting uncompressed pixel information the method comprising:

receiving image data;

formatting the image data for transport over the interface by:

in a first mode, generating a stream of first data elements which carry pixel data of a 2D image; and,

in a second mode, generating a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

66. (New) The interface part according to claim 50, wherein the signaling information comprises information for enabling the second audio-visual device to determine a stereoscopic image format being used.

67. (New) A method of processing image data at a digital display interface part of an audio-visual device, the digital display interface for transmitting uncompressed pixel information the method comprising:

receiving formatted image data from the interface;

extracting image data by:

in a first mode, extracting pixel image data for a 2D image from a stream of first data elements; and,

in a second mode, demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

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PCT

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(25) Filing Language: English

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(71) Applicant *(for all designated States except US)*: **KONINKLIJKE PHILIPS ELECTRONICS N.V.** [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **SHEPHERD, Nicoll, B.** [GB/GB]; c/o High Tech Campus 44, NL-5656 AE Eindhoven (NL).

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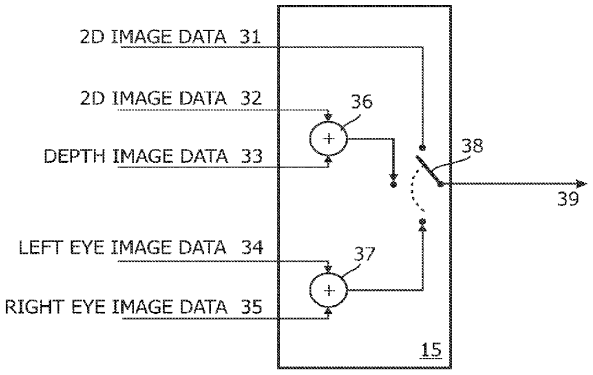


FIG. 2

(57) Abstract: A digital display interface (40) connects a first audio-visual device (10) to a second audio-visual device (20). Stereoscopic image data is transmitter over the display interface (40). Components of stereoscopic image data are multiplexed and inserted into an image data carrying element. An existing deep color mode can be re-used for this purpose. Signaling information to help identify or decode the stereoscopic image data is carried in auxiliary data carrying elements. Stereoscopic image data can be distributed between image data carrying data elements and auxiliary data carrying data elements. Auxiliary data carrying elements can be transmitted in horizontal or vertical blanking periods, and can comprise HDMI Data Island Packets. Stereoscopic image data can be sent over an auxiliary data channel. The auxiliary data channel can form part of the same cable as is used to carry a primary channel of the display interface, a separate cable, or a wireless link.

WO 2009/077969 A2

Transport of stereoscopic image data over a display interface

FIELD OF THE INVENTION

This invention relates to transport of image data for the display of stereoscopic images.

BACKGROUND TO THE INVENTION

Various schemes for displaying three dimensional images (static, or moving images) are known. One well-known scheme simultaneously displays two images which are encoded for the left eye and right eye by means of different optical polarizations, or colors (e.g. red and green). A viewer wears a pair of special glasses which have lenses in front of the left and right eyes. The lenses are arranged to pass only the image intended for that eye, i.e. a left eye sees only the image intended for that eye. Another stereoscopic display technique sequentially presents an image intended for the left eye, and an image intended for the right eye. A user wears a special pair of glasses which are shuttered in synchronism with the displayed images, such that the left eye shutter is open during the period when the left eye image is displayed, and the right eye shutter is open during the period when the right eye image is displayed.

Auto stereoscopic display techniques remove the need for a viewer to wear special glasses. One known scheme uses a flat panel display with multisided slanted ventricular lenses mounted in front of display elements. An example of this kind of display is described in WO07/069195 A2.

Historically, 3D displays have been limited to specialized applications (e.g. medical imaging) or feature film presentation where it is possible to provide bespoke, high cost, display apparatus. There is now considerable interest in delivering stereoscopic content to a much wider audience, including the consumer electronics market. However, an issue with delivering stereoscopic images in a consumer electronics environment is that conventional displays, and display interfaces which connect displays or projectors to media players, have been designed specifically for the display of conventional 2D images.

Schemes for conveying stereoscopic image data within the confines of existing display interfaces have tended to sacrifice part of the active portion of an image to carry

additional data necessary to render a stereoscopic image. The WOWvx format developed by Koninklijke Philips Electronics N.V. divides the overall display frame into a number of separate regions where different data can be carried. The overall frame is divided into two sub-frames, arranged side-by-side: a first of the sub-frames carries 2D image data and a second of the sub-frames carries depth information. A header is added to the beginning of the upper left-hand corner of the frame. The image data is carried in a normal manner across a display interface. A display extracts depth data from the second sub-frame and creates a 3D image having a resolution of the first sub-frame. This 3D image can then be 'stretched' to occupy the full visible area of the display.

Digital displays and media players are increasingly being equipped with digital display interfaces such as the High Definition Multimedia Interface (HDMI). The present invention seeks to provide an alternative way of delivering stereoscopic image data over a digital display interface.

SUMMARY OF THE INVENTION

A first aspect of the present invention provides a digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable in:

a first mode in which the formatter generates a stream of first data elements which carry pixel data of a 2D image;

a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

An advantage of this arrangement is that the stereoscopic image data can be carried across a digital display interface using the existing capacity of the interface. Advantageously, where the display interface supports various color depths of image data, such as 48-bit color as well as conventional 24-bit color, the higher capacity transport modes which are intended to transport higher color depth data can be re-used to carry the multiplexed stereoscopic image data. Therefore, no additional capacity is required from the interface to carry the stereoscopic data, while still allowing good color depth for the stereoscopic content. It also has the benefit that little or no changes are required to an existing standard defining the display interface. It also allows stereoscopic image content to be sent

with a resolution which is significantly higher than schemes which sacrifice part of the active image area to carry the stereo image data.

Advantageously, the second data elements have a capacity which is no greater than, and preferably the same as, the first data elements. This allows the stereoscopic data to be carried with minimal modification to the standards defining the interface.

The term "stereoscopic image data components" is intended to include any scheme which sends data to construct a stereoscopic (or autostereoscopic) display to a user, and includes: schemes which send left eye image data and right eye image data; schemes which send 2D image data and image depth data; schemes which send 2D image data and image depth data and occlusion information, indicating which objects in the picture are occluded by other objects.

In the case of a stereoscopic image which uses left eye and right eye image data, the formatter can use a portion of the second data element to carry the left eye image data and another portion of the second data element to carry the right eye image data.

In the case of a stereoscopic image which uses 2D + depth data, the formatter can use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data. The depth data may additionally be carried in other parts of a signal, such as periods within horizontal or vertical blanking periods. In HDMI, Data Island Packets are carried within these periods, and certain Data Island Packets can be identified as carrying depth data.

Advantageously, signaling information is sent across the interface identifying which mode the formatter is using and further signaling information can allow the second audio-visual device (e.g. a display or projector) to indicate whether it has the capability to render stereoscopic data sent in that formatting mode.

In a High Definition Multimedia Interface (HDMI), signaling can be carried by packets carried within the Data Islands between image data. The capability of a sink device to handle stereoscopic data can be signaled between interface parts using the HDMI Display Data Channel (DDC) channel, with capability data being stored in an Extended Display Identification Data (EDID) ROM at a sink.

A related aspect of the present invention provides a digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract image data, the processor being operable in:

a first mode in which the processor extracts pixel image data for a 2D image from a stream of first data elements; and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

A related aspect of the present invention provides a method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface between the first audio-visual device and a second audio-visual device, the method comprising:

receiving image data;

formatting the image data for transport over the interface by:

in a first mode, generating a stream of first data elements which carry pixel data of a 2D image; and,

in a second mode, generating a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

A related aspect of the present invention provides a method of processing image data at a digital display interface part of an audio-visual device, the method comprising:

receiving formatted image data from the interface;

extracting image data by:

in a first mode, extracting pixel image data for a 2D image from a stream of first data elements; and,

in a second mode, demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

A further aspect of the invention provides a digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable to send a portion of the stereoscopic image data over a primary image data transport channel of the interface and another portion of the stereoscopic image data over an auxiliary data channel.

The interface part can send signaling information across the interface identifying how stereoscopic data is distributed between the primary data channel and the auxiliary data channel.

Advantageously, the stereoscopic image data comprises 2D image data and image depth data and the formatter is arranged to send depth data across the auxiliary data channel.

The auxiliary data channel can comprise a separate line, or lines, within the same cable as the primary channel; a second cable which is separate from a first cable carrying the primary channel; or a wireless link.

A related aspect of the present invention provides a digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for connecting to a primary image data transport channel of the interface and an auxiliary data channel;

a processor arranged to extract a portion of the stereoscopic image data from the primary image data transport channel of the interface and another portion of the stereoscopic image data from the auxiliary data channel.

A related aspect of the present invention provides a method of sending stereoscopic image data over a digital display interface between a first audio-visual device and a second audio-visual device, comprising, at the first audio-visual device:

receiving stereoscopic image data for transport over the interface;

sending a portion of the stereoscopic image data over a primary image data transport channel of the interface and another portion of the stereoscopic image data over an auxiliary data channel.

A related aspect of the present invention provides a method of processing stereoscopic image data at an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the method comprising:

extracting a portion of the stereoscopic image data from a primary image data transport channel of the interface and another portion of the stereoscopic image data from an auxiliary data channel.

A further aspect of the invention provides a digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data;

a formatter arranged to generate a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein signaling information for use in decoding the stereoscopic image data is carried in at least one of the auxiliary data elements.

Where the stereoscopic image data comprises left eye image data and right eye image data, the signaling information can specify what data elements carry the left eye image data and what data elements carry the right eye image data. Where the left eye images and right eye images are interleaved on a line-by-line basis, the signaling information can be sent as often as once for each pair of interleaved lines, although it can be sent much less frequently, such as once per field or frame.

Where the stereoscopic image data comprises 2D image data and depth information, the signaling information can specify at least one of: the transmission location, quantity of the depth information.

Advantageously, where the stereoscopic image data has a plurality of different possible formats, the signaling information specifies the format. One of the formats for the stereoscopic image data can be a scheme which encodes the stereoscopic image data within a conventional 2D image format.

Advantageously, the signaling information is carried in a horizontal or vertical blanking period and for a High Definition Multimedia Interface (HDMI) the signaling information can be sent in a Data Island Packet.

A related aspect of the present invention provides a digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream;

using signaling information carried in at least one of the auxiliary data elements to decode the stereoscopic image data.

A related aspect of the present invention provides a method of sending stereoscopic image data over a digital display interface between a first audio-visual device and a second audio-visual device comprising, at the first audio-visual device:

receiving stereoscopic image data;

generating a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein signaling information for use in decoding the stereoscopic image data is carried in at least one of the auxiliary data elements.

A related aspect of the present invention provides a method of processing stereoscopic image data at a digital display interface part of an audio-visual device, the method comprising:

receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream;

using signaling information carried in at least one of the auxiliary data elements to decode the stereoscopic image data.

A further aspect of the invention provides a digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data components;

a formatter arranged to generate a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein the stereoscopic image data is distributed between the image data carrying data elements and the auxiliary data carrying data elements.

Advantageously, the stereoscopic image data components are 2D image data and image depth data and wherein the depth data is carried in the auxiliary data carrying data elements. Advantageously, the stream further comprises signaling information, carried within auxiliary data carrying data elements, specifying which part of an image the depth information relates to.

The auxiliary data carrying data elements are sent in a horizontal or vertical blanking period, such as HDMI Data Island Packets.

A related aspect of the present invention provides a digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements;

a processor arranged to extract stereoscopic image data from the image data carrying data elements and at least part of the stereoscopic image data from the auxiliary data carrying data elements.

A related aspect of the present invention provides a method of sending stereoscopic data across a digital display interface between a first audio-visual device and a second audio-visual device, the method comprising, at the first audio-visual device:

receiving stereoscopic image data components;

generating a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and distributing the stereoscopic image data between the image data carrying data elements and the auxiliary data carrying data elements.

A related aspect of the present invention provides a method of processing stereoscopic image data at a digital display interface part of an audio-visual device, the method comprising:

receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements;

extracting stereoscopic image data from the image data carrying data elements and at least part of the stereoscopic image data from the auxiliary data carrying data elements.

The functionality described here can be implemented in software, hardware or a combination of these. The invention can be implemented by means of hardware comprising several distinct elements, and by means of a suitably programmed computer. Accordingly, further aspects of the invention provide software for implementing any of the methods. The software may be stored on an electronic memory device, hard disk, optical disk or other machine-readable storage medium. The software may be delivered as a computer program product on a machine-readable carrier or it may be downloaded to the AV device via a network connection.

The invention also extends to signals, for transmission over the display interface, which result from any of the methods.

Features of the various aspects of the invention can be combined.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 shows a display interface for carrying image data between two AV devise;

Fig. 2 shows a formatting function at one end of the interface;

Fig. 3 shows a conventional way of sending 2D image data across a display interface;

Figs. 4 and 5 show ways of sending stereoscopic image data across a display interface;

Fig. 6 shows format of an HDMI video frame; and,

Fig. 7 shows a display interface which includes an auxiliary data channel.

DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 shows an example scenario in which the invention can be used. In Figure 1, an AV device 10 which is capable of providing a source of digital AV content is connected to a display (or video projector) 20 via a digital display interface (DDI) 40. Interface parts 12, 22 in devices 10, 20 support the interface 40, and provide functions such as formatting signals into the form required by standards defining the interface 40. The source device 10 can be a device which can retrieve digital AV content from a store 11, such as a hard disk, a solid state memory or an optical disc or any other fixed or removable storage medium or device. Examples of device 10 include a personal video recorder (PVR), an optical disc player such as a DVD player, an HD-DVD player or a Blu-ray player. Alternatively, device 10 can take the form of a set-top box which receives content from a distribution channel (such as a broadcast channel or broadband network or other type of network (e.g. home network)).

There are a variety of methods for displaying stereoscopic (3D) images. The two main methods for transferring 3D image data across an interface are: to transmit two complete, separate, stereoscopic images representing the left and right views as seen by human eyes; and a normal 2D image with associated depth information that can be used to generate the stereoscopic images within the display. The first method generally requires a significantly higher bandwidth (up to twice that needed for a 2D image) over the interface, but needs little processing in the display, while the second method can require a smaller increase in bandwidth, but at the expense of some fast real-time processing in the display to process the depth information.

Current digital display interfaces, such as HDMI, offer a very high bandwidth. These interfaces transfer uncompressed pixel information, unlike other transport mechanisms (such as Ethernet, USB, IEEE1394) which have to transfer compressed images because of their bandwidth limitations. Originally, images transferred by HDMI were limited to 8 bits per color per pixel, so-called “24-bit color”. Improvements to HDMI from version 1.3 have allowed HDMI to carry more bits per pixel, with the options of carrying 10, 12 and 16 bits per color per pixel, i.e. up to 48-bit color. HDMI describes Deep Color Pixel Packing modes (HDMI 1.3a, section 6.5.3) which allow the higher color depths just described.

According to one embodiment of the present invention, the deep color modes are used to transport stereoscopic image data. The stereoscopic image data can be left image

data + right image data or 2D + depth information. Figure 2 shows a formatting function 15 used within an interface part 12. The formatter 15 can selectively operate in one of a number of different modes. This is shown schematically by formatter selecting one of the sets of inputs: 2D image data 31; 2D + depth image data 32, 33; or left eye and right eye image data 34, 35 for processing and selectively connecting 38 to an interface output 39. Formatter 15 can receive conventional 2D image data 31, such as 24-bit color image data 31. Typically this is received in an RGB or component video (Y,Cr,Cb) format. When receiving stereoscopic image data, formatter 15 multiplexes 36, 37 the image data components. For left eye/right eye image data, the left eye data and right eye data will typically be taken from the same pixel in the left eye/right eye frames or fields of the images, although other algorithms for combining pixels are also within the scope of the present invention. For 2D image + depth information, the 2D image data will typically correspond to a single pixel (e.g. RGB or component video format) and the depth information can take a different form, and may correspond to a different region of the image to the pixel of the 2D image. The formatter 15 may only support one of the 3D formats (i.e. just L+R, or just 2D+depth) or both types of 3D format.

Figures 3 to 5 show a range of different ways in which the image data can be multiplexed. Figure 3 shows conventional image data. In HDMI, the three color components (R,G,B or Y,Cr,Cb) are sent simultaneously on three Transition Minimised Differential Signaling (TMDS) channels 41. TMDS refers to line-level coding applied to the data to maintain an approximate DC balance as well as a reduction in the number of transitions in the data stream. Each color component can be sent using a standard color depth (e.g. 8 bits per color per pixel) or an enhanced color depth, such as 16 bits per color per pixel. Figure 4 shows a way in which stereoscopic left eye/right eye data can be multiplexed. The components of the left eye data (R,G,B or Y,Cr,Cb) are sent in a first portion of each data-carrying element, and then immediately followed by the components of the right eye data (R,G,B or Y,Cr,Cb). Both left eye and right eye are either sent within the same packet, consecutive image data packets, or parts of consecutive image data packets. As an example, where a 16-bit per color per pixel mode is used, bits 0-7 can carry the left image Y data and bits 8-15 carry the right image Y data. HDMI 1.3a currently allows a color depth of up to 16-bits per color per pixel (48-bit color). Figure 4 shows how two 24-bit color images can be carried within the existing 48-bit color mode with no additional capacity required from the interface. It will be appreciated that future revisions of HDMI (and other) specifications may

extend the bandwidth to permit a larger color depth, which will allow each of the left eye and right eye images to use more bits per pixel, so allowing richer 3D images.

Figure 5 shows a scheme for sending 2D image data + depth information where the 2D data is sent first, followed by the depth data. Each color component (R,G,B or Y,Cr,Cb) follows the same format. In Figure 6 the capacity of the packet is divided equally between the 2D data and depth information, although any other division is possible. It may be possible to send significantly less depth data than 2D data, which can allow the 2D image to use a wide color palette and/or high resolution. It is also possible to send some – or all – of the depth information in a different part of the transmitted data stream, such as within specific HDMI Data Island Packets carried within the horizontal and vertical line blanking intervals. This is particularly useful for depth data that is not attached directly to a specific pixel, for instance, it applies to a region of the image.

Interface part 12 sends signaling 42 which indicates the format of the image data, e.g. indicating whether the image data is 2D, stereo (L+R) or stereo (2D+depth). The signaling can also indicate further details of the multiplexing scheme, such as which color depth mode is being used to carry the multiplexed data, the number of bits per data element that are allocated to 2D data and the number of bits per data element that are allocated to depth data. This signaling allows flexibility in how the stereo data is allocated to data carrying elements sent across the interface 40 and allows for the amount of Depth information to be changed dynamically, according to the requirements of the content which is to be displayed. In HDMI, Data Island Packets are sent in horizontal and vertical line blanking periods. The signaling information can conveniently be carried within a Data Island Packet. Figure 6 shows the layout of an HDMI video frame, showing a region 61 where pixel data is sent across TMDS channels, a horizontal blanking period 63 and a vertical blanking period. Data Island Packets 64 are sent within Data Island periods positioned within the horizontal and vertical blanking periods 62, 63. The signaling data can be carried in a General Control Packet, an Auxiliary Video InfoFrame (AVI) packet or an InfoFrame Packet specifically designated for this purpose. If depth data is carried both within the pixel data carrying data elements and other places of the stream, the signaling can indicate where the depth data is to be found. The amount of depth data and the location(s) of the depth data can vary on a dynamic basis during an image, or sequence of images, depending on the required color depth, resolution or complexity of the image (e.g. the amount of depth information within an image).

AV device 20 includes a processor 21 applies suitable processing to the data to render a 3D image. In the case of stereoscopic display, where a user is simultaneously or sequentially presented with separate left and right eye images, processor 21 constructs the separate left eye/right eye images and outputs them 24 at the required time. For sequential stereoscopic displays, a further output 23 is provided to synchronize operation of shuttered glasses. In the case of an autostereoscopic display, such as a display using a ventricular screen, processor 21 constructs the image data which is required to be output 24 to the display elements to generate the autostereoscopic display. Interface part 22 and processor 21 use the signaling information sent across the interface to:

determine if stereoscopic image data is being sent; determine what general stereoscopic image format is being used (e.g. left+right image; 2D+depth; stereo encoded within active image data);

determine more detail of how the image data is being encoded on the interface, and therefore what decoding scheme should be used at the receiver. This may include information about which deep color mode is being used, bit allocation between 2D and depth data, transmission location of depth data (e.g. specific Data Island Packets or auxiliary channel locations).

Further signaling between the AV devices 10, 20 allows the sink device 20 to indicate it's capabilities to receive and process image data. The capability information may indicate the maximum allowed bandwidth for each mode of sending 2D and stereo image data. In HDMI, the capability of a sink device can use the Display Data Channel (DDC) channel, with capability data being stored in an Extended Display Identification Data (EDID) ROM at a sink.

The interface may support other schemes for sending stereoscopic data. A first alternative is to send two separate complete images, carried sequentially (such as a complete left image followed by a complete right image). The indication of the left and right image can be indicated by signaling information carried directly adjacent the position of the image data, such as an HDMI Data Island Packet.

A second alternative is to send two separate images, but with the lines of the two images interleaved. For example, the first line of the left image is sent first, followed by the first line of the right image, and so on.

A third alternative is to send a 2D image in a conventional manner, and to carry depth information in specific Data Island Packets dedicated to carrying depth information.

In each of these alternatives, signaling information carried directly adjacent the position of the image data, such as an HDMI Data Island Packet, can indicate what the image data corresponds to. For the third alternative, the signaling information can specify which part of the image the depth data relates to. As noted above, the HDMI Data Island Packets can be a General Control Packet, an Auxiliary Video InfoFrame (AVI) packet or an InfoFrame Packet specifically designated for this purpose. The information in these packets can identify:

the current stereoscopic method (field, line or byte) being used (see above);

whether a Deep Color Pixel Packing mode is being used to carry 3D information or a Deep Color Mode 2D image;

the mapping of left and right images to the current field, line or byte;

how many of the Data Island Packet packets/sub-packets are being uses to carry Depth information;

the location of other stereoscopic image data components.

The embodiments above show how the separate stereoscopic image components can be carried over a display interface. For some applications, especially those intended for display on a ventricular screen, the picture received at the interface part 12 may already be encoded with stereoscopic content. As an example, a WOWvx encoded image as described in the background section, comprises a 2D image, depth information and/or occlusion information already embedded into separate regions of a conventional image. In one embodiment, the 2D image is carried in one quarter of the image pixels (e.g. in half a line for half the total lines in the picture). The associated depth and/or occlusion information is carried in the other three-quarters of the presented picture. In this case, the lines of the picture are transported across the HDMI link as thought they were a single 2D image occupying all of each line, for all the available lines. In order to identify such a 3D image, an HDMI Data Island Packet (typically a General Control Packet, Auxiliary Video InfoFrame (AVI) packet or specifically designated InfoFrame Packet) indicates this method. The information in this Packet identifies:

- the current stereoscopic method (e.g. 2D+Depth) being used;
- any information pertaining to this method which is required by the display.

The sink identifies the transmitted picture as using this method and processes the picture accordingly. The sink also carries information in the EDID indicating that it supports this method.

In the above description, stereoscopic image data is carried over a channel of an interface (e.g. an HDMI Transport Stream) either by multiplexing the stereoscopic image data within normal data carrying elements of the channels, or by carrying at least part of the stereoscopic image data within other packets (e.g. Data Island Packets) carried over the same channel. A further embodiment of the invention carries at least some of the stereoscopic image data over an associated high speed auxiliary data link such as Gigabit Ethernet, IEEE 1394 or a high-speed wireless link. Signaling information identifies which information is carried by the primary channels of the interface and which is carried by the associated auxiliary link. In HDMI, the signaling information can be carried in Data Island Packets. Similar, or complementary, identification information may also be carried on the associated high speed auxiliary link. The sink uses the received Data Island Packets to identify which information is carried on which link and combines the two streams of data in the necessary format for presentation or processing. Depending on the characteristics of the HDMI and associated auxiliary link, it may be necessary to buffer the data contained in the two streams in order to maintain synchronicity between them. In one embodiment using the above embodiment, the associated wires for the auxiliary link are carried within the HDMI cable; this option is shown in Figure 7 by additional line 50 connecting modules 51, 52 in interface parts 12, 22. In other embodiments, the associated auxiliary link is carried in a separate cable connecting the devices 10, 20, or by a high-speed wireless link.

Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

1. A digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable in:

a first mode in which the formatter generates a stream of first data elements, which carry pixel data of a 2D image; and,

a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

2. An interface part according to claim 1 wherein the second data elements have a capacity which is no greater than the first data elements.

3. An interface part according to claim 1 or 2 wherein the stereoscopic image data components are left eye image data and right eye image data.

4. An interface part according to claim 3 wherein the formatter is arranged to use a portion of the second data element to carry the left eye image data and another portion of the second data element to carry the right eye image data.

5. An interface part according to claim 4 wherein the formatter is arranged to multiplex a corresponding pixel of the left eye image data and the right eye image data into the second data element.

6. An interface part according to claim 1 or 2 wherein the stereoscopic image data components are 2D image data and image depth data.

7. An interface part according to claim 6 wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data.

8. An interface part according to claim 7 wherein the formatter is arranged to multiplex a pixel of the 2D image with depth data from a different part of the image.

9. An interface part according to any one of the preceding claims wherein the formatter is operable in a third mode in which the formatter generates third data elements carrying per pixel data, the third data elements having a capacity which is smaller than each of the first data elements and the second data elements.

10. An interface part according to any one of the preceding claims which is arranged to send signaling information across the interface identifying which mode the formatter is using.

11. An interface part according to any one of the preceding claims which is arranged to receive signaling information across the interface specifying capabilities of the second audio-visual device.

12. An interface part according to claim 10 wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet between image data.

13. An interface part according to any one of the preceding claims wherein the interface is a High Definition Multimedia Interface (HDMI) and the first mode and the second mode are Deep Color Modes having a capacity of greater than 24-bits of color data per pixel.

14. A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract image data, the processor being operable in:

a first mode in which the processor extracts pixel image data for a 2D image from a stream of first data elements; and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

15. A method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface between the first audio-visual device and a second audio-visual device, the method comprising:

receiving image data;

formatting the image data for transport over the interface by:

in a first mode, generating a stream of first data elements which carry pixel data of a 2D image; and,

in a second mode, generating a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

16. A method of processing image data at a digital display interface part of an audio-visual device, the method comprising:

receiving formatted image data from the interface;

extracting image data by:

in a first mode, extracting pixel image data for a 2D image from a stream of first data elements; and,

in a second mode, demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

17. Software for performing the method of claim 15 or 16.

18. A signal resulting from the method of claim 15.

19. A digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable to send a portion of the stereoscopic image data over a primary image data transport channel of the interface and another portion of the stereoscopic image data over an auxiliary data channel.

20. An interface part according to claim 19 which is arranged to send signaling information across the interface identifying how stereoscopic data is distributed between the primary data channel and the auxiliary data channel.

21. An interface part according to claim 19 or 20 wherein the stereoscopic image data comprises 2D image data and image depth data and the formatter is arranged to send depth data across the auxiliary data channel.

22. An interface part according to any of claims 19 to 21 wherein the interface comprises a set of lines within a cable and the auxiliary data channel comprises a separate line, or lines, within the same cable.

23. An interface part according to any of claims 19 to 21 wherein the interface comprises a first cable and the auxiliary data channel is carried by a second cable.

24. An interface part according to any of claims 19 to 21 wherein the auxiliary data channel is carried by a wireless connection.

25. A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for connecting to a primary image data transport channel of the interface and an auxiliary data channel;

a processor arranged to extract a portion of the stereoscopic image data from the primary image data transport channel of the interface and another portion of the stereoscopic image data from the auxiliary data channel.

26. A method of sending stereoscopic image data over a digital display interface between a first audio-visual device and a second audio-visual device, comprising, at the first

audio-visual device:

receiving stereoscopic image data for transport over the interface;

sending a portion of the stereoscopic image data over a primary image data transport channel of the interface and another portion of the stereoscopic image data over an auxiliary data channel.

27. A method of processing stereoscopic image data at an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the method comprising:

extracting a portion of the stereoscopic image data from a primary image data transport channel of the interface and another portion of the stereoscopic image data from an auxiliary data channel.

28. A digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data;

a formatter arranged to generate a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein signaling information for use in decoding the stereoscopic image data is carried in at least one of the auxiliary data elements.

29. An interface part according to claim 28 wherein the stereoscopic image data comprises left eye image data and right eye image data and the signaling information specifies what data elements carry the left eye image data and what data elements carry the right eye image data.

30. An interface part according to claim 28 wherein the stereoscopic image data comprises 2D image data and depth information and the signaling information specifies at least one of: the transmission location, quantity of the depth information.

31. An interface part according to any one of claims 28 to 30 wherein the stereoscopic image data has a plurality of different formats and the signaling information specifies the format.

32. An interface part according to claim 31 wherein one of the formats for the stereoscopic image data is encoding the stereoscopic image data within a conventional 2D image format.

33. An interface part according to any one of claims 28 to 32 wherein the signaling information is carried in a horizontal or vertical blanking period.

34. An interface part according to claim 33 wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet.

35. A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream;

using signaling information carried in at least one of the auxiliary data elements to decode the stereoscopic image data.

36. A method of sending stereoscopic image data over a digital display interface between a first audio-visual device and a second audio-visual device comprising, at the first audio-visual device:

receiving stereoscopic image data;

generating a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein signaling information for use in decoding the stereoscopic image data is carried in at least one of the auxiliary data elements.

37. A method of processing stereoscopic image data at a digital display interface part of an audio-visual device, the method comprising:

receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream;

using signaling information carried in at least one of the auxiliary data elements to decode the stereoscopic image data.

38. Software for performing the method of claim 36 or 37.

39. A signal resulting from the method of claim 36.

40. A digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data components;

a formatter arranged to generate a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein the stereoscopic image data is distributed between the image data carrying data elements and the auxiliary data carrying data elements.

41. An interface part according to claim 40 wherein the stereoscopic image data components are 2D image data and image depth data and wherein the depth data is carried in the auxiliary data carrying data elements.

42. An interface part according to claim 41 further comprising carrying signaling information within auxiliary data carrying data elements specifying which part of an image the depth information relates to.

43. An interface part according to any one of claims 40 to 42 wherein the auxiliary data carrying data elements are sent in a horizontal or vertical blanking period.

44. An interface part according to claim 43 wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet.

45. A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements;

a processor arranged to extract stereoscopic image data from the image data carrying data elements and at least part of the stereoscopic image data from the auxiliary data carrying data elements.

46. A method of sending stereoscopic data across a digital display interface between a first audio-visual device and a second audio-visual device, the method comprising, at the first audio-visual device:

receiving stereoscopic image data components;

generating a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and distributing the stereoscopic image data between the image data carrying data elements and the auxiliary data carrying data elements.

47. A method of processing stereoscopic image data at a digital display interface part of an audio-visual device, the method comprising:

receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements;

extracting stereoscopic image data from the image data carrying data elements and at least part of the stereoscopic image data from the auxiliary data carrying data elements.

48. Software for performing the method of claim 46 or 47.

49. A signal resulting from the method of claim 46.

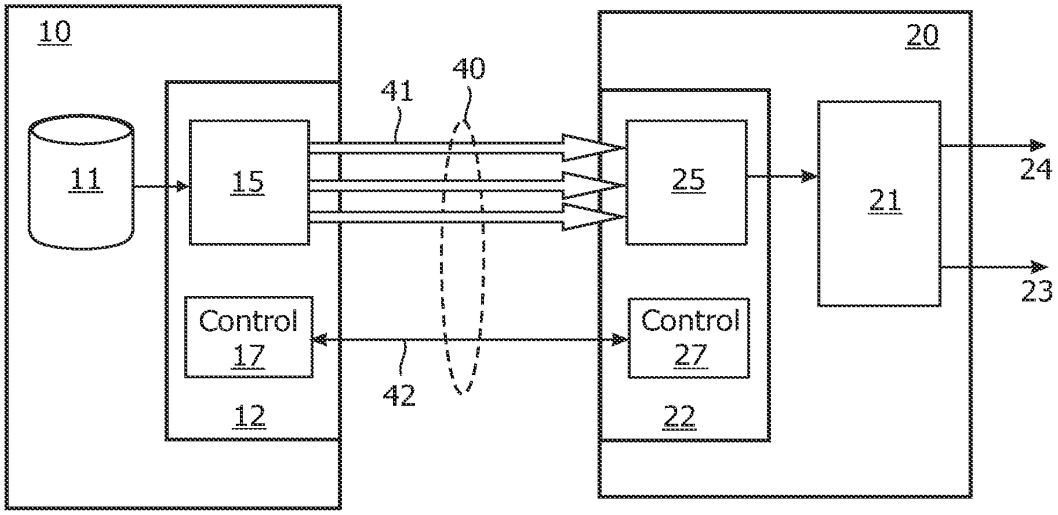

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FIG. 1

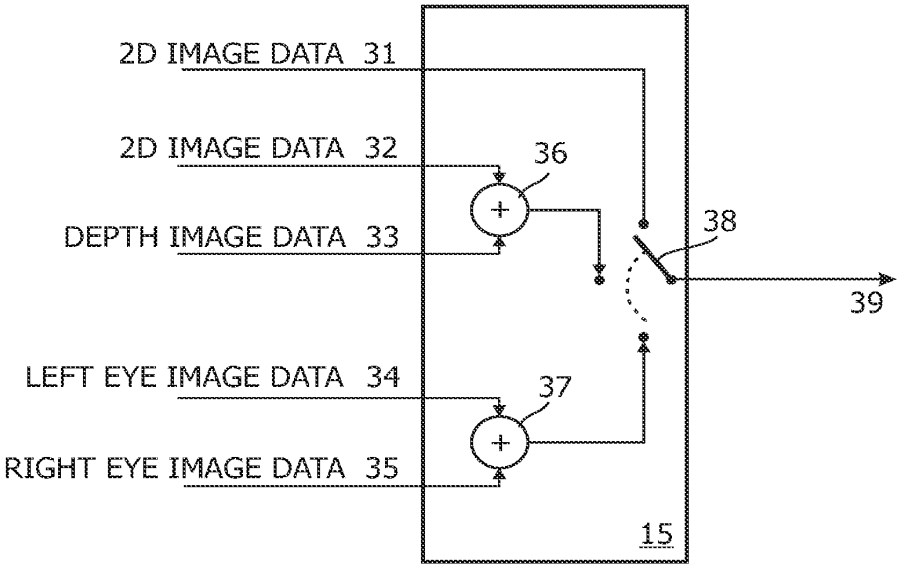

2D IMAGE DATA 31
2D IMAGE DATA 32
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DEPTH IMAGE DATA 33
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LEFT EYE IMAGE DATA 34
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RIGHT EYE IMAGE DATA 35
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FIG. 2

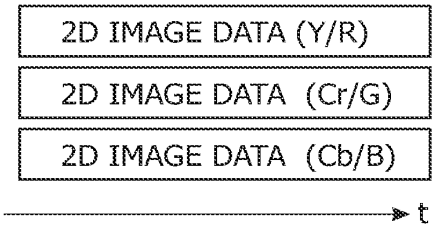


FIG. 3

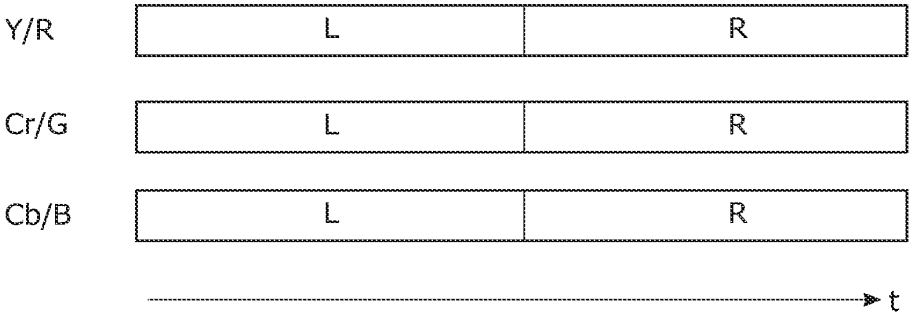


FIG. 4

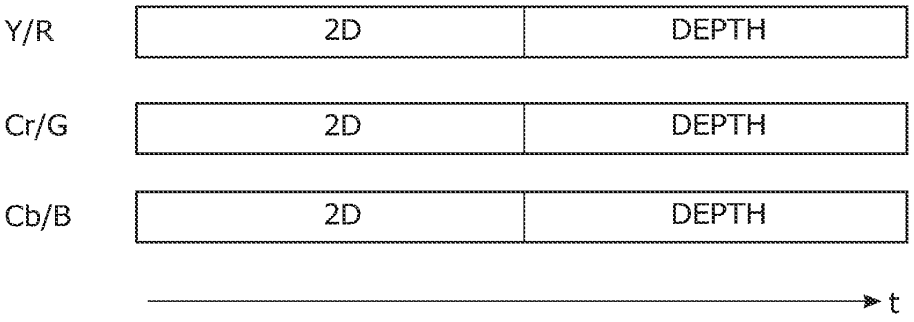


FIG. 5

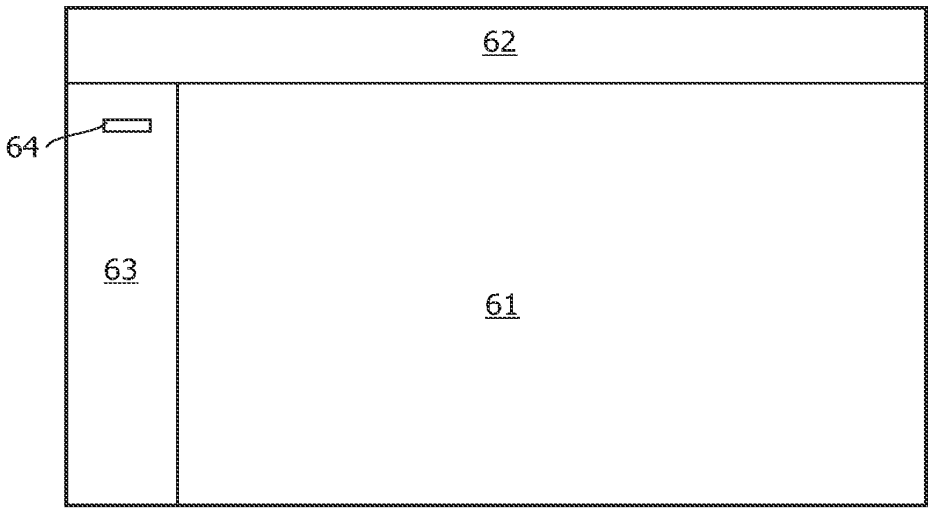

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FIG. 6

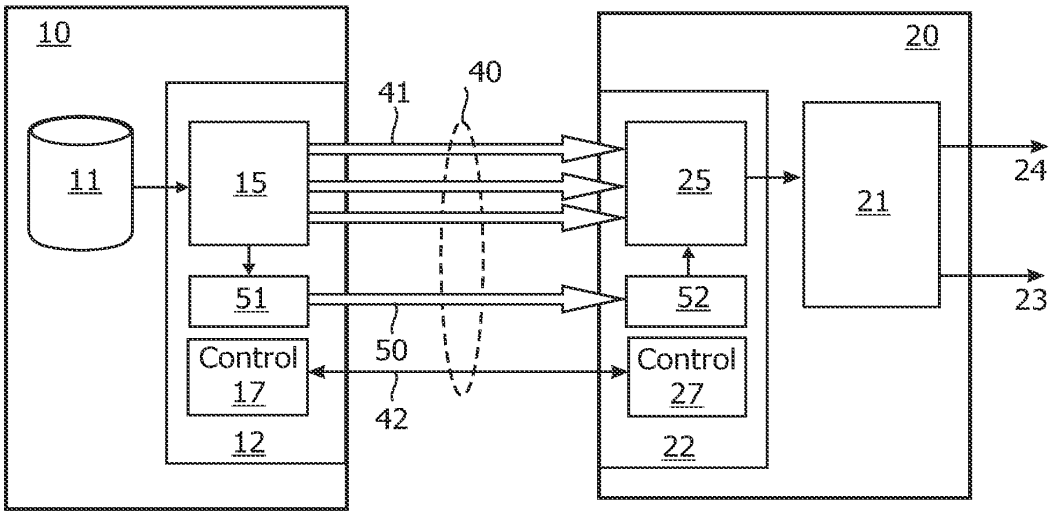

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FIG. 7

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[Continued on next page]

(54) Title: TRANSPORT OF STEREOSCOPIC IMAGE DATA OVER A DISPLAY INTERFACE

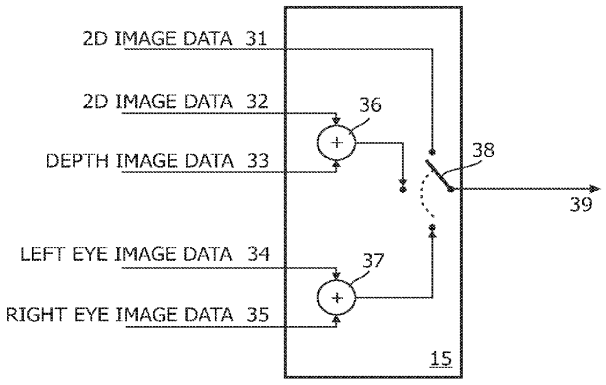


FIG. 2

(57) Abstract: A digital display interface (40) connects a first audio-visual device (10) to a second audio-visual device (20). Stereoscopic image data is transmitter over the display interface (40). Components of stereoscopic image data are multiplexed and inserted into an image data carrying element. An existing deep color mode can be re-used for this purpose. Signaling information to help identify or decode the stereoscopic image data is carried in auxiliary data carrying elements. Stereoscopic image data can be distributed between image data carrying data elements and auxiliary data carrying data elements. Auxiliary data carrying elements can be transmitted in horizontal or vertical blanking periods, and can comprise HDMI Data Island Packets. Stereoscopic image data can be sent over an auxiliary data channel. The auxiliary data channel can form part of the same cable as is used to carry a primary channel of the display interface, a separate cable, or a wireless link.

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Patentanmeldung Nr.	Patent application No.	Demande de brevet n°
	07123461.1 / EP07123461	

The organization code and number of your priority application, to be used for filing abroad under the Paris Convention, is EP07123461.

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le President de l'Office européen des brevets
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R.C. van Dijk

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Demande no :

Anmeldetag:
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5621 BA Eindhoven/NL

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(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se référer à la description.)

Transport of stereoscopic image data over a display interface

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Transport of stereoscopic image data over a display interface

FIELD OF THE INVENTION

This invention relates to transport of image data for the display of stereoscopic images.

BACKGROUND TO THE INVENTION

Various schemes for displaying three dimensional images (static, or moving images) are known. One well-known scheme simultaneously displays two images which are encoded for the left eye and right eye by means of different optical polarizations, or colors (e.g. red and green). A viewer wears a pair of special glasses which have lenses in front of the left and right eyes. The lenses are arranged to pass only the image intended for that eye, i.e. a left eye sees only the image intended for that eye. Another stereoscopic display technique sequentially presents an image intended for the left eye, and an image intended for the right eye. A user wears a special pair of glasses which are shuttered in synchronism with the displayed images, such that the left eye shutter is open during the period when the left eye image is displayed, and the right eye shutter is open during the period when the right eye image is displayed.

Auto stereoscopic display techniques remove the need for a viewer to wear special glasses. One known scheme uses a flat panel display with multisided slanted ventricular lenses mounted in front of display elements. An example of this kind of display is described in WO07/069195 A2.

Historically, 3D displays have been limited to specialized applications (e.g. medical imaging) or feature film presentation where it is possible to provide bespoke, high cost, display apparatus. There is now considerable interest in delivering stereoscopic content to a much wider audience, including the consumer electronics market. However, an issue with delivering stereoscopic images in a consumer electronics environment is that conventional displays, and display interfaces which connect displays or projectors to media players, have been designed specifically for the display of conventional 2D images.

Schemes for conveying stereoscopic image data within the confines of existing display interfaces have tended to sacrifice part of the active portion of an image to carry

additional data necessary to render a stereoscopic image. The WOWvx format developed by Koninklijke Philips Electronics N.V. divides the overall display frame into a number of separate regions where different data can be carried. The overall frame is divided into two sub-frames, arranged side-by-side: a first of the sub-frames carries 2D image data and a second of the sub-frames carries depth information. A header is added to the beginning of the upper left-hand corner of the frame. The image data is carried in a normal manner across a display interface. A display extracts depth data from the second sub-frame and creates a 3D image having a resolution of the first sub-frame. This 3D image can then be 'stretched' to occupy the full visible area of the display.

Digital displays and media players are increasingly being equipped with digital display interfaces such as the High Definition Multimedia Interface (HDMI). The present invention seeks to provide an alternative way of delivering stereoscopic image data over a digital display interface.

SUMMARY OF THE INVENTION

A first aspect of the present invention provides a digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable in:

a first mode in which the formatter generates a stream of first data elements which carry pixel data of a 2D image;

a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

An advantage of this arrangement is that the stereoscopic image data can be carried across a digital display interface using the existing capacity of the interface. Advantageously, where the display interface supports various color depths of image data, such as 48-bit color as well as conventional 24-bit color, the higher capacity transport modes which are intended to transport higher color depth data can be re-used to carry the multiplexed stereoscopic image data. Therefore, no additional capacity is required from the interface to carry the stereoscopic data, while still allowing good color depth for the stereoscopic content. It also has the benefit that little or no changes are required to an existing standard defining the display interface. It also allows stereoscopic image content to be sent

with a resolution which is significantly higher than schemes which sacrifice part of the active image area to carry the stereo image data.

Advantageously, the second data elements have a capacity which is no greater than, and preferably the same as, the first data elements. This allows the stereoscopic data to be carried with minimal modification to the standards defining the interface.

The term "stereoscopic image data components" is intended to include any scheme which sends data to construct a stereoscopic (or autostereoscopic) display to a user, and includes: schemes which send left eye image data and right eye image data; schemes which send 2D image data and image depth data; schemes which send 2D image data and image depth data and occlusion information, indicating which objects in the picture are occluded by other objects.

In the case of a stereoscopic image which uses left eye and right eye image data, the formatter can use a portion of the second data element to carry the left eye image data and another portion of the second data element to carry the right eye image data.

In the case of a stereoscopic image which uses 2D + depth data, the formatter can use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data. The depth data may additionally be carried in other parts of a signal, such as periods within horizontal or vertical blanking periods. In HDMI, Data Island Packets are carried within these periods, and certain Data Island Packets can be identified as carrying depth data.

Advantageously, signaling information is sent across the interface identifying which mode the formatter is using and further signaling information can allow the second audio-visual device (e.g. a display or projector) to indicate whether it has the capability to render stereoscopic data sent in that formatting mode.

In a High Definition Multimedia Interface (HDMI), signaling can be carried by packets carried within the Data Islands between image data. The capability of a sink device to handle stereoscopic data can be signaled between interface parts using the HDMI Display Data Channel (DDC) channel, with capability data being stored in an Extended Display Identification Data (EDID) ROM at a sink.

A related aspect of the present invention provides a digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract image data, the processor being operable in:

a first mode in which the processor extracts pixel image data for a 2D image from a stream of first data elements; and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

A related aspect of the present invention provides a method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface between the first audio-visual device and a second audio-visual device, the method comprising:

receiving image data;

formatting the image data for transport over the interface by:

in a first mode, generating a stream of first data elements which carry pixel data of a 2D image; and,

in a second mode, generating a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

A related aspect of the present invention provides a method of processing image data at a digital display interface part of an audio-visual device, the method comprising:

receiving formatted image data from the interface;

extracting image data by:

in a first mode, extracting pixel image data for a 2D image from a stream of first data elements; and,

in a second mode, demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

A further aspect of the invention provides a digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable to send a portion of the stereoscopic image data over a primary image data transport channel of the interface and another portion of the stereoscopic image data over an auxiliary data channel.

The interface part can send signaling information across the interface identifying how stereoscopic data is distributed between the primary data channel and the auxiliary data channel.

Advantageously, the stereoscopic image data comprises 2D image data and image depth data and the formatter is arranged to send depth data across the auxiliary data channel.

The auxiliary data channel can comprise a separate line, or lines, within the same cable as the primary channel; a second cable which is separate from a first cable carrying the primary channel; or a wireless link.

A related aspect of the present invention provides a digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for connecting to a primary image data transport channel of the interface and an auxiliary data channel;

a processor arranged to extract a portion of the stereoscopic image data from the primary image data transport channel of the interface and another portion of the stereoscopic image data from the auxiliary data channel.

A related aspect of the present invention provides a method of sending stereoscopic image data over a digital display interface between a first audio-visual device and a second audio-visual device, comprising, at the first audio-visual device:

receiving stereoscopic image data for transport over the interface;

sending a portion of the stereoscopic image data over a primary image data transport channel of the interface and another portion of the stereoscopic image data over an auxiliary data channel.

A related aspect of the present invention provides a method of processing stereoscopic image data at an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the method comprising:

extracting a portion of the stereoscopic image data from a primary image data transport channel of the interface and another portion of the stereoscopic image data from an auxiliary data channel.

A further aspect of the invention provides a digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data;

a formatter arranged to generate a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein signaling information for use in decoding the stereoscopic image data is carried in at least one of the auxiliary data elements.

Where the stereoscopic image data comprises left eye image data and right eye image data, the signaling information can specify what data elements carry the left eye image data and what data elements carry the right eye image data. Where the left eye images and right eye images are interleaved on a line-by-line basis, the signaling information can be sent as often as once for each pair of interleaved lines, although it can be sent much less frequently, such as once per field or frame.

Where the stereoscopic image data comprises 2D image data and depth information, the signaling information can specify at least one of: the transmission location, quantity of the depth information.

Advantageously, where the stereoscopic image data has a plurality of different possible formats, the signaling information specifies the format. One of the formats for the stereoscopic image data can be a scheme which encodes the stereoscopic image data within a conventional 2D image format.

Advantageously, the signaling information is carried in a horizontal or vertical blanking period and for a High Definition Multimedia Interface (HDMI) the signaling information can be sent in a Data Island Packet.

A related aspect of the present invention provides a digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream;

using signaling information carried in at least one of the auxiliary data elements to decode the stereoscopic image data.

A related aspect of the present invention provides a method of sending stereoscopic image data over a digital display interface between a first audio-visual device and a second audio-visual device comprising, at the first audio-visual device:

receiving stereoscopic image data;

generating a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein signaling information for use in decoding the stereoscopic image data is carried in at least one of the auxiliary data elements.

A related aspect of the present invention provides a method of processing stereoscopic image data at a digital display interface part of an audio-visual device, the method comprising:

receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream;

using signaling information carried in at least one of the auxiliary data elements to decode the stereoscopic image data.

A further aspect of the invention provides a digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data components;

a formatter arranged to generate a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein the stereoscopic image data is distributed between the image data carrying data elements and the auxiliary data carrying data elements.

Advantageously, the stereoscopic image data components are 2D image data and image depth data and wherein the depth data is carried in the auxiliary data carrying data elements. Advantageously, the stream further comprises signaling information, carried within auxiliary data carrying data elements, specifying which part of an image the depth information relates to.

The auxiliary data carrying data elements are sent in a horizontal or vertical blanking period, such as HDMI Data Island Packets.

A related aspect of the present invention provides a digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements;

a processor arranged to extract stereoscopic image data from the image data carrying data elements and at least part of the stereoscopic image data from the auxiliary data carrying data elements.

A related aspect of the present invention provides a method of sending stereoscopic data across a digital display interface between a first audio-visual device and a second audio-visual device, the method comprising, at the first audio-visual device:

receiving stereoscopic image data components;

generating a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and distributing the stereoscopic image data between the image data carrying data elements and the auxiliary data carrying data elements.

A related aspect of the present invention provides a method of processing stereoscopic image data at a digital display interface part of an audio-visual device, the method comprising:

receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements;

extracting stereoscopic image data from the image data carrying data elements and at least part of the stereoscopic image data from the auxiliary data carrying data elements.

The functionality described here can be implemented in software, hardware or a combination of these. The invention can be implemented by means of hardware comprising several distinct elements, and by means of a suitably programmed computer. Accordingly, further aspects of the invention provide software for implementing any of the methods. The software may be stored on an electronic memory device, hard disk, optical disk or other machine-readable storage medium. The software may be delivered as a computer program product on a machine-readable carrier or it may be downloaded to the AV device via a network connection.

The invention also extends to signals, for transmission over the display interface, which result from any of the methods.

Features of the various aspects of the invention can be combined.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 shows a display interface for carrying image data between two AV devise;

Fig. 2 shows a formatting function at one end of the interface;

Fig. 3 shows a conventional way of sending 2D image data across a display interface;

Figs. 4 and 5 show ways of sending stereoscopic image data across a display interface;

Fig. 6 shows format of an HDMI video frame; and,

Fig. 7 shows a display interface which includes an auxiliary data channel.

DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 shows an example scenario in which the invention can be used. In Figure 1, an AV device 10 which is capable of providing a source of digital AV content is connected to a display (or video projector) 20 via a digital display interface (DDI) 40. Interface parts 12, 22 in devices 10, 20 support the interface 40, and provide functions such as formatting signals into the form required by standards defining the interface 40. The source device 10 can be a device which can retrieve digital AV content from a store 11, such as a hard disk, a solid state memory or an optical disc or any other fixed or removable storage medium or device. Examples of device 10 include a personal video recorder (PVR), an optical disc player such as a DVD player, an HD-DVD player or a Blu-ray player. Alternatively, device 10 can take the form of a set-top box which receives content from a distribution channel (such as a broadcast channel or broadband network or other type of network (e.g. home network)).

There are a variety of methods for displaying stereoscopic (3D) images. The two main methods for transferring 3D image data across an interface are: to transmit two complete, separate, stereoscopic images representing the left and right views as seen by human eyes; and a normal 2D image with associated depth information that can be used to generate the stereoscopic images within the display. The first method generally requires a significantly higher bandwidth (up to twice that needed for a 2D image) over the interface, but needs little processing in the display, while the second method can require a smaller increase in bandwidth, but at the expense of some fast real-time processing in the display to process the depth information.

Current digital display interfaces, such as HDMI, offer a very high bandwidth. These interfaces transfer uncompressed pixel information, unlike other transport mechanisms (such as Ethernet, USB, IEEE1394) which have to transfer compressed images because of their bandwidth limitations. Originally, images transferred by HDMI were limited to 8 bits per color per pixel, so-called "24-bit color". Improvements to HDMI from version 1.3 have allowed HDMI to carry more bits per pixel, with the options of carrying 10, 12 and 16 bits per color per pixel, i.e. up to 48-bit color. HDMI describes Deep Color Pixel Packing modes (HDMI 1.3a, section 6.5.3) which allow the higher color depths just described.

According to one embodiment of the present invention, the deep color modes are used to transport stereoscopic image data. The stereoscopic image data can be left image

data + right image data or 2D + depth information. Figure 2 shows a formatting function 15 used within an interface part 12. The formatter 15 can selectively operate in one of a number of different modes. This is shown schematically by formatter selecting one of the sets of inputs: 2D image data 31; 2D + depth image data 32, 33; or left eye and right eye image data 34, 35 for processing and selectively connecting 38 to an interface output 39. Formatter 15 can receive conventional 2D image data 31, such as 24-bit color image data 31. Typically this is received in an RGB or component video (Y,Cr,Cb) format. When receiving stereoscopic image data, formatter 15 multiplexes 36, 37 the image data components. For left eye/right eye image data, the left eye data and right eye data will typically be taken from the same pixel in the left eye/right eye frames or fields of the images, although other algorithms for combining pixels are also within the scope of the present invention. For 2D image + depth information, the 2D image data will typically correspond to a single pixel (e.g. RGB or component video format) and the depth information can take a different form, and may correspond to a different region of the image to the pixel of the 2D image. The formatter 15 may only support one of the 3D formats (i.e. just L+R, or just 2D+depth) or both types of 3D format.

Figures 3 to 5 show a range of different ways in which the image data can be multiplexed. Figure 3 shows conventional image data. In HDMI, the three color components (R,G,B or Y,Cr,Cb) are sent simultaneously on three Transition Minimised Differential Signaling (TMDS) channels 41. TMDS refers to line-level coding applied to the data to maintain an approximate DC balance as well as a reduction in the number of transitions in the data stream. Each color component can be sent using a standard color depth (e.g. 8 bits per color per pixel) or an enhanced color depth, such as 16 bits per color per pixel. Figure 4 shows a way in which stereoscopic left eye/right eye data can be multiplexed. The components of the left eye data (R,G,B or Y,Cr,Cb) are sent in a first portion of each data-carrying element, and then immediately followed by the components of the right eye data (R,G,B or Y,Cr,Cb). Both left eye and right eye are either sent within the same packet, consecutive image data packets, or parts of consecutive image data packets. As an example, where a 16-bit per color per pixel mode is used, bits 0-7 can carry the left image Y data and bits 8-15 carry the right image Y data. HDMI 1.3a currently allows a color depth of up to 16-bits per color per pixel (48-bit color). Figure 4 shows how two 24-bit color images can be carried within the existing 48-bit color mode with no additional capacity required from the interface. It will be appreciated that future revisions of HDMI (and other) specifications may

extend the bandwidth to permit a larger color depth, which will allow each of the left eye and right eye images to use more bits per pixel, so allowing richer 3D images.

Figure 5 shows a scheme for sending 2D image data + depth information where the 2D data is sent first, followed by the depth data. Each color component (R,G,B or Y,Cr,Cb) follows the same format. In Figure 6 the capacity of the packet is divided equally between the 2D data and depth information, although any other division is possible. It may be possible to send significantly less depth data than 2D data, which can allow the 2D image to use a wide color palette and/or high resolution. It is also possible to send some – or all – of the depth information in a different part of the transmitted data stream, such as within specific HDMI Data Island Packets carried within the horizontal and vertical line blanking intervals. This is particularly useful for depth data that is not attached directly to a specific pixel, for instance, it applies to a region of the image.

Interface part 12 sends signaling 42 which indicates the format of the image data, e.g. indicating whether the image data is 2D, stereo (L+R) or stereo (2D+depth). The signaling can also indicate further details of the multiplexing scheme, such as which color depth mode is being used to carry the multiplexed data, the number of bits per data element that are allocated to 2D data and the number of bits per data element that are allocated to depth data. This signaling allows flexibility in how the stereo data is allocated to data carrying elements sent across the interface 40 and allows for the amount of Depth information to be changed dynamically, according to the requirements of the content which is to be displayed. In HDMI, Data Island Packets are sent in horizontal and vertical line blanking periods. The signaling information can conveniently be carried within a Data Island Packet. Figure 6 shows the layout of an HDMI video frame, showing a region 61 where pixel data is sent across TMDS channels, a horizontal blanking period 63 and a vertical blanking period. Data Island Packets 64 are sent within Data Island periods positioned within the horizontal and vertical blanking periods 62, 63. The signaling data can be carried in a General Control Packet, an Auxiliary Video InfoFrame (AVI) packet or an InfoFrame Packet specifically designated for this purpose. If depth data is carried both within the pixel data carrying data elements and other places of the stream, the signaling can indicate where the depth data is to be found. The amount of depth data and the location(s) of the depth data can vary on a dynamic basis during an image, or sequence of images, depending on the required color depth, resolution or complexity of the image (e.g. the amount of depth information within an image).

AV device 20 includes a processor 21 applies suitable processing to the data to render a 3D image. In the case of stereoscopic display, where a user is simultaneously or sequentially presented with separate left and right eye images, processor 21 constructs the separate left eye/right eye images and outputs them 24 at the required time. For sequential stereoscopic displays, a further output 23 is provided to synchronize operation of shuttered glasses. In the case of an autostereoscopic display, such as a display using a ventricular screen, processor 21 constructs the image data which is required to be output 24 to the display elements to generate the autostereoscopic display. Interface part 22 and processor 21 use the signaling information sent across the interface to:

determine if stereoscopic image data is being sent; determine what general stereoscopic image format is being used (e.g. left+right image; 2D+depth; stereo encoded within active image data);

determine more detail of how the image data is being encoded on the interface, and therefore what decoding scheme should be used at the receiver. This may include information about which deep color mode is being used, bit allocation between 2D and depth data, transmission location of depth data (e.g. specific Data Island Packets or auxiliary channel locations).

Further signaling between the AV devices 10, 20 allows the sink device 20 to indicate it's capabilities to receive and process image data. The capability information may indicate the maximum allowed bandwidth for each mode of sending 2D and stereo image data. In HDMI, the capability of a sink device can use the Display Data Channel (DDC) channel, with capability data being stored in an Extended Display Identification Data (EDID) ROM at a sink.

The interface may support other schemes for sending stereoscopic data. A first alternative is to send two separate complete images, carried sequentially (such as a complete left image followed by a complete right image). The indication of the left and right image can be indicated by signaling information carried directly adjacent the position of the image data, such as an HDMI Data Island Packet.

A second alternative is to send two separate images, but with the lines of the two images interleaved. For example, the first line of the left image is sent first, followed by the first line of the right image, and so on.

A third alternative is to send a 2D image in a conventional manner, and to carry depth information in specific Data Island Packets dedicated to carrying depth information.

In each of these alternatives, signaling information carried directly adjacent the position of the image data, such as an HDMI Data Island Packet, can indicate what the image data corresponds to. For the third alternative, the signaling information can specify which part of the image the depth data relates to. As noted above, the HDMI Data Island Packets can be a General Control Packet, an Auxiliary Video InfoFrame (AVI) packet or an InfoFrame Packet specifically designated for this purpose. The information in these packets can identify:

the current stereoscopic method (field, line or byte) being used (see above);

whether a Deep Color Pixel Packing mode is being used to carry 3D information or a Deep Color Mode 2D image;

the mapping of left and right images to the current field, line or byte;

how many of the Data Island Packet packets/sub-packets are being uses to carry Depth information;

the location of other stereoscopic image data components.

The embodiments above show how the separate stereoscopic image components can be carried over a display interface. For some applications, especially those intended for display on a ventricular screen, the picture received at the interface part 12 may already be encoded with stereoscopic content. As an example, a WOWvx encoded image as described in the background section, comprises a 2D image, depth information and/or occlusion information already embedded into separate regions of a conventional image. In one embodiment, the 2D image is carried in one quarter of the image pixels (e.g. in half a line for half the total lines in the picture). The associated depth and/or occlusion information is carried in the other three-quarters of the presented picture. In this case, the lines of the picture are transported across the HDMI link as thought they were a single 2D image occupying all of each line, for all the available lines. In order to identify such a 3D image, an HDMI Data Island Packet (typically a General Control Packet, Auxiliary Video InfoFrame (AVI) packet or specifically designated InfoFrame Packet) indicates this method. The information in this Packet identifies:

- the current stereoscopic method (e.g. 2D+Depth) being used;
- any information pertaining to this method which is required by the display.

The sink identifies the transmitted picture as using this method and processes the picture accordingly. The sink also carries information in the EDID indicating that it supports this method.

In the above description, stereoscopic image data is carried over a channel of an interface (e.g. an HDMI Transport Stream) either by multiplexing the stereoscopic image data within normal data carrying elements of the channels, or by carrying at least part of the stereoscopic image data within other packets (e.g. Data Island Packets) carried over the same channel. A further embodiment of the invention carries at least some of the stereoscopic image data over an associated high speed auxiliary data link such as Gigabit Ethernet, IEEE 1394 or a high-speed wireless link. Signaling information identifies which information is carried by the primary channels of the interface and which is carried by the associated auxiliary link. In HDMI, the signaling information can be carried in Data Island Packets. Similar, or complementary, identification information may also be carried on the associated high speed auxiliary link. The sink uses the received Data Island Packets to identify which information is carried on which link and combines the two streams of data in the necessary format for presentation or processing. Depending on the characteristics of the HDMI and associated auxiliary link, it may be necessary to buffer the data contained in the two streams in order to maintain synchronicity between them. In one embodiment using the above embodiment, the associated wires for the auxiliary link are carried within the HDMI cable; this option is shown in Figure 7 by additional line 50 connecting modules 51, 52 in interface parts 12, 22. In other embodiments, the associated auxiliary link is carried in a separate cable connecting the devices 10, 20, or by a high-speed wireless link.

Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

1. A digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable in:

a first mode in which the formatter generates a stream of first data elements, which carry pixel data of a 2D image; and,

a second mode in which the formatter generates a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

2. An interface part according to claim 1 wherein the second data elements have a capacity which is no greater than the first data elements.

3. An interface part according to claim 1 or 2 wherein the stereoscopic image data components are left eye image data and right eye image data.

4. An interface part according to claim 3 wherein the formatter is arranged to use a portion of the second data element to carry the left eye image data and another portion of the second data element to carry the right eye image data.

5. An interface part according to claim 4 wherein the formatter is arranged to multiplex a corresponding pixel of the left eye image data and the right eye image data into the second data element.

6. An interface part according to claim 1 or 2 wherein the stereoscopic image data components are 2D image data and image depth data.

7. An interface part according to claim 6 wherein the formatter is arranged to use a portion of the second data element to carry the 2D image data and another portion of the second data element to carry the image depth data.

8. An interface part according to claim 7 wherein the formatter is arranged to multiplex a pixel of the 2D image with depth data from a different part of the image.

9. An interface part according to any one of the preceding claims wherein the formatter is operable in a third mode in which the formatter generates third data elements carrying per pixel data, the third data elements having a capacity which is smaller than each of the first data elements and the second data elements.

10. An interface part according to any one of the preceding claims which is arranged to send signaling information across the interface identifying which mode the formatter is using.

11. An interface part according to any one of the preceding claims which is arranged to receive signaling information across the interface specifying capabilities of the second audio-visual device.

12. An interface part according to claim 10 wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet between image data.

13. An interface part according to any one of the preceding claims wherein the interface is a High Definition Multimedia Interface (HDMI) and the first mode and the second mode are Deep Color Modes having a capacity of greater than 24-bits of color data per pixel.

14. A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving formatted image data from the interface;

a processor arranged to extract image data, the processor being operable in:

a first mode in which the processor extracts pixel image data for a 2D image from a stream of first data elements; and,

a second mode in which the processor demultiplexes components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

15. A method of formatting image data at a digital display interface part of a first audio-visual device for transport over a digital display interface between the first audio-visual device and a second audio-visual device, the method comprising:

receiving image data;

formatting the image data for transport over the interface by:

in a first mode, generating a stream of first data elements which carry pixel data of a 2D image; and,

in a second mode, generating a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

16. A method of processing image data at a digital display interface part of an audio-visual device, the method comprising:

receiving formatted image data from the interface;

extracting image data by:

in a first mode, extracting pixel image data for a 2D image from a stream of first data elements; and,

in a second mode, demultiplexing components of a stereoscopic image from a stream of second data elements which carry a multiplexed combination of components of a stereoscopic image.

17. Software for performing the method of claim 15 or 16.

18. A signal resulting from the method of claim 15.

19. A digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data;

a formatter arranged to format the data for transport over the interface, wherein the formatter is operable to send a portion of the stereoscopic image data over a primary image data transport channel of the interface and another portion of the stereoscopic image data over an auxiliary data channel.

20. An interface part according to claim 19 which is arranged to send signaling information across the interface identifying how stereoscopic data is distributed between the primary data channel and the auxiliary data channel.

21. An interface part according to claim 19 or 20 wherein the stereoscopic image data comprises 2D image data and image depth data and the formatter is arranged to send depth data across the auxiliary data channel.

22. An interface part according to any of claims 19 to 21 wherein the interface comprises a set of lines within a cable and the auxiliary data channel comprises a separate line, or lines, within the same cable.

23. An interface part according to any of claims 19 to 21 wherein the interface comprises a first cable and the auxiliary data channel is carried by a second cable.

24. An interface part according to any of claims 19 to 21 wherein the auxiliary data channel is carried by a wireless connection.

25. A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for connecting to a primary image data transport channel of the interface and an auxiliary data channel;

a processor arranged to extract a portion of the stereoscopic image data from the primary image data transport channel of the interface and another portion of the stereoscopic image data from the auxiliary data channel.

26. A method of sending stereoscopic image data over a digital display interface between a first audio-visual device and a second audio-visual device, comprising, at the first

audio-visual device:

receiving stereoscopic image data for transport over the interface;

sending a portion of the stereoscopic image data over a primary image data transport channel of the interface and another portion of the stereoscopic image data over an auxiliary data channel.

27. A method of processing stereoscopic image data at an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the method comprising:

extracting a portion of the stereoscopic image data from a primary image data transport channel of the interface and another portion of the stereoscopic image data from an auxiliary data channel.

28. A digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data;

a formatter arranged to generate a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein signaling information for use in decoding the stereoscopic image data is carried in at least one of the auxiliary data elements.

29. An interface part according to claim 28 wherein the stereoscopic image data comprises left eye image data and right eye image data and the signaling information specifies what data elements carry the left eye image data and what data elements carry the right eye image data.

30. An interface part according to claim 28 wherein the stereoscopic image data comprises 2D image data and depth information and the signaling information specifies at least one of: the transmission location, quantity of the depth information.

31. An interface part according to any one of claims 28 to 30 wherein the stereoscopic image data has a plurality of different formats and the signaling information specifies the format.

32. An interface part according to claim 31 wherein one of the formats for the stereoscopic image data is encoding the stereoscopic image data within a conventional 2D image format.

33. An interface part according to any one of claims 28 to 32 wherein the signaling information is carried in a horizontal or vertical blanking period.

34. An interface part according to claim 33 wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet.

35. A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream;

using signaling information carried in at least one of the auxiliary data elements to decode the stereoscopic image data.

36. A method of sending stereoscopic image data over a digital display interface between a first audio-visual device and a second audio-visual device comprising, at the first audio-visual device:

receiving stereoscopic image data;

generating a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein signaling information for use in decoding the stereoscopic image data is carried in at least one of the auxiliary data elements.

37. A method of processing stereoscopic image data at a digital display interface part of an audio-visual device, the method comprising:

receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream;

using signaling information carried in at least one of the auxiliary data elements to decode the stereoscopic image data.

38. Software for performing the method of claim 36 or 37.

39. A signal resulting from the method of claim 36.

40. A digital display interface part for use in a first audio-visual device for supporting a digital display interface between the first audio-visual device and a second audio-visual device, the interface part comprising:

an input for receiving stereoscopic image data components;

a formatter arranged to generate a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and wherein the stereoscopic image data is distributed between the image data carrying data elements and the auxiliary data carrying data elements.

41. An interface part according to claim 40 wherein the stereoscopic image data components are 2D image data and image depth data and wherein the depth data is carried in the auxiliary data carrying data elements.

42. An interface part according to claim 41 further comprising carrying signaling information within auxiliary data carrying data elements specifying which part of an image the depth information relates to.

43. An interface part according to any one of claims 40 to 42 wherein the auxiliary data carrying data elements are sent in a horizontal or vertical blanking period.

44. An interface part according to claim 43 wherein the interface is a High Definition Multimedia Interface (HDMI) and the signaling information is sent in a Data Island Packet.

45. A digital display interface part for use in an audio-visual device for supporting a digital display interface between the audio-visual device and another audio-visual device, the interface part comprising:

an input for receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements;

a processor arranged to extract stereoscopic image data from the image data carrying data elements and at least part of the stereoscopic image data from the auxiliary data carrying data elements.

46. A method of sending stereoscopic data across a digital display interface between a first audio-visual device and a second audio-visual device, the method comprising, at the first audio-visual device:

receiving stereoscopic image data components;

generating a stream of image data carrying data elements and auxiliary data carrying data elements at intervals in the stream, and distributing the stereoscopic image data between the image data carrying data elements and the auxiliary data carrying data elements.

47. A method of processing stereoscopic image data at a digital display interface part of an audio-visual device, the method comprising:

receiving, from the interface, a stream of image data carrying data elements and auxiliary data carrying data elements;

extracting stereoscopic image data from the image data carrying data elements and at least part of the stereoscopic image data from the auxiliary data carrying data elements.

48. Software for performing the method of claim 46 or 47.

49. A signal resulting from the method of claim 46.

ABSTRACT:

A digital display interface (40) connects a first audio-visual device (10) to a second audio-visual device (20). Stereoscopic image data is transmitter over the display interface (40). Components of stereoscopic image data are multiplexed and inserted into an image data carrying element. An existing deep color mode can be re-used for this purpose. Signaling information to help identify or decode the stereoscopic image data is carried in auxiliary data carrying elements. Stereoscopic image data can be distributed between image data carrying data elements and auxiliary data carrying data elements. Auxiliary data carrying elements can be transmitted in horizontal or vertical blanking periods, and can comprise HDMI Data Island Packets. Stereoscopic image data can be sent over an auxiliary data channel. The auxiliary data channel can form part of the same cable as is used to carry a primary channel of the display interface, a separate cable, or a wireless link.

Fig. 2

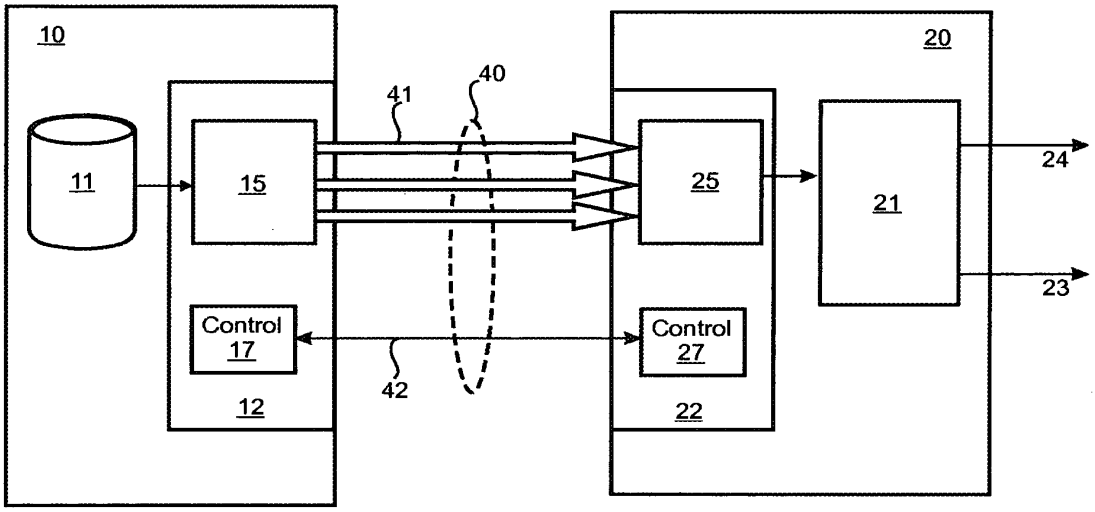

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Control
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Control
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Fig. 1

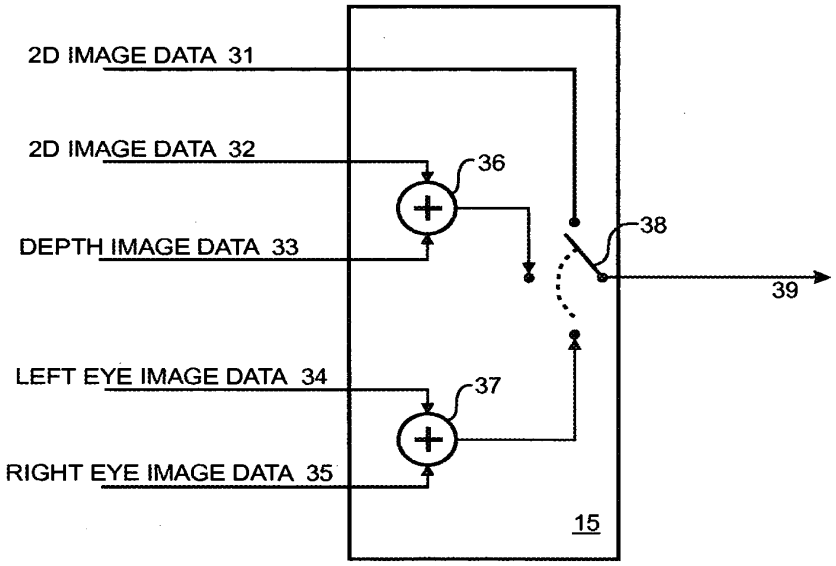

2D IMAGE DATA 31
2D IMAGE DATA 32
36
DEPTH IMAGE DATA 33
38
39
LEFT EYE IMAGE DATA 34
37
RIGHT EYE IMAGE DATA 35
15

Fig. 2

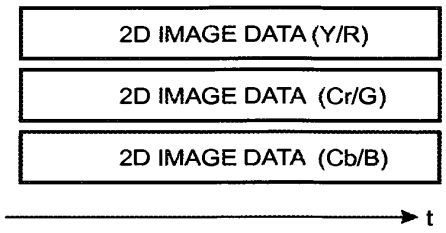


Fig. 3

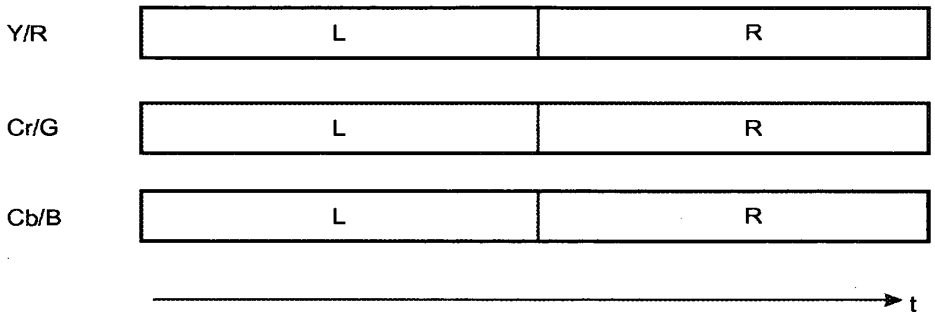


Fig. 4

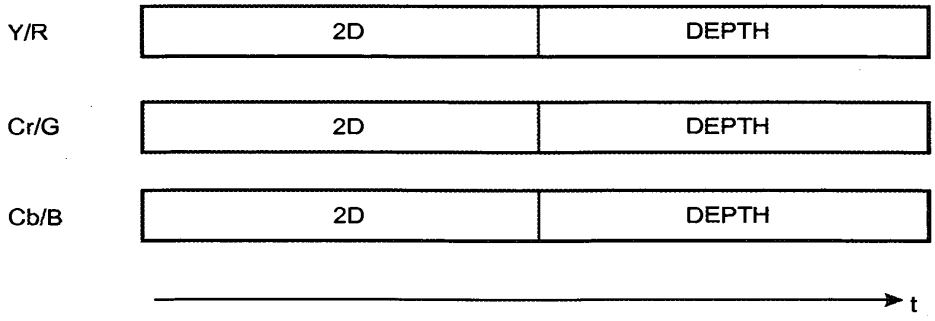


Fig. 5

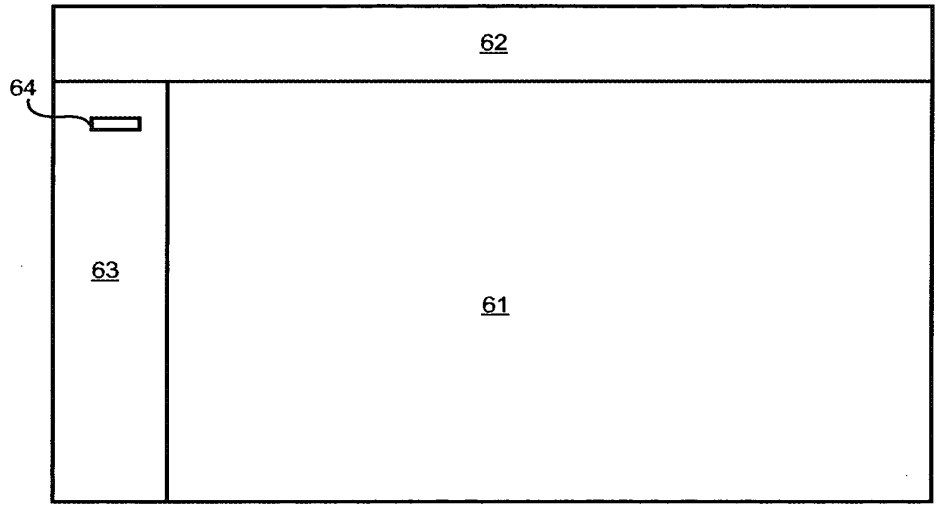

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Fig. 6

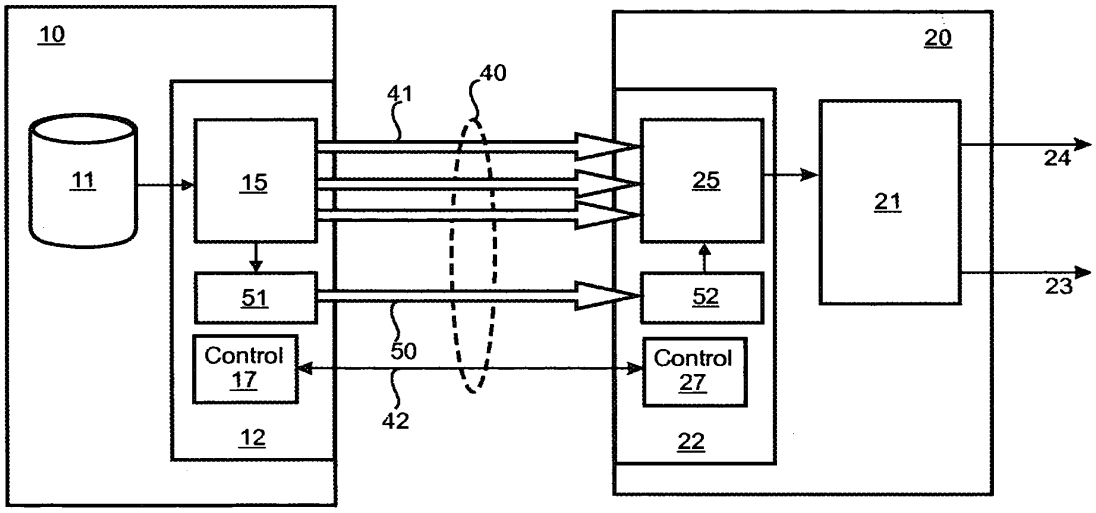

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Fig. 7

VIII-2-1	**Declaration: Entitlement to apply for and be granted a patent** Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent (Rules 4.17(ii) and 51bis.1(a)(ii)), in a case where the declaration under Rule 4.17(iv) is not appropriate: Name (LAST, First)	in relation to this international application KONINKLIJKE PHILIPS ELECTRONICS N.V. is entitled to apply for and be granted a patent by virtue of the following:
VIII-2-1(iii)		KONINKLIJKE PHILIPS ELECTRONICS N.V. is entitled as employer of the inventor, SHEPHERD, Nicoll, B.

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 2, 2008

Application or Docket Number: 12/808685

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)	SMALL ENTITY RATE	SMALL ENTITY FEE	OR	LARGE ENTITY RATE	LARGE ENTITY FEE
U.S. NATIONAL STAGE FEES							
BASIC FEE	SMALL ENT.=$165	LARGE ENT.=$330	BASIC FEE		OR	BASIC FEE	330
EXAMINATION FEE	SMALL ENT. = $110	LARGE ENT. = $220	EXAM. FEE			EXAM. FEE	220
SEARCH FEE	U.S. is ISA = $50/$100 ALL other countries = $215/$430	ALL other situations = $270/$540	SEARCH FEE			SEARCH FEE	430
FEE FOR EXTRA SPEC. PGS.	minus 100 =	/ 50 =	X $ 135 =			X $ 270 =	
TOTAL CHARGEABLE CLAIMS	18 minus 20 =		X $ 26 =		OR	X $ 52 =	
INDEPENDENT CLAIMS	4 minus 3 =	1	X $ 110 =		OR	X $ 220 =	220
MULTIPLE DEPENDENT CLAIM PRESENT		N	+ $ 195 =		OR	+ $ 390 =	
* If the difference in column 1 is less than zero, enter "0" in column 2			TOTAL		OR	TOTAL	1200

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM	☐			

SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
X $ 26 =		OR	X $ 52 =	
X $ 110 =		OR	X $ 220 =	
+ $ 195 =		OR	+ $ 390 =	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM	☐			

SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
X $ 26 =		OR	X $ 52 =	
X $ 110 =		OR	X $ 220 =	
+ $ 195 =		OR	+ $ 390 =	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than '20', enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than '3', enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

FORM PTO-875 (Rev. 02/2005) — Patent and Trademark Office - U.S. DEPARTMENT OF COMMERCE

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET
(FOR USE WITH FORM PTO-875)

SERIAL NO. 12/808,685 | FILING DATE

APPLICANT(S)

CLAIMS

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
1	1					
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37	1					
38		2				
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43		1				
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45	1					
46						
47	1					
48		2				
49						
50			1			
TOTAL IND.		⬇		⬇		⬇
TOTAL DEP.		⬅		⬅		⬅
TOTAL CLAIMS						

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
51				1		
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TOTAL IND.		⬇	4	⬇		⬇
TOTAL DEP.		⬅	14	⬅		⬅
TOTAL CLAIMS			18			

PTO - 1360 (REV. 11/04)

U.S. DEPARTMENT of COMMERCE
Patent and Trademark Office