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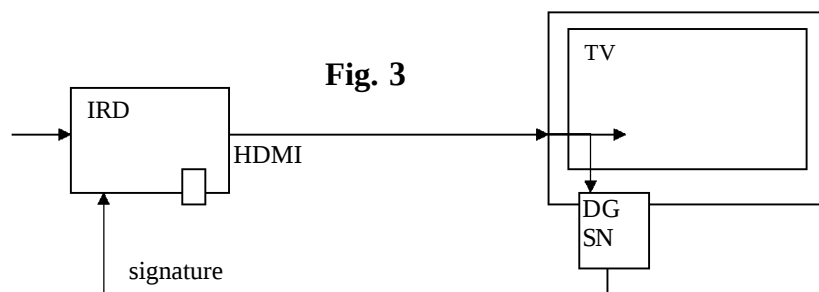
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(54) Title: SYSTEM AND METHOD TO PREVENT MANIPULATION OF TRANSMITTED VIDEO DATA



(57) Abstract: The aim of the invention is to provide a solution to ensure that the content sent by the IRD is the content effectively displayed on the screen. It is then proposed a system to prevent manipulation of transmitted video data comprising an Integrated Receiver Decoder (IRD) receiving audio/video data, a display device (TV), said IRD comprising means to transmit an HDMI compliant audio/video data stream toward the display device. This system comprising: - means to define a variable area at a location of the image displayed on the display device, - means to store reference data corresponding to video data of said area which are sent to the display device. - means internal or external to the display device to extract the actual displayed video data of said area, - means to send, to said IRD, test data determined from said extracted video data, - means to compare said test data with said reference data, - means for switching an operating mode of the system from a standard mode to a disrupted mode in case of difference resulting from this comparison.

System and method to prevent manipulation of transmitted video data

Introduction

The present invention concerns the field of television devices, in particular a set-top-boxes (or IRD Integrated Receiver Decoder) designed to providing additional media
5 experience on the television.

Prior art

The today's situation is described in respect with the figure 1. The IRD is connected to the various sources of data (IP, satellite, cable, antenna) and is in charge of
10 extending the capabilities of the television by providing decryption of the encrypted data as well as handling the access rights. The IRD proposes also storage capabilities, parental control with identification of the user to apply the proper profile and a program guide. The output is connected to a television or a screen to take advantage of the multimedia experience.

15 One of the revenue model of the media content providers is the advertisement introduced during appealing broadcast content. It is therefore important that the advertisements sent by the IRD to the television is not replaced by other information.

Brief description of the invention

The aim of the invention is to provide a solution to ensure that the content sent by
20 the IRD is the content effectively displayed on the screen.

It is then proposed a system to prevent manipulation of transmitted video data comprising an Integrated Receiver Decoder (IRD) receiving audio/ video data, a display device (TV), said IRD comprising means to transmit an HDMI compliant audio/ video data stream toward the display device. The system comprises:

- 25
- means to define a variable area at a location of the image displayed on the display device, i.e. a versatile portion within the image displayed on this device,
 - means to store reference data corresponding to video data of said area which are sent to the display device.

- means internal or external to the display device to extract the actual displayed video data of said area,
 - means to send, to said IRD, test data determined from said extracted video data,
 - means to compare said test data with said reference data,
- 5 - means for switching an operating mode of the system from a standard mode to a disrupted mode in case of difference resulting from this comparison.

Brief description of the figures

The present invention will be better understood thanks to the attached figures in which :

10 The **figure 1** illustrates the standard known system.

The **figure 2** shows the so-called "man-in-the-middle" attack

The **figure 3** illustrates the invention using a dongle to determine the actual displayed image

15 The **figure 4** is similar to the figure 3 with the difference that feedback data is sent wirelessly

The **figure 5** illustrates the same embodiment as the figure 4 with an external dongle wireless received on the IRD side.

The **figure 6** illustrates the case with a second HDMI feedback channel

The **figure 7** illustrate a case when the signature is calculated by the display device

20 The **figure 8** illustrates a case when the back channel is used to control the access to the content

Description of the various embodiments

The **figure 1** illustrates the standard known system. The IRD (Integrated Receiver Decoder) is on one side connected to the broadcast channels, such as via an antenna,
25 cable, or IP, and on the other side is connected to a display device TV. The purpose of the IRD is to receive the signal, convert it into a plurality of channels, and if necessary, decrypt the selected channel with the cooperation of a security module. The selected channel is then transmitted to the TV via an HDMI cable. Other

functions are also proposed by the IRD such as recording an event, either directly while it is broadcasted, or according to a programmed time/date.

The IRD is also in charge of the reception, preparation and display of the Electronic Program Guide (EPG) that helps the user to quickly access the desired channel.

- 5 The HDMI communication is protected by HDCP protocol which defines the frame of data exchange. HDCP is based on certificates verification and data encryption. Before the data are outputted by a source device, a handshake is initiated during which the certificate of the source and the sink are exchanged. The received certificate (e.g. X509) is then verified and used to establish a common encryption key.
- 10 The verification can use white or black lists.

The **figure 2** shows the so-called "man-in-the-middle" attack in which an additional device MM is placed at the output of the IRD and intercepts the audio/ video data stream. The risk in such a case is to bypass the security rules that were associated with the content such as "view only", "view once", "no record". The fact that the

15 content is in an external device opens the possibility for a third party to use the content in a way not authorized by the content provider. The aim of this patent application is to detect the presence of such external and in-between device by the IRD and take appropriate action.

To prevent manipulation of transmitted video data by such an additional device

20 MM, the system of the present invention suggests to define a variable area on the display device, then to store reference data corresponding to these video data which are sent to the display device. On the other side of the system, it comprises means to extract the displayed video data contained within the same area and means to send back to the IRD, test data referring to the extracted video data. Finally, the system

25 comprises means to compare test data with reference data and means to take appropriate measures in case of difference resulting from this comparison.

The variable area defined on the display device corresponds to a portion of the display which is changing at each time the system checks if manipulations have been made on the reference video data. By limiting the area to be processed by the system

30 of the present invention to a part of the display device, e.g. to a relatively small size

area, the reference data and the test data are small sizes too and can be advantageously quickly transferred between the devices located at the two ends of the system. Responsiveness of the system is also improved.

The variable area can be defined by coordinates within a two dimensions system.

5 These coordinates can be sent from the IRD to means in charge of extracting the predefined area of the actual displayed video data within an encrypted message. This message can be parameterized by a proprietary encryption key known only by the two devices in communication, namely the IRD and the extracting means. The latter being internal or external to the display device.

10 In order to proceed with the comparison of the data, the system also comprises means to temporarily store reference data corresponding to video data of the area sent to the display device. These data being stored until the comparison of test data with reference data is made.

15 According to the preferred embodiment of the invention, the location of the variable area defined on the display device is determined according to a pseudo random process so as to be unpredictable. Further, such a process can be sampling process which progressively checks the whole possible areas of the display device, taking into account the areas which have been already checked.

The **figure 3** illustrates the invention using a dongle as means to determine the actual
20 displayed image. A dongle DG-SN is connected to the display device with the aim of gathering information about what is currently displayed on the device. This can be done by outputting the HDMI signal entering into the display device toward the dongle. For that purpose, the dongle can be connected to the HDMI output of the display device or to another interface such as CI+, for instance in case the dongle has
25 the shape of a CI+ card and is powered by a CI+ interface of the display device.

According to a preferred embodiment of the invention, the system comprises means to calculate a reference signature on video data, limited to the variable area, which are sent to the display device and a test signature on extracted video data within the same area. Preferably, reference data, used during the data comparison, correspond

to this reference signature and test data, sent back to the IRD, correspond to this test signature.

Typically, the dongle DG can comprise means to extract the video data displayed in the variable area and/or means to calculate the signature on these extracted video data; this signature being compared with a reference signature calculated by the IRD according to the preferred embodiment. The comparison of both signatures can be executed within the dongle DG or by the IRD. In the first case, the dongle receives the reference signature from the IRD through another connection, such as a USB connection and simply send back a signal for positive or negative comparison to the IRD. In the second example, the dongle transmits the test signature of the displayed image to the IRD and the latter executes the comparison.

Each signature is calculated firstly by using a hash function applied to the video data to be signed. A digest is obtained as a result from this hash function. Secondly, this digest is then encrypted by an encryption function. The hash or digest ensures the integrity of the video data and its encryption ensures the authentication. Thus, the data sent to the IRD are encrypted by the dongle or by any means used to calculate the signature on the extracted data. In case video data are directly sent to the IRD for calculating the signature, these video data are firstly encrypted by the dongle or any other means before to be sent.

Alternately, the video data comprised inside the variable area and which are sent to the display device can be directly used as reference data without calculating a signature on this data. In the same way, the extracted video data which are sent to the IRD can be directly used as test data. However, it is more judicious to use the signature of the video data sent to the display device as reference data and to use the signature of the extracted data as test data.

The **figure 4** illustrates an embodiment similar to that of figure 3. The only difference is the connection between the dongle DG-SN and the IRD which is wirelessly. In this case, the IRD comprises no wireless means and this is why the IRD is connected to a transmitter RC. The transmitter RC is for example connected with the IRD thanks to an USB connection.

The **figure 5** is similar to the figure 4 with a dongle external to the display device and wireless received on the IRD side.

The **figure 6** is based on the same principle but the dongle described above is included into the IRD. The display device TV comprises an output that gives the data currently displayed e.g. HDMI output. The IRD then calculate the signature based on the received data and compare it with the one calculated on the video data sent by the HDMI output of the IRD.

The **figure 7** is still based on signature comparison, the display device having a processing module that can calculate the signature on the displayed image. This signature is then sent to the IRD by various means, such as USB, Bluetooth, wifi, powerline. The IRD calculates the reference signature on the image sent to the display device and compares the received signature, namely the test signature, with the reference signature.

The system of the invention comprises means for switching the operating mode of the system from a standard or regular mode to a disrupted mode in case of difference between these signatures. According to the preferred embodiment, the IRD comprises means to interrupt the transmission of video signal in case of difference. However, it should be understood that other measures could be undertake in case of difference between the couple of signatures.

Another aspect of this embodiment, which is common to the previous one about the video data to be used for the comparison, is the synchronization between the module processing with the displayed image (e.g. by calculating the test signature) and the module processing with the reference image (e.g. by calculating the reference signature). This synchronization aims at defining which image, namely which reference data and which test data, will serve as the basis of the calculation of the signatures for instance. For the sake of understanding, the module within the display device (or attached to the display device) will be named "receiver signature module" and the equivalent module within the IRD is named "emitter signature module". The IRD can send a command to the receiver signature module that trigs the calculation of the signature. This command can comprise the indication (e.g. coordinates) about the area on which the calculation should be done. The command sent by the IRD to

the receiver signature module can also indicate a frame index. The display device displays a succession of frame, each having an index. When the proper index is detected, the receiver signature module calculates the test signature and sends it to the IRD (or compares it locally with the reference signature received from the IRD).

5 Another embodiment to ensure the synchronisation of the images resulting from reference data and the images resulting from test data is to calculate the transmission delay needed by the system between the time where the video data to be displayed are sent by the IRD and the time where these data are effectively displayed by the display device. This transmission delay can be different from one system to another
10 given that each system does not necessarily comprise the same components/ devices. A solution to determine this transmission delay is to send a signal emitted by the IRD, for instance by generating a marker during a short time, as a clear marker which can be reliably detected by the receiver module or by means which is in charge of extracting the video data, and to calculate the elapsed time between the emission and
15 the reception of this signal. Once determined, the transmission delay of the video data from the emitter to the receiver module of the system can be used to configure the extraction process and to ensure that the reference data are compared with the appropriate test data. As the time required until an image is displayed can slightly fluctuate, a tolerance can be allocated to the transmission delay. Typically, such
20 tolerance may be in the order of some milliseconds. If needed, the transmission delay and / or the tolerance can be sent to the extraction means and / or to the receiver module via a command or a specific message. All of these operations could be, for example, contained within a calibration process which could be implemented by a calibration means. According to the preferred embodiment, means to extract the
25 actual displayed video data comprises means to trigger the extraction so that the extracted video data refer to the corresponding video data sent to the display device. To this end, the trigger means are configured to take into account the afore-mentioned transmission delay.

The **figure 8** illustrates another embodiment based on the technology describes in the
30 document WO 2004/ 073292. The audio / video data entering into the IRD are lured, i.e. part of the data are extracted and replaced by dummy data. The IRD thus create

two streams, one modified stream and one control object. The modified stream is sent in a conventional way to the display device, e.g. using HDMI. The control object CO created by the IRD and contains the data extracted during this luring phase. The control object CO can be sent to an equivalent module attached (or within) the display device for reconstructing the original audio/ video stream. A further function of the reconstruction module is to check the consistency of the reconstructed stream. This module, once the original data being re-establish into the proper location into the modified stream, can calculate a checksum on the expected original stream (or equivalent verification information). This verification can take various forms, such as verifying the dummy value that was inserted in lieu of the original value into the modified stream. It can be the verification of another value at a location indicated into the second stream or a hash value of a packet of data. The result of the verification is then sent to the IRD that can take the necessary measures in case of difference.

Claims

1. System to prevent manipulation of transmitted video data comprising an Integrated Receiver Decoder (IRD) receiving audio/ video data, a display device (TV), said IRD comprising means to transmit an HDMI compliant audio/ video data stream toward the display device, **characterized in that** it comprises:
 - means to define a variable area at a location of the image displayed on the display device,
 - means to store reference data corresponding to video data of said area which are sent to the display device.
- 10 - means internal or external to the display device to extract the actual displayed video data of said area,
 - means to send, to said IRD, test data determined from said extracted video data,
 - means to compare said test data with said reference data,
 - means for switching an operating mode of the system from a standard mode to a disrupted mode in case of difference resulting from this comparison.
- 15 2. System of claim 1, wherein it comprises trigger means to trigger the extraction of the actual displayed data so that the latter refers to the corresponding video data transmitted to the display device, said trigger means taking into account a transmission delay which corresponds to the time interval between the instant where the video data to be displayed are sent by the IRD and the instant where these data are displayed by the display device.
- 20 3. System of claim 2, wherein said transmission delay is determined by a calibration means which is able to measure the time interval required by a marking signal between a first instant where it is emitted by the IRD and a second instant where it is received by the display device.

4. System of any of claims 1 to 3, wherein the location of said area is determined according to a pseudo random process, said location being communicated to the display device.

5

5. System of any claims 1 to 4, wherein said location is determined according to a sampling process which progressively checks the whole possible areas of the display device.

10

6. System of any of claims 1 to 5, wherein it further comprises means to calculate : a reference signature on video data of said area sent to the display device and a test signature of the test data and;

wherein the comparison step is carried out with the reference signature and the test signature.

15

7. System of any claims 1 to 4, wherein said means to extract said video data and/ or said means to send said test data are parts of a dongle which comprises connection means with the IRD for sending said test data.

20

8. System of claim 7, wherein the connection means with the IRD is wireless.

9. System of claim 7 or 8, wherein the dongle is connected to a HDMI output of the display device.

25

10. System of any of the claims 7 to 9, wherein the dongle comprises said means to calculate said test signature.

11. System of any of the claims 7 to 10, wherein the IRD comprises said means to compare the test signature with the reference signature.

5 12. System of claim 1, wherein said means for switching the operating mode of the system allows interrupting the transmission of video signal in case of difference in said comparison.

10 13. System of any of the claims 1 to 12, wherein the displayed video data are a succession of frames, and the means to extract the displayed information receives a triggering signal from the IRD, said signal indicating which frame is to be extracted for the calculation of the test signature.

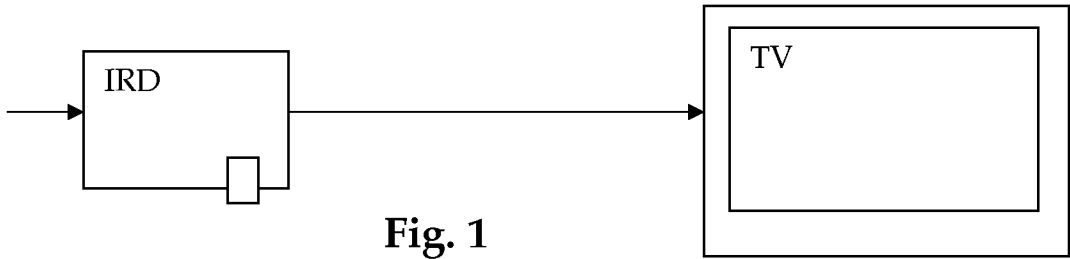


Fig. 1

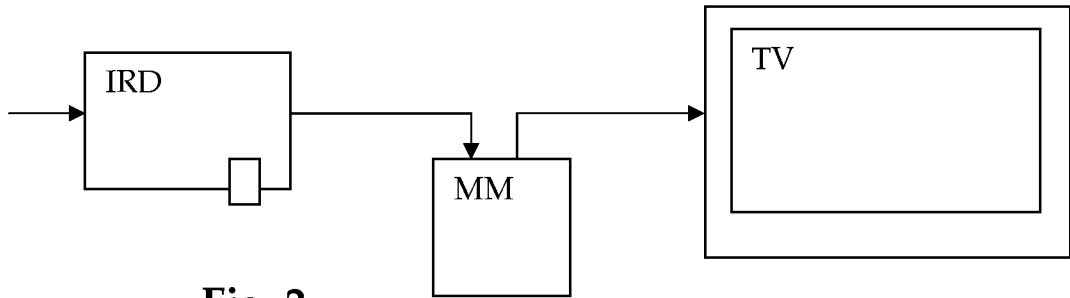


Fig. 2

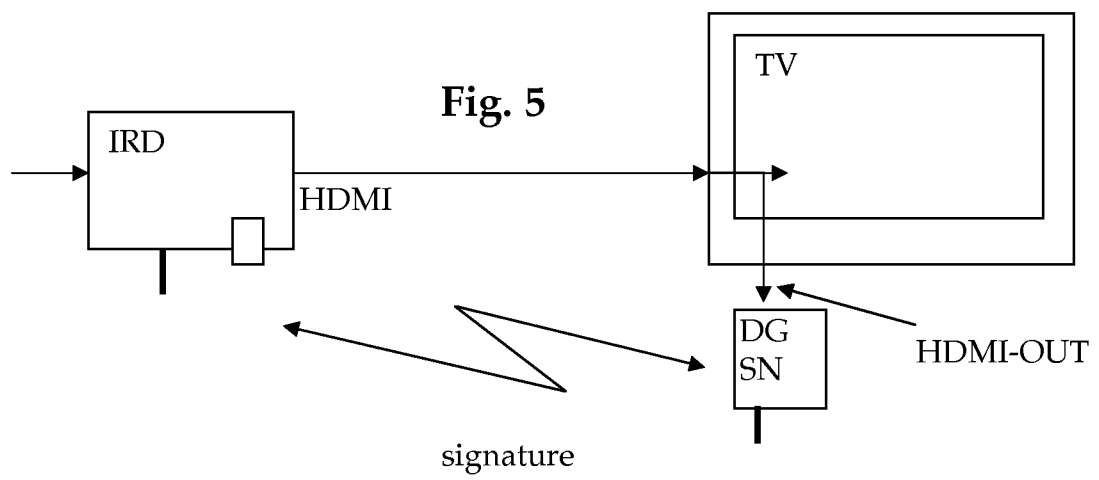
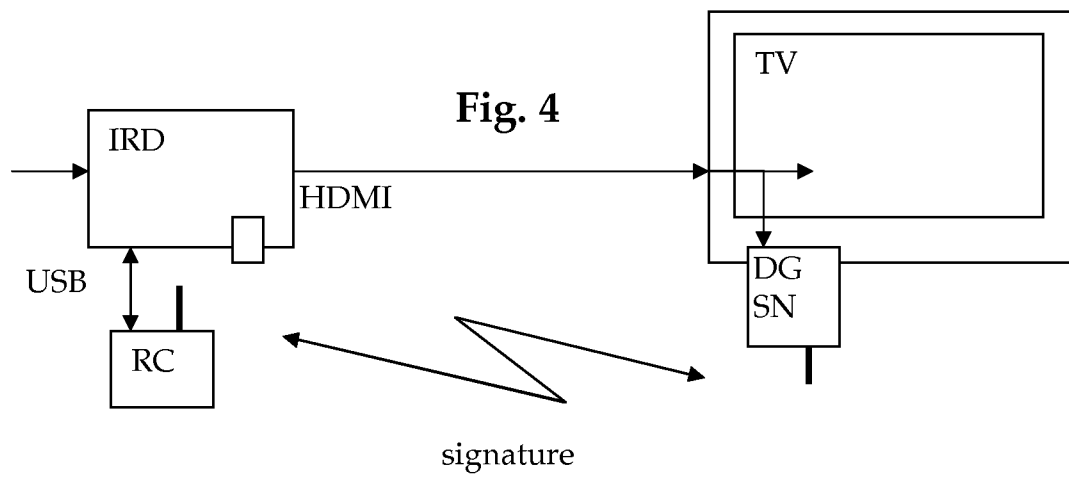
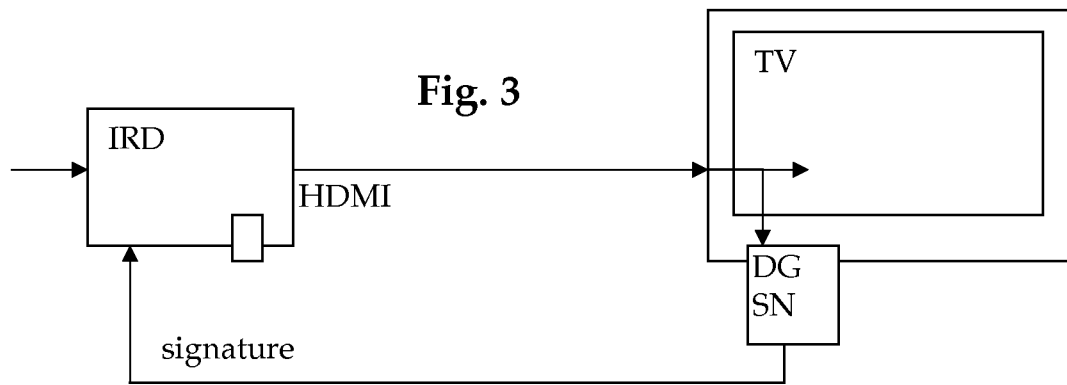


Fig. 6

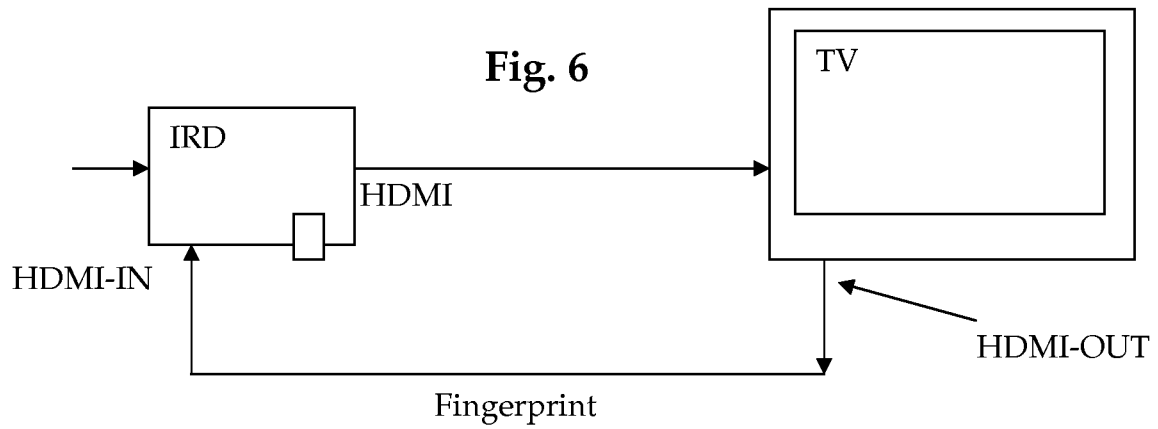


Fig. 7

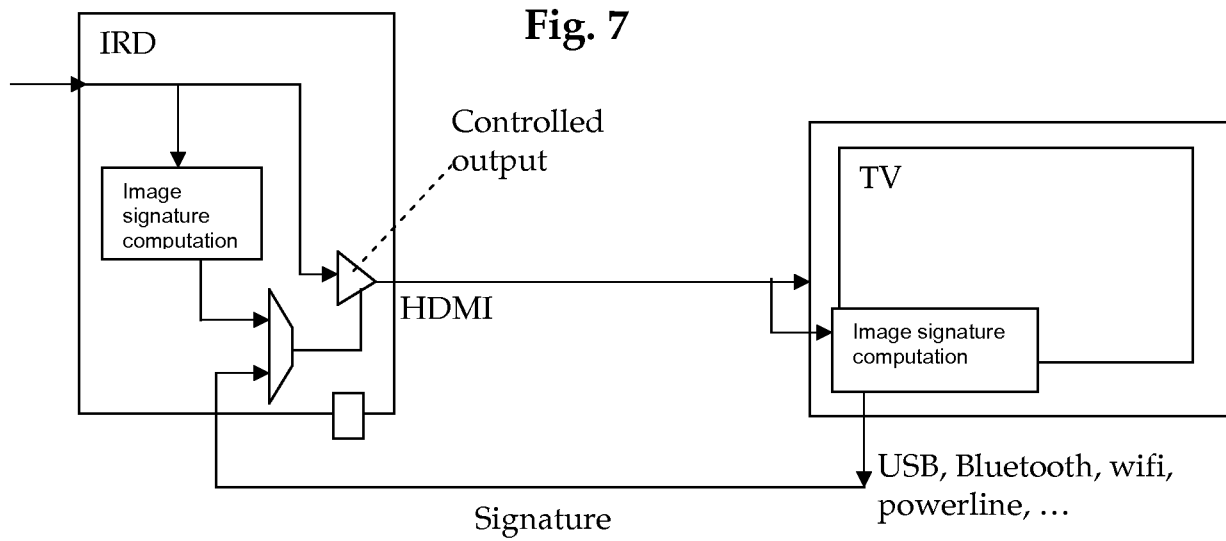
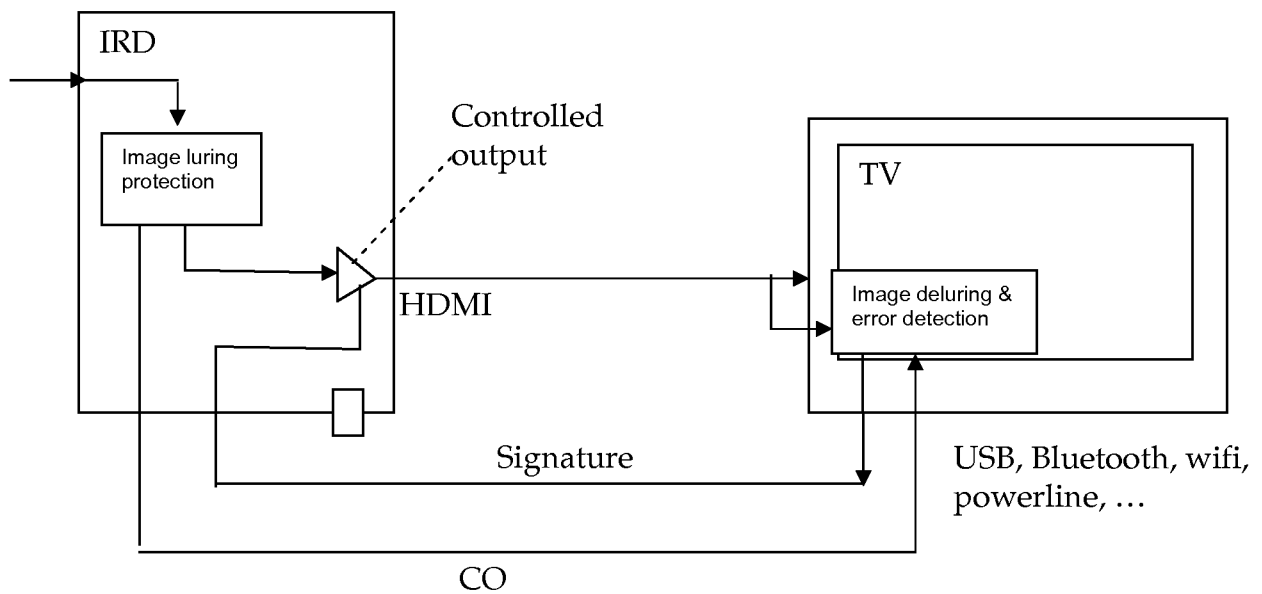


Fig. 8



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2011/060652

A. CLASSIFICATION OF SUBJECT MATTER		
INV. H04N5/913	G11B20/00	H04N7/16 H04N7/173 H04N7/24
H04L9/32		
ADD.		
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 G11B H04L		
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 A	DE 10 2008 003364 AI (FRAUNHOFER GES FORSCHUNG [DE]) 16 July 2009 (2009-07-16) abstract; figures 3,4 paragraph [0056] - paragraph [0059] ; claims 1,3 -----	1-3 ,6-13 4
X A	US 2007/277041 AI (KULESSA RALPH [DE] ET AL) 29 November 2007 (2007-11-29) abstract paragraphs [0004] - [0006] , [0014] , [0015] , [0045] , [0050] , [0053] , [0055] , [0057] -----	1-3 ,6-13 4
X A	US 6 370 209 BI (ZELLER JUERGEN [DE] ET AL) 9 April 2002 (2002-04-09) abstract column 1 column 2, line 55 - column 4, line 19 ----- -/- .	1-3 ,6-13 4
☒ 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
7 October 2011		14/10/2011
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Oel sner, Marti n

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/060652

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2011/060652

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.: 5
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:
see FURTHER INFORMATION sheet PCT/ISA/210

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:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable 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 report covers 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. :

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

Continuation of Box 11.2

Claims Nos.: 5

The meaning of claim 5 is entirely obscure. The description provides no further clarification.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.