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(54) **MULTIMEDIA DEVICE HAVING FLEXIBLE DISPLAY AND CONTROLLING METHOD THEREOF**

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PCT Filed: **Sep. 10, 2013**
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§ 371 (c)(1),
(2) Date: **Dec. 2, 2015**
PCT Pub. No.: **WO2014/200151**
PCT Pub. Date: **Dec. 18, 2014**

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H04N 21/426 (2011.01)
G06F 1/16 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H04N 21/426*** (2013.01); ***G06F 1/1601*** (2013.01); ***G06F 1/1605*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC H04N 21/426; H04N 21/4131; H04N 21/42201; H04N 21/431; H04N 21/44218;
(Continued)

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Primary Examiner — Jeffrey D Carlson

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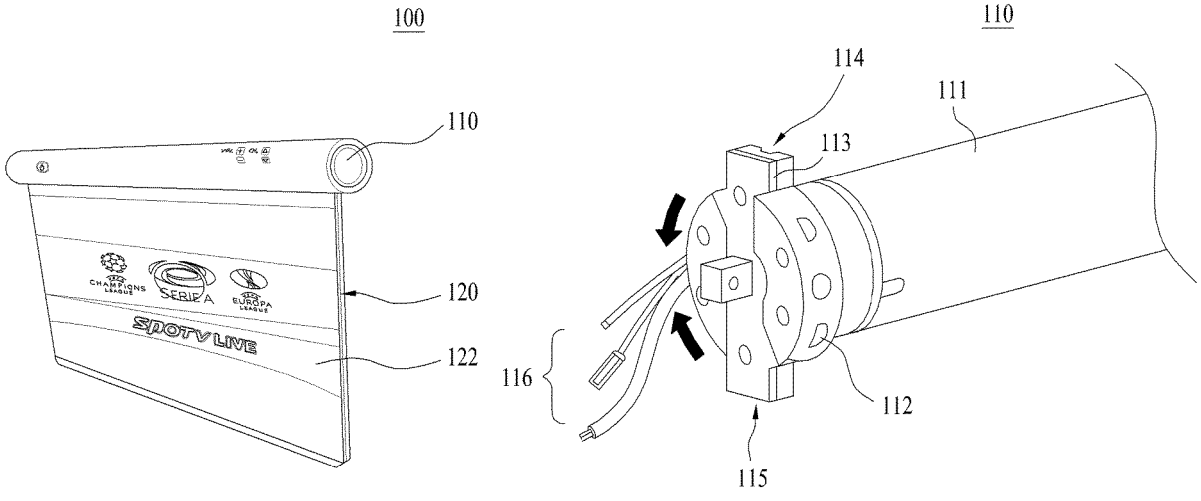
(57) **ABSTRACT**

Disclosed are a multimedia device including a flexible display and controlling method thereof. The present invention includes a guide bar, a flexible display configured to be rolled up on an outer circumference of the guide bar, the flexible display having a first region rolled up on the outer circumference of the guide bar and a second region not rolled up on the outer circumference of the guide bar, a receiving unit configured to receive a content and metadata corresponding to the content from a source device, and a control unit adjusting a vertical width of the second region of the flexible display in accordance with a preset condition.

30 Claims, 16 Drawing Sheets



(51) **Int. Cl.**

G06F 3/01	(2006.01)
G06F 3/03	(2006.01)
G06F 3/0346	(2013.01)
G09G 3/00	(2006.01)
H04N 5/64	(2006.01)
H04N 7/01	(2006.01)
H04N 21/41	(2011.01)
H04N 21/422	(2011.01)
H04N 21/431	(2011.01)
H04N 21/442	(2011.01)
H04N 21/485	(2011.01)
H04N 21/488	(2011.01)

(52) **U.S. Cl.**

CPC ***G06F 1/1652*** (2013.01); ***G06F 3/013*** (2013.01); ***G06F 3/017*** (2013.01); ***G06F 3/0304*** (2013.01); ***G06F 3/0346*** (2013.01); ***G09G 3/00*** (2013.01); ***H04N 5/64*** (2013.01); ***H04N 7/0122*** (2013.01); ***H04N 21/4131*** (2013.01); ***H04N 21/42201*** (2013.01); ***H04N 21/431*** (2013.01); ***H04N 21/44218*** (2013.01); ***H04N 21/4858*** (2013.01); ***H04N 21/4884*** (2013.01); ***H04N 21/4886*** (2013.01); *G09G 2340/0442* (2013.01); *G09G 2380/02* (2013.01); *H04N 21/4852* (2013.01)

(58) **Field of Classification Search**

CPC H04N 21/4858; H04N 21/4884; H04N 21/4886; H04N 7/0122; H04N 5/64; H04N 21/4852; G09G 3/00; G09G 2340/0442; G09G 2380/02; G06F 1/1605; G06F 1/1652; G06F 3/013; G06F 3/017; G06F 3/0304; G06F 3/0346; G06F 1/1601; G06F 1/16

See application file for complete search history.

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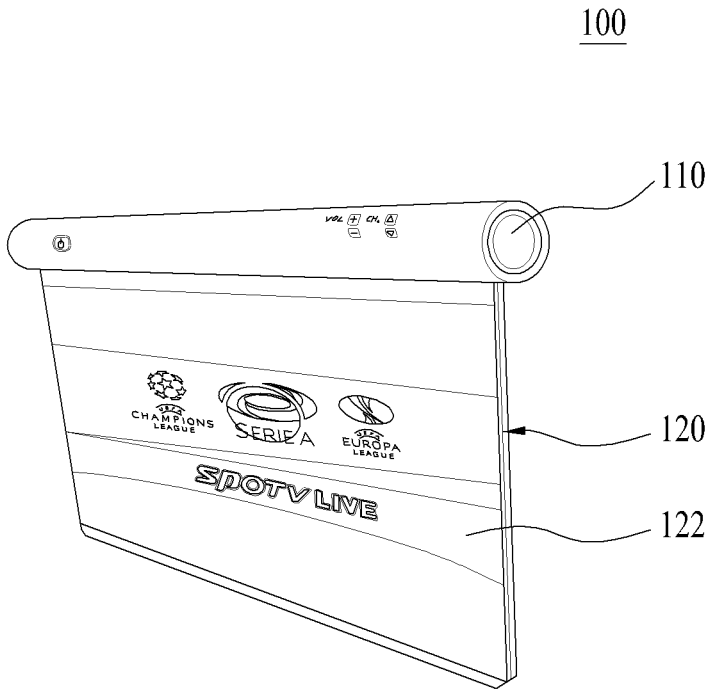
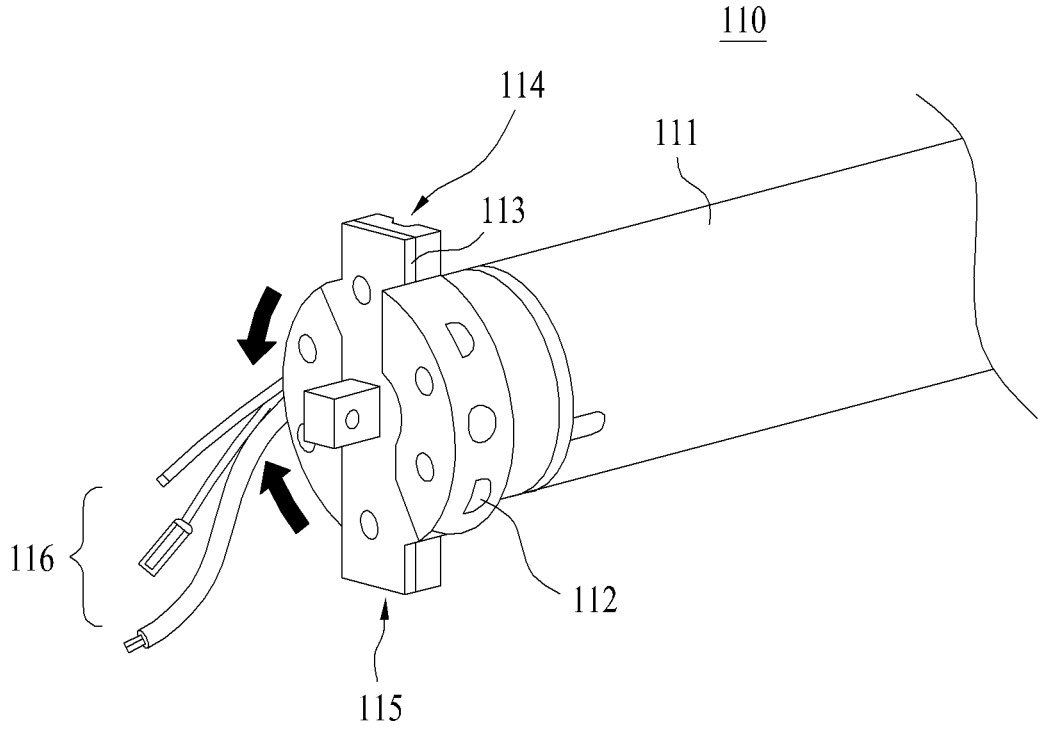
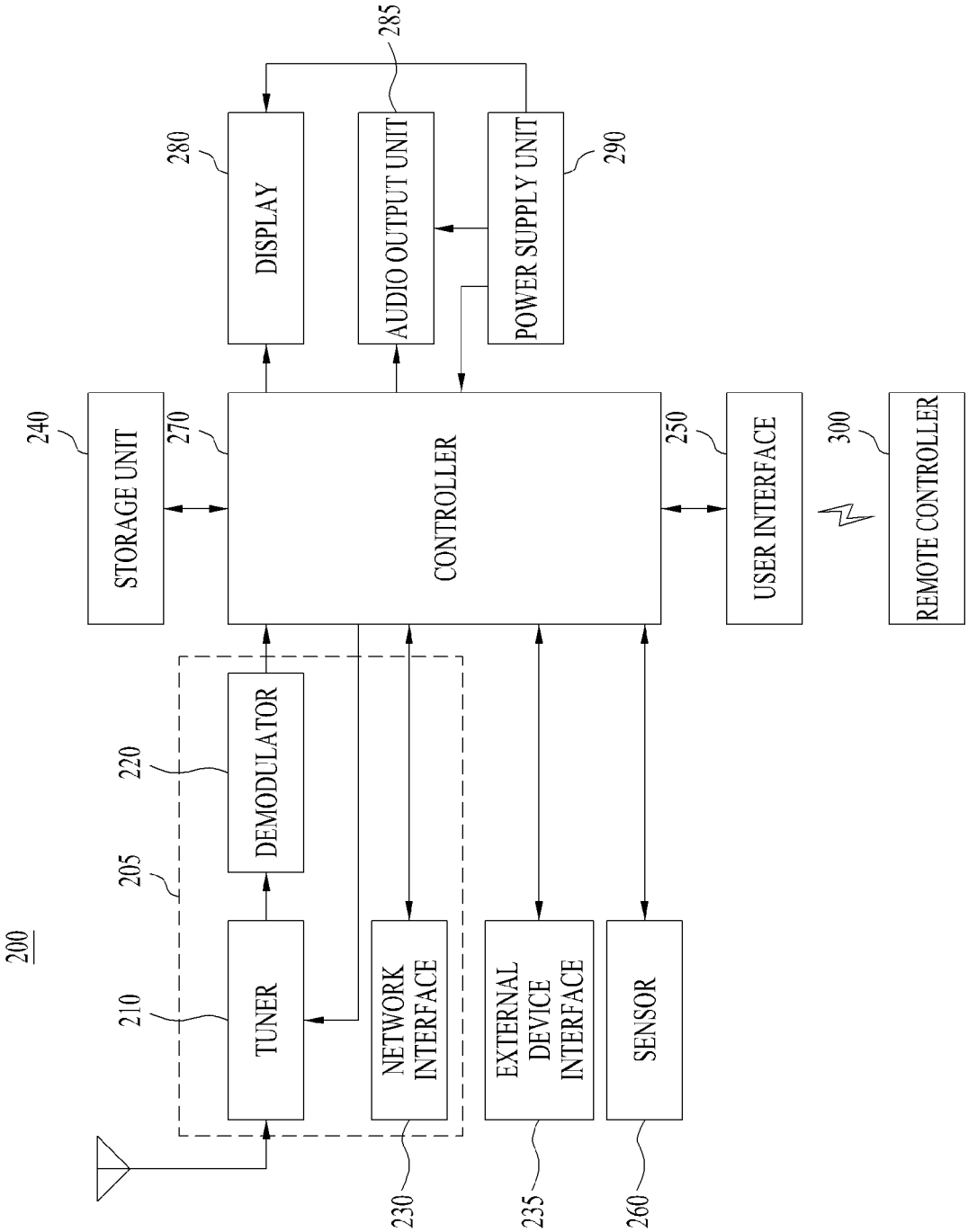
[Fig. 1a]



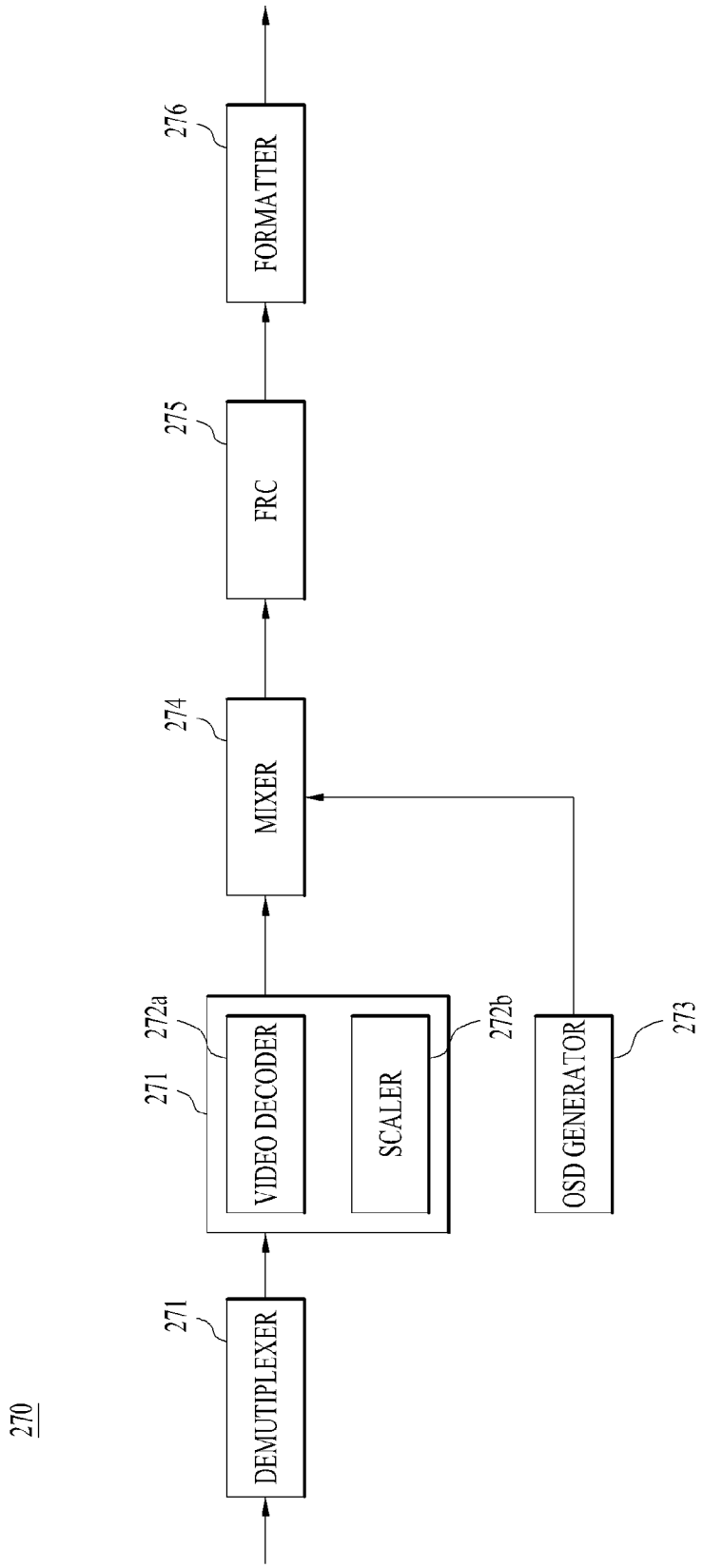
[Fig. 1b]



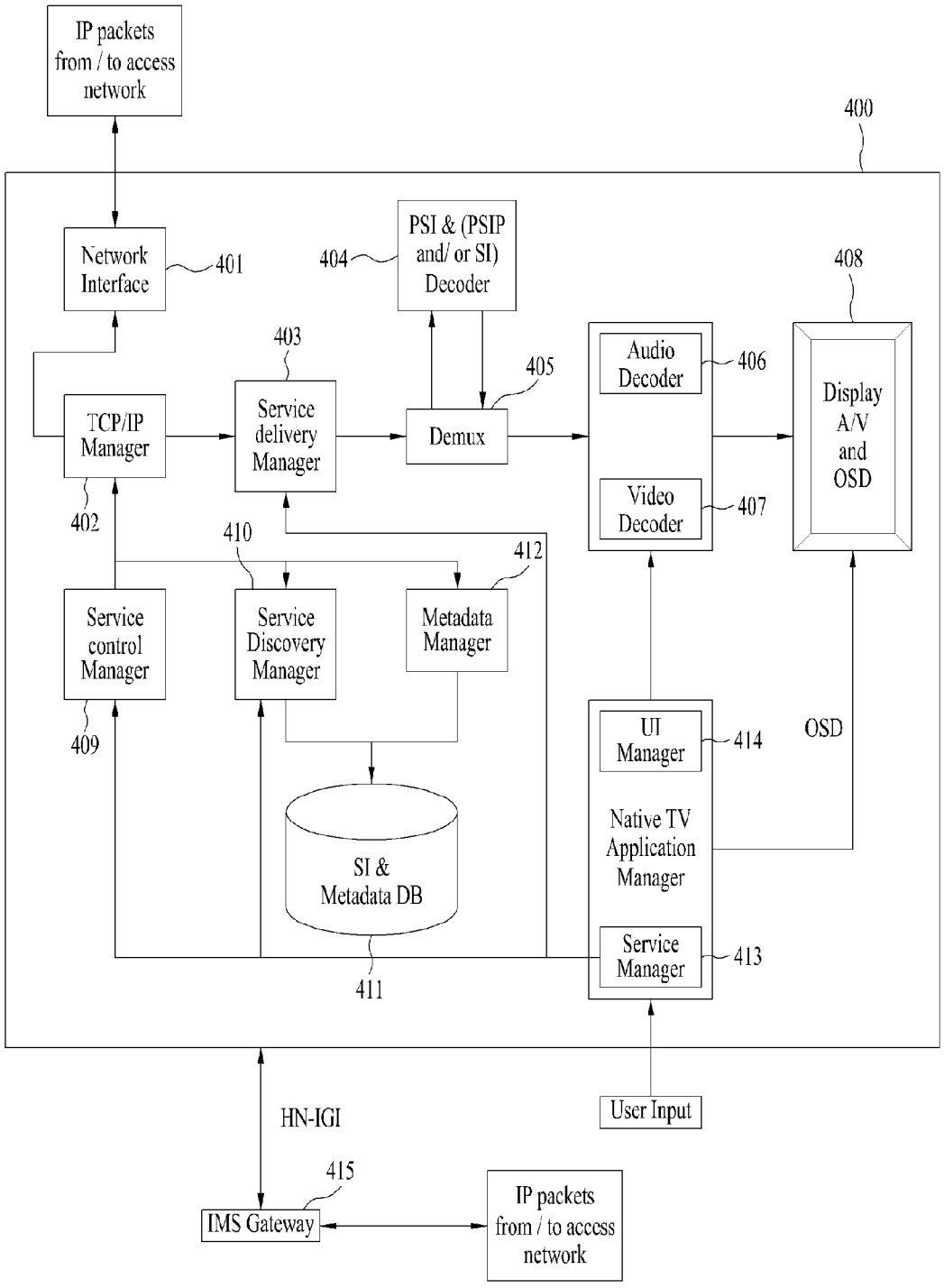
[Fig. 2]


200
205
210
TUNER
220
DEMODULATOR
230
NETWORK INTERFACE
235
EXTERNAL DEVICE INTERFACE
260
SENSOR
240
STORAGE UNIT
270
CONTROLLER
250
USER INTERFACE
300
REMOTE CONTROLLER
280
DISPLAY
285
AUDIO OUTPUT UNIT
290
POWER SUPPLY UNIT

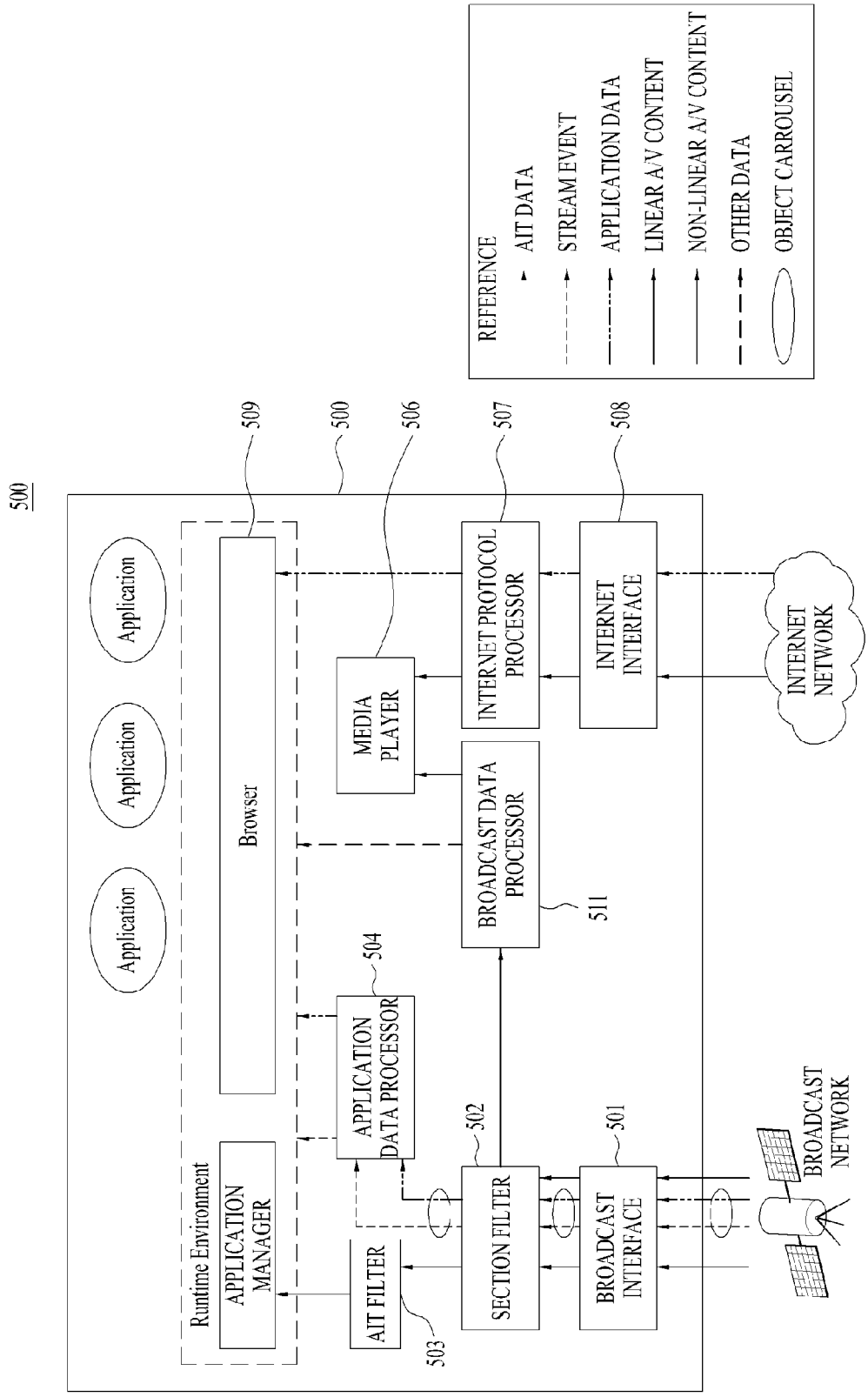
[Fig. 3]


270
271
DEMUTIPLEXER
271
272a
VIDEO DECODER
272b
SCALER
273
OSD GENERATOR
274
MIXER
275
FRC
276
FORMATTER

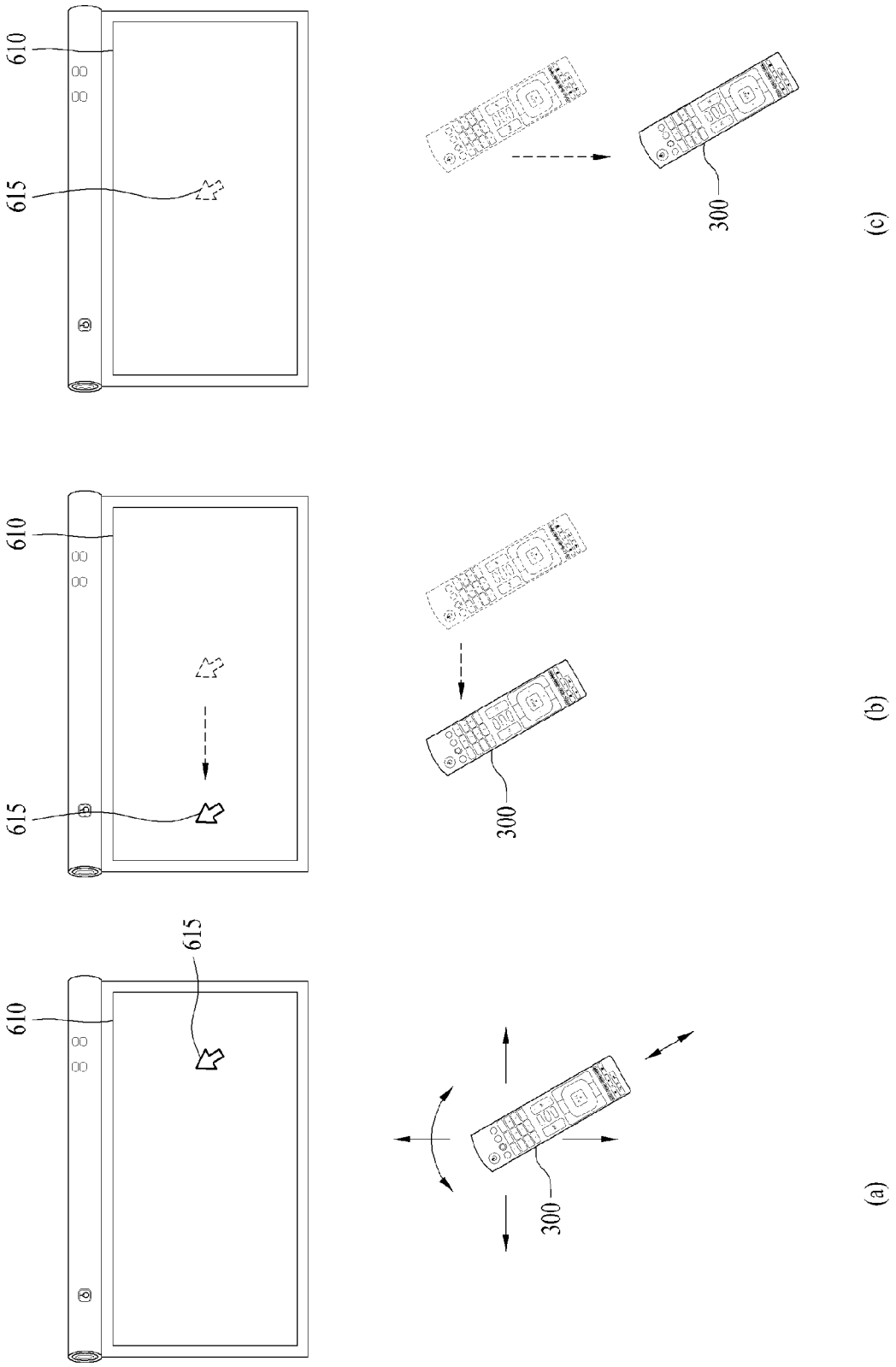
[Fig. 4]


IP packets from / to access network
400
Network Interface
401
PSI & (PSIP and/ or SI) Decoder
404
408
403
405
Audio Decoder
406
Display A/V and OSD
TCP/IP Manager
Service delivery Manager
Demux
Video Decoder
407
402
410
412
Service control Manager
Service Discovery Manager
Metadata Manager
409
UI Manager
414
OSD
Native TV Application Manager
SI & Metadata DB
Service Manager
413
411
HN-IGI
User Input
415
IMS Gateway
IP packets from / to access network

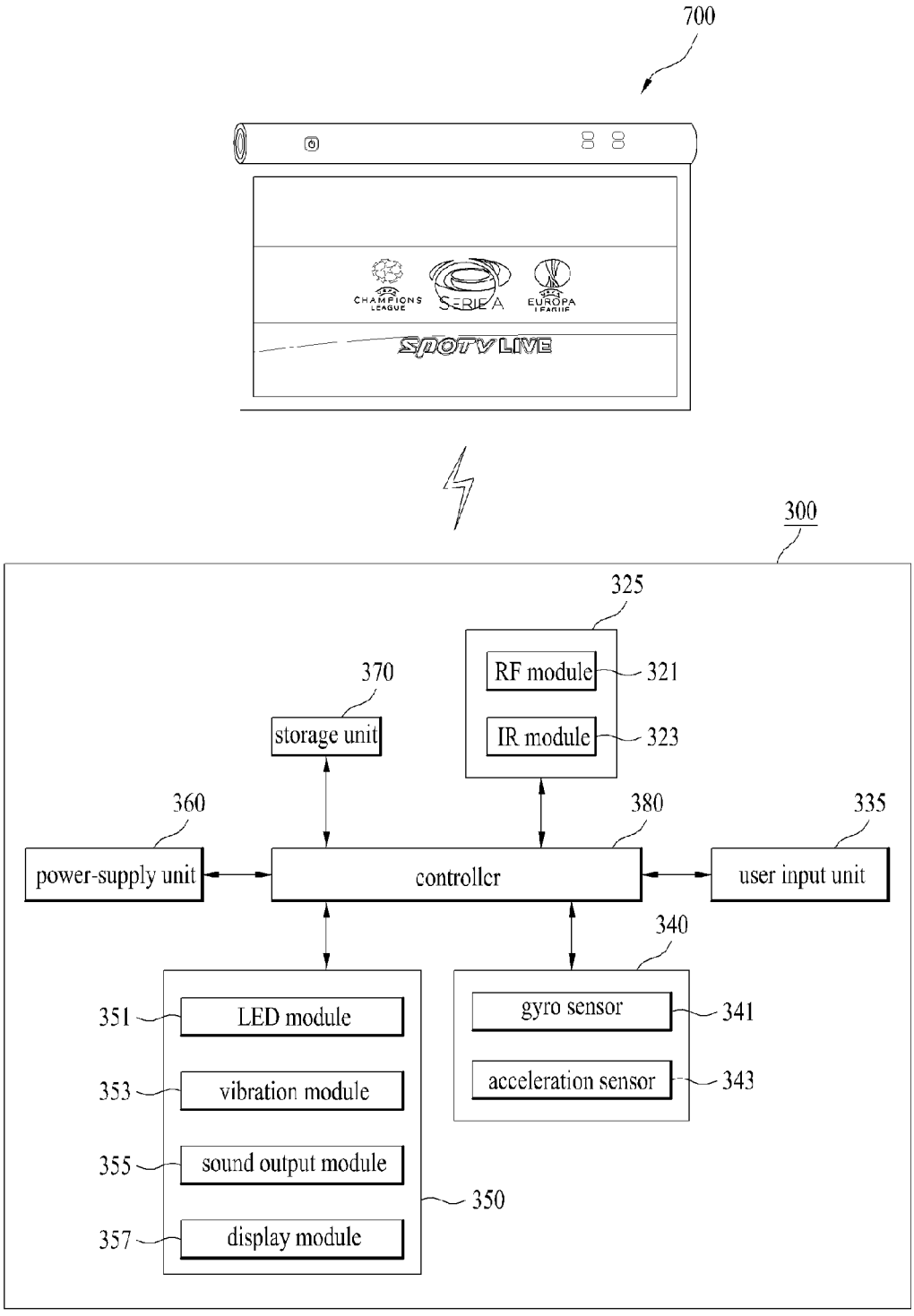
[Fig. 5]


500
509
500
506
507
508
REFERENCE
AIT DATA
STREAM EVENT
APPLICATION DATA
LINEAR A/V CONTENT
NON-LINEAR A/V CONTENT
OTHER DATA
OBJECT CARROUSEL
Application
Application
Application
Runtime Environment
APPLICATION MANAGER
Browser
APPLICATION DATA PROCESSOR
504
AIT FILTER
503
SECTION FILTER
502
BROADCAST INTERFACE
501
MEDIA PLAYER
BROADCAST DATA PROCESSOR
511
INTERNET PROTOCOL PROCESSOR
INTERNET INTERFACE
INTERNET NETWORK
BROADCAST NETWORK

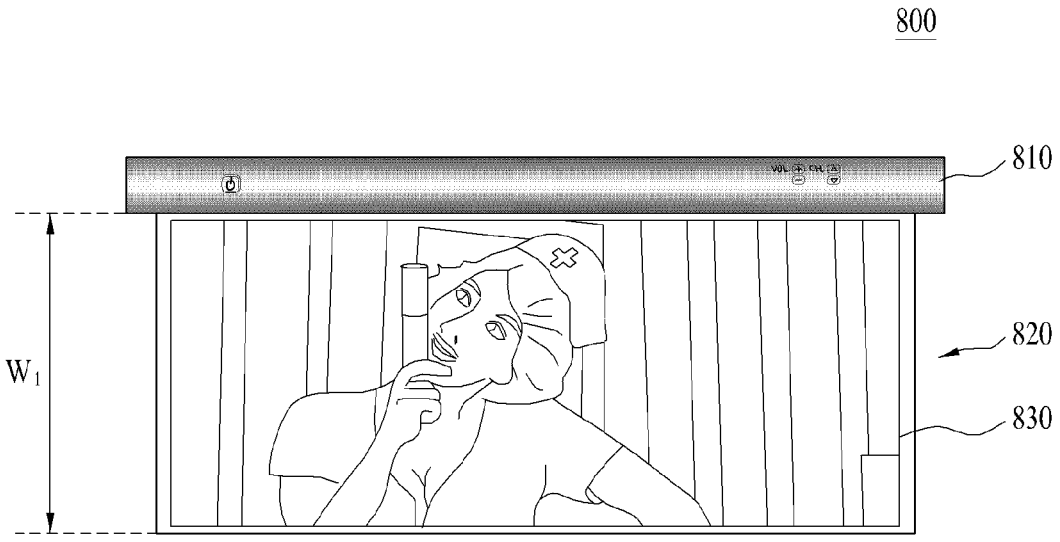
[Fig. 6]



[Fig. 7]


700
CHAMPIONS LEAGUE
SERIE A
EUROPA LEAGUE
SKY TV LIVE
300
325
RF module
321
IR module
323
370
storage unit
360
power-supply unit
380
controller
335
user input unit
340
gyro sensor
341
acceleration sensor
343
351
LED module
353
vibration module
355
sound output module
357
display module
350

[Fig. 8]



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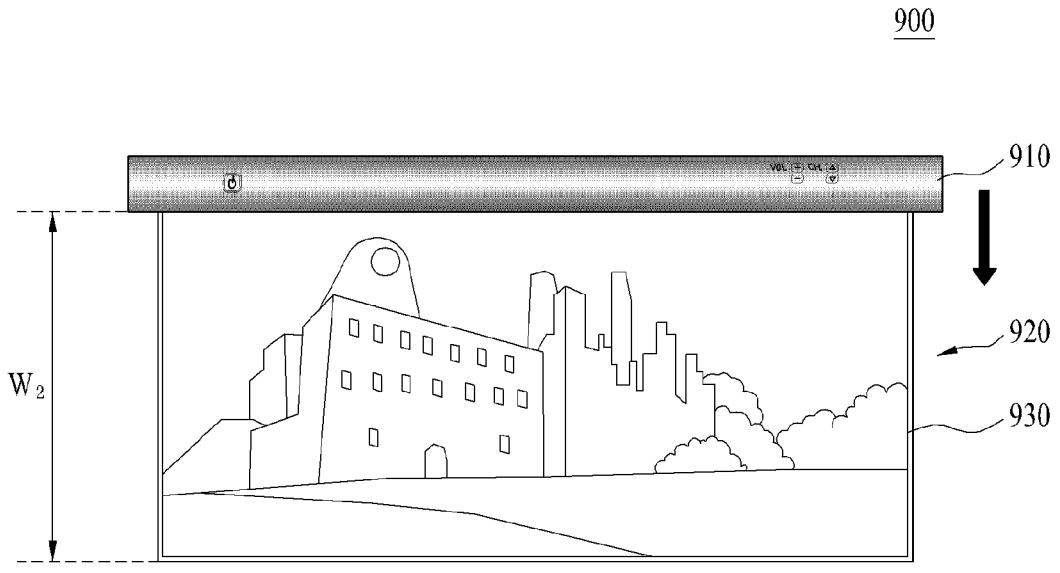
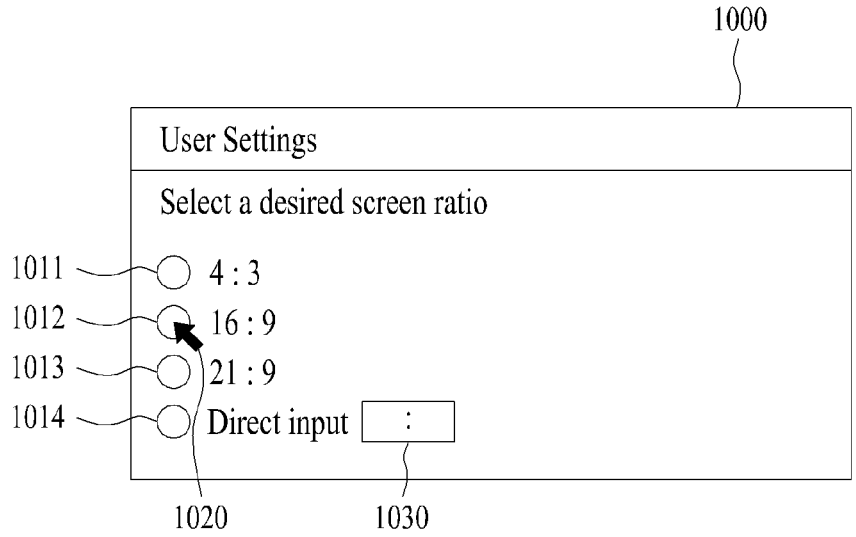
[Fig. 9]

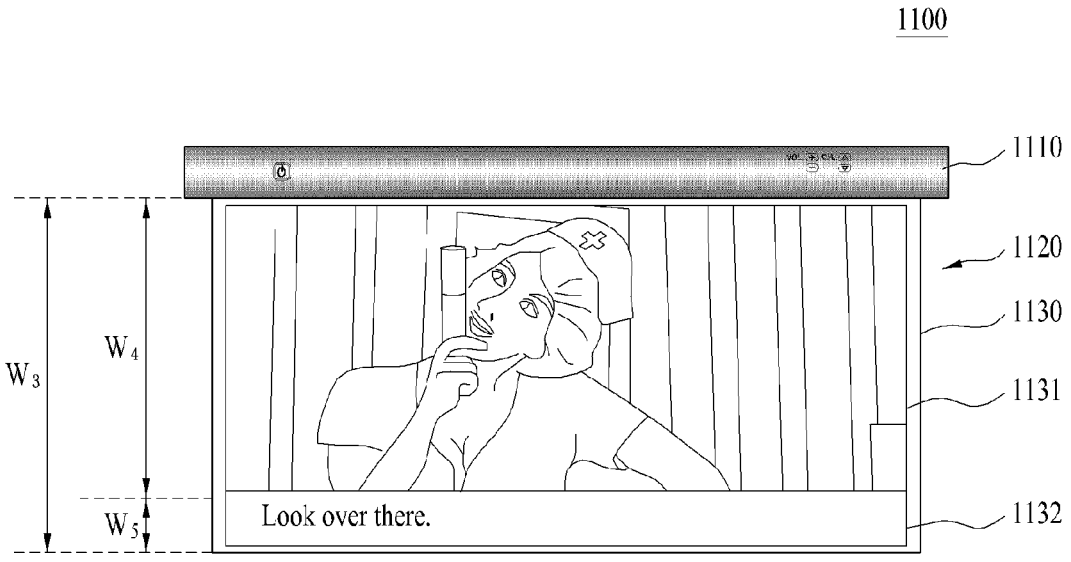


< 16 : 9 >

[Fig. 10]


1000
User Settings
Select a desired screen ratio
1011
4 : 3
1012
16 : 9
1013
21 : 9
1014
Direct input
:
1020
1030

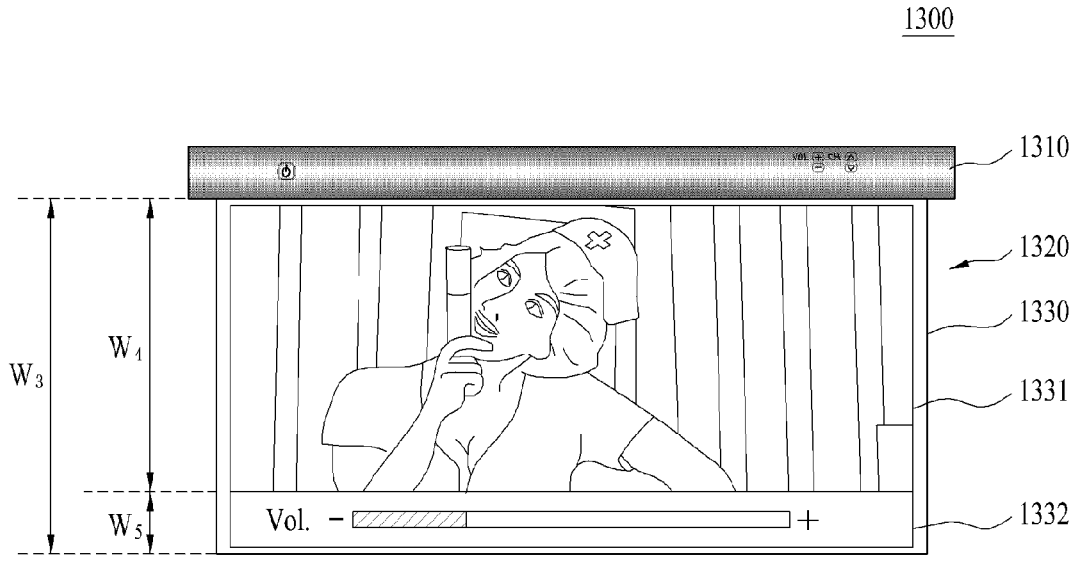
[Fig. 11]


1100
1110
1120
1130
1131
1132
W3
W4
W5
Look over there.

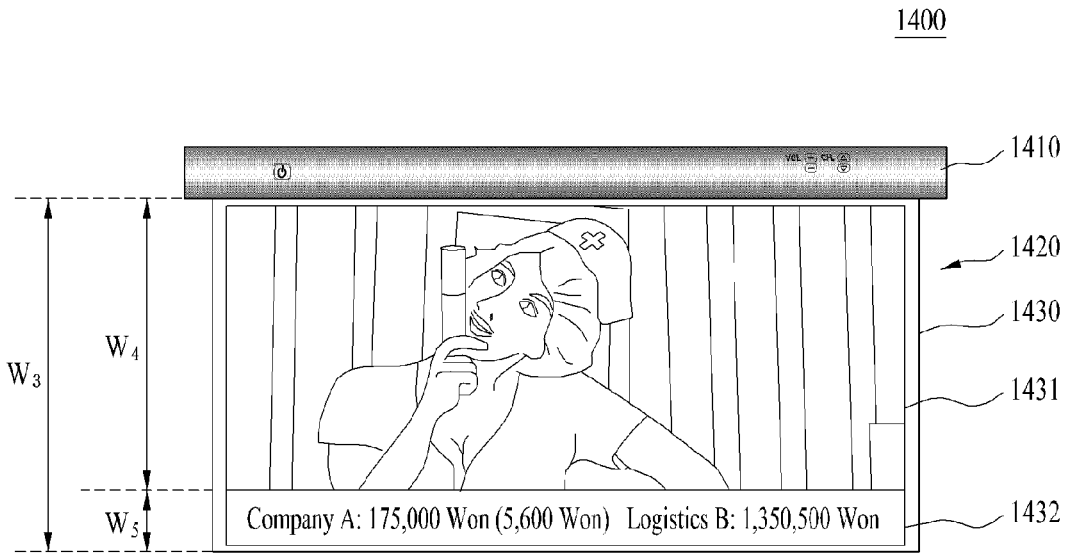
[Fig. 12]

1200
1210
1220
1230
1231
1232
W4
W3
W5
Look over there.
저 곳을 봐.

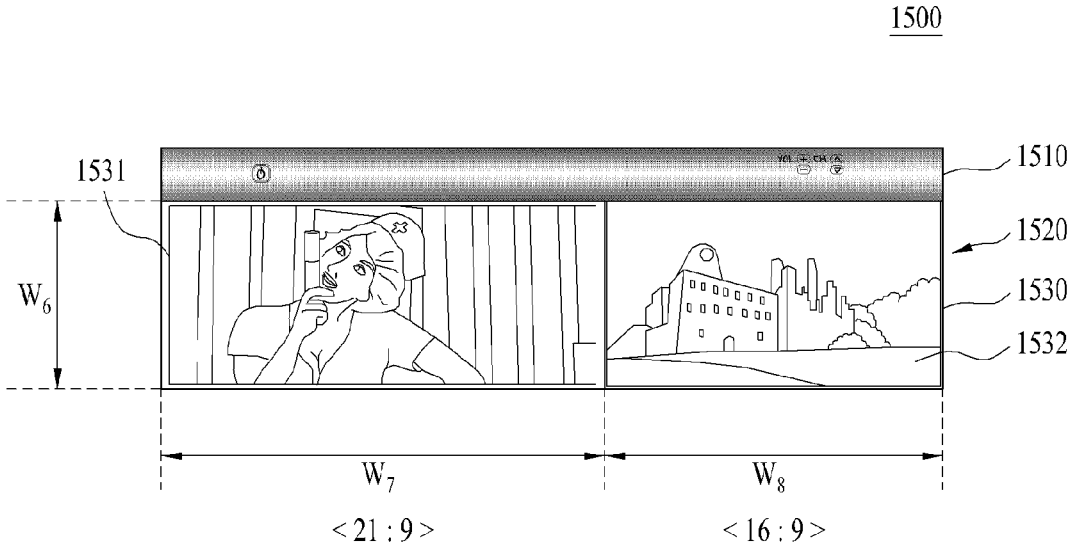
[Fig. 13]


1300
1310
1320
1330
1331
1332
W4
W3
W5
Vol. − +

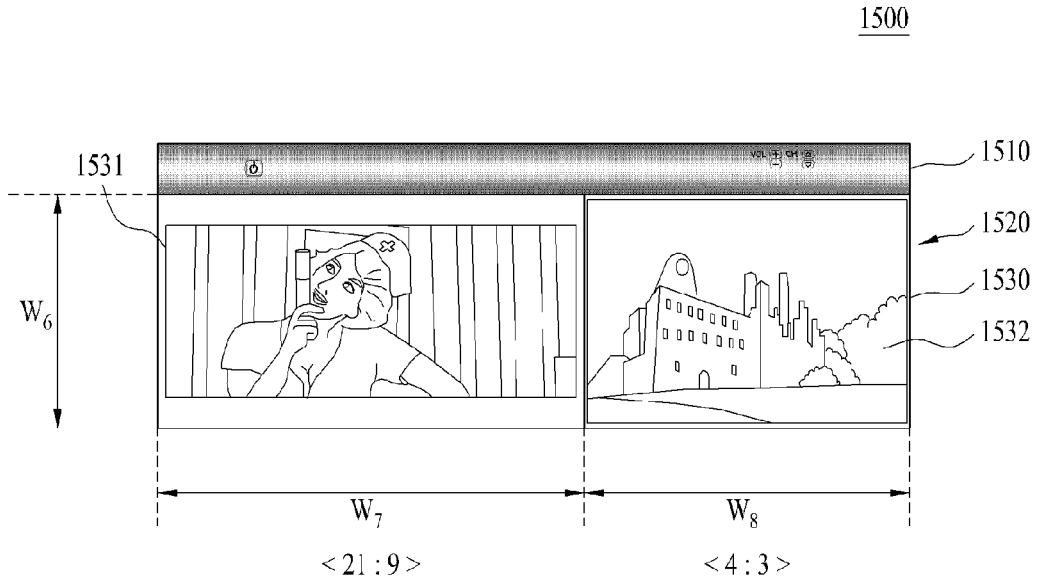
[Fig. 14]


1400
1410
1420
1430
1431
1432
W3
W4
W5
Company A: 175,000 Won (5,600 Won) Logistics B: 1,350,500 Won

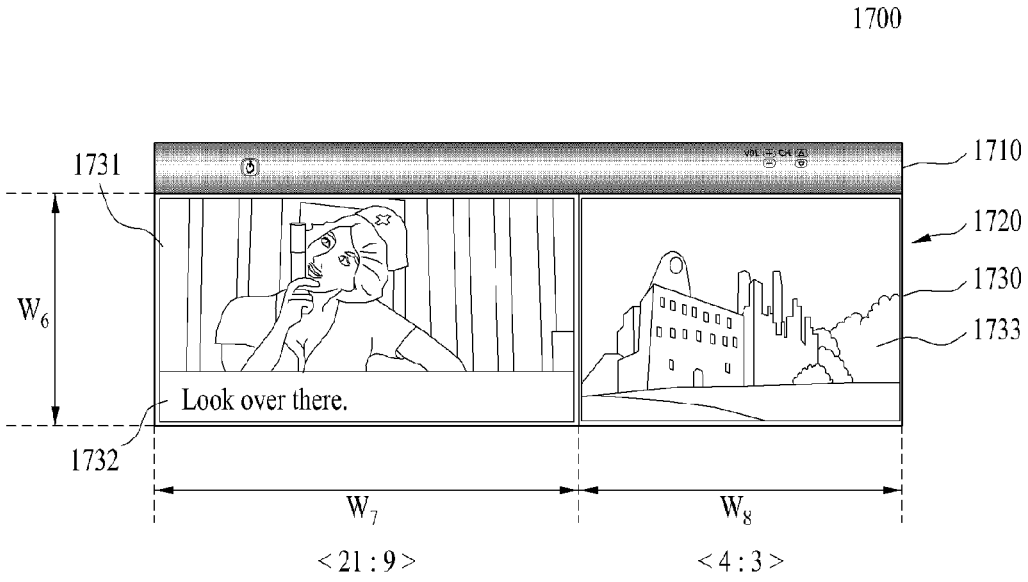
[Fig. 15]


1500
1510
1520
1530
1531
1532
W6
W7
W8
< 21 : 9 >
< 16 : 9 >

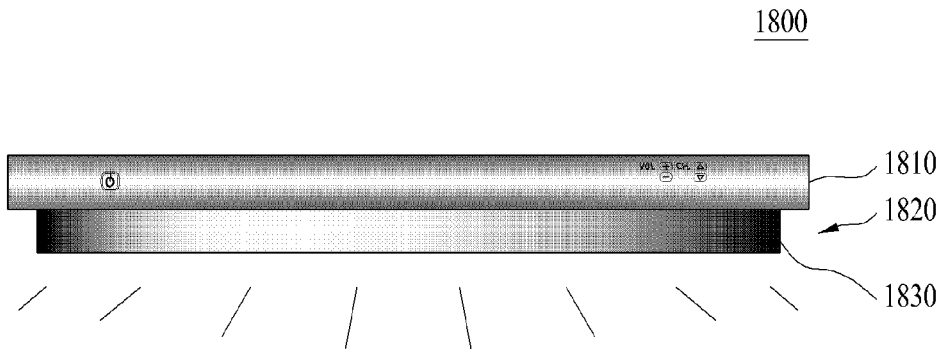
[Fig. 16]



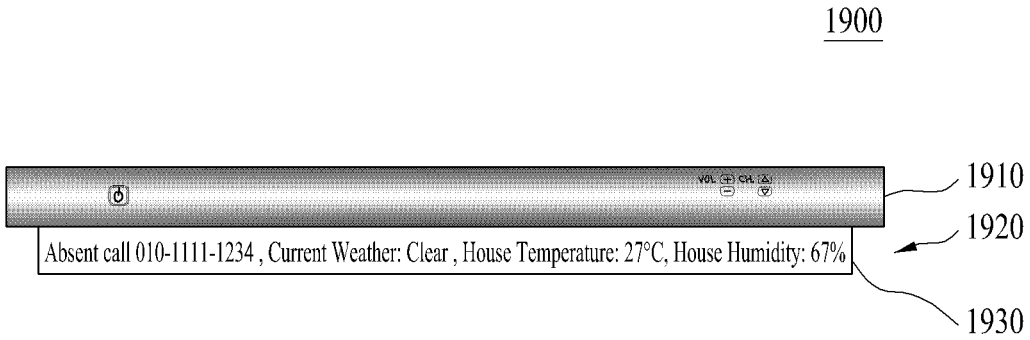
[Fig. 17]



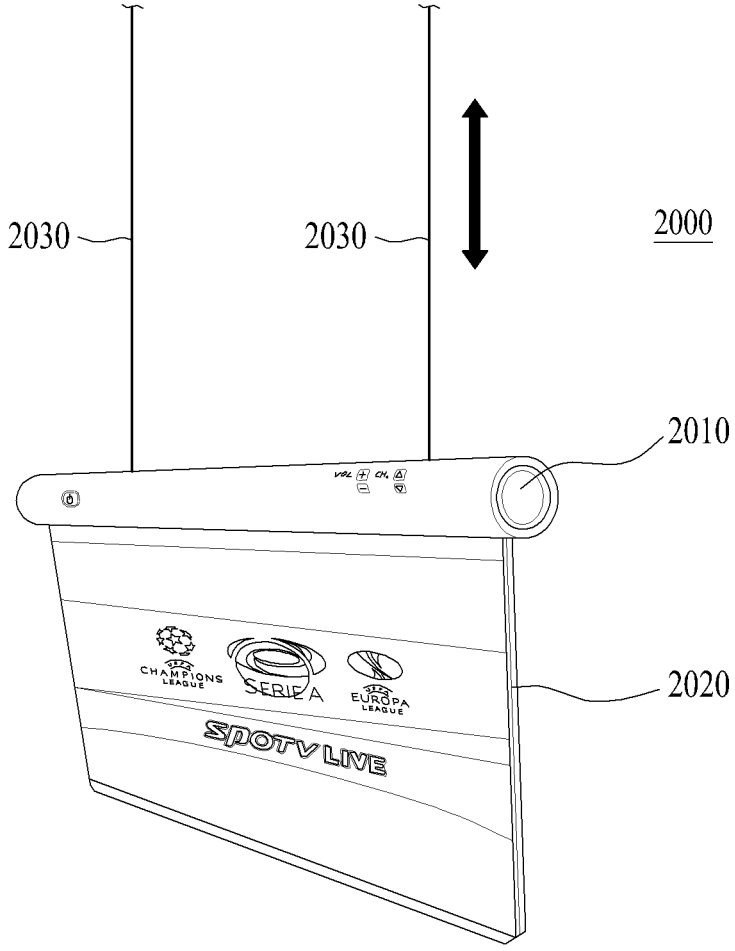
[Fig. 18]



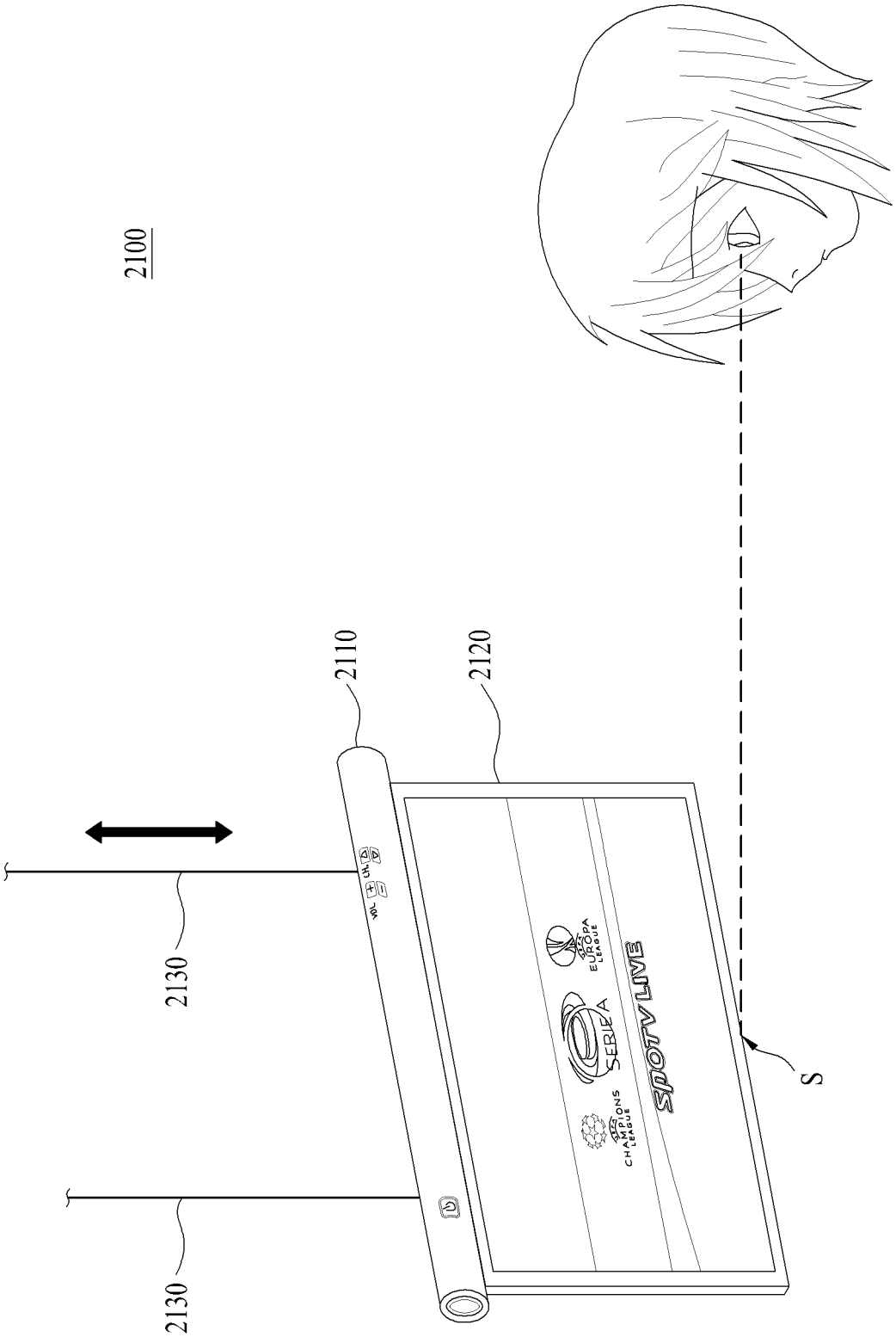
[Fig. 19]


1900
1910
1920
1930
Absent call 010-1111-1234 , Current Weather: Clear , House Temperature: 27°C, House Humidity: 67%

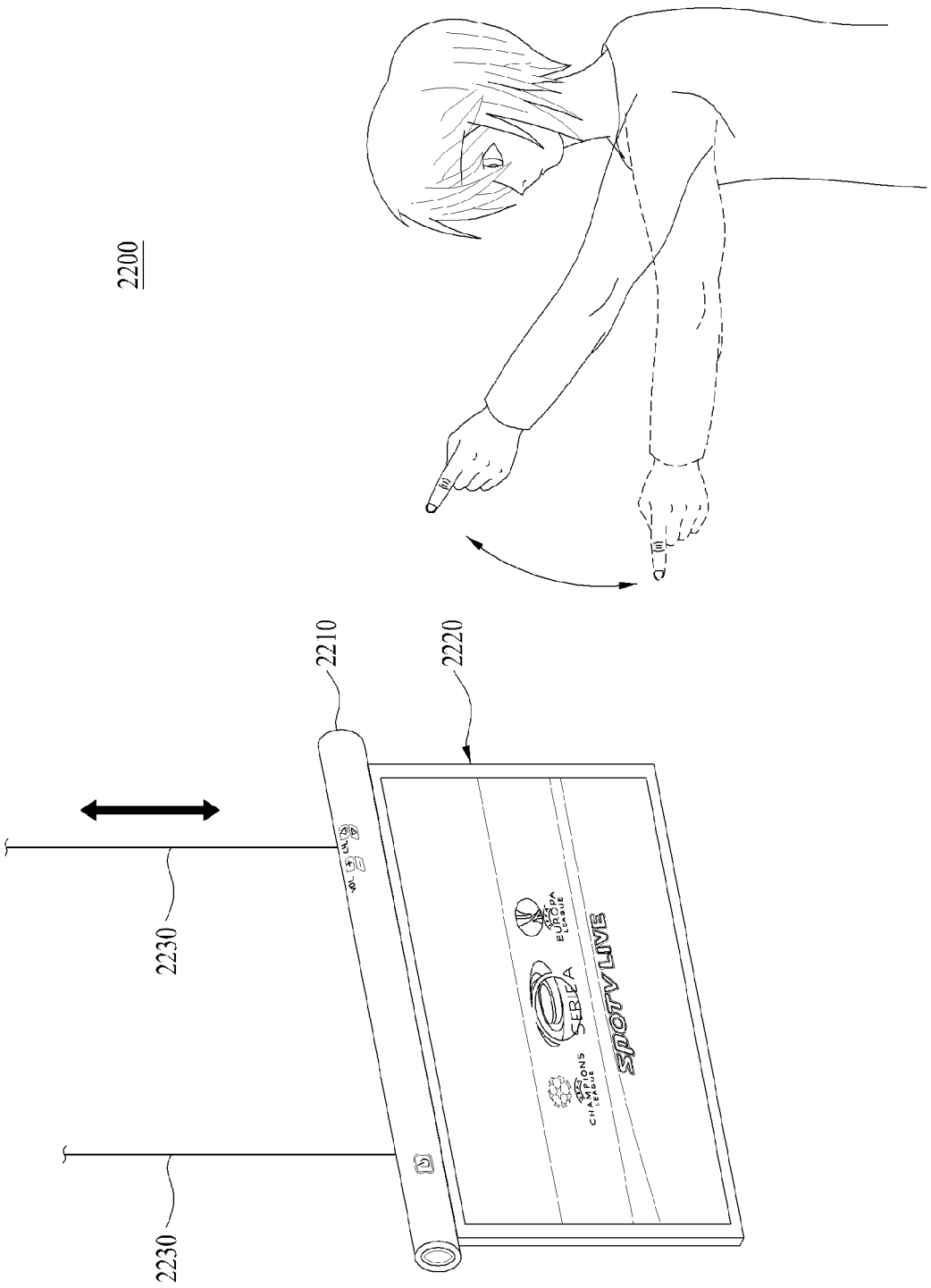
[Fig. 20]


2030
2030
2000
2010
2020
CHAMPIONS LEAGUE
SERIE A
EUROPA LEAGUE
SPOTV LIVE

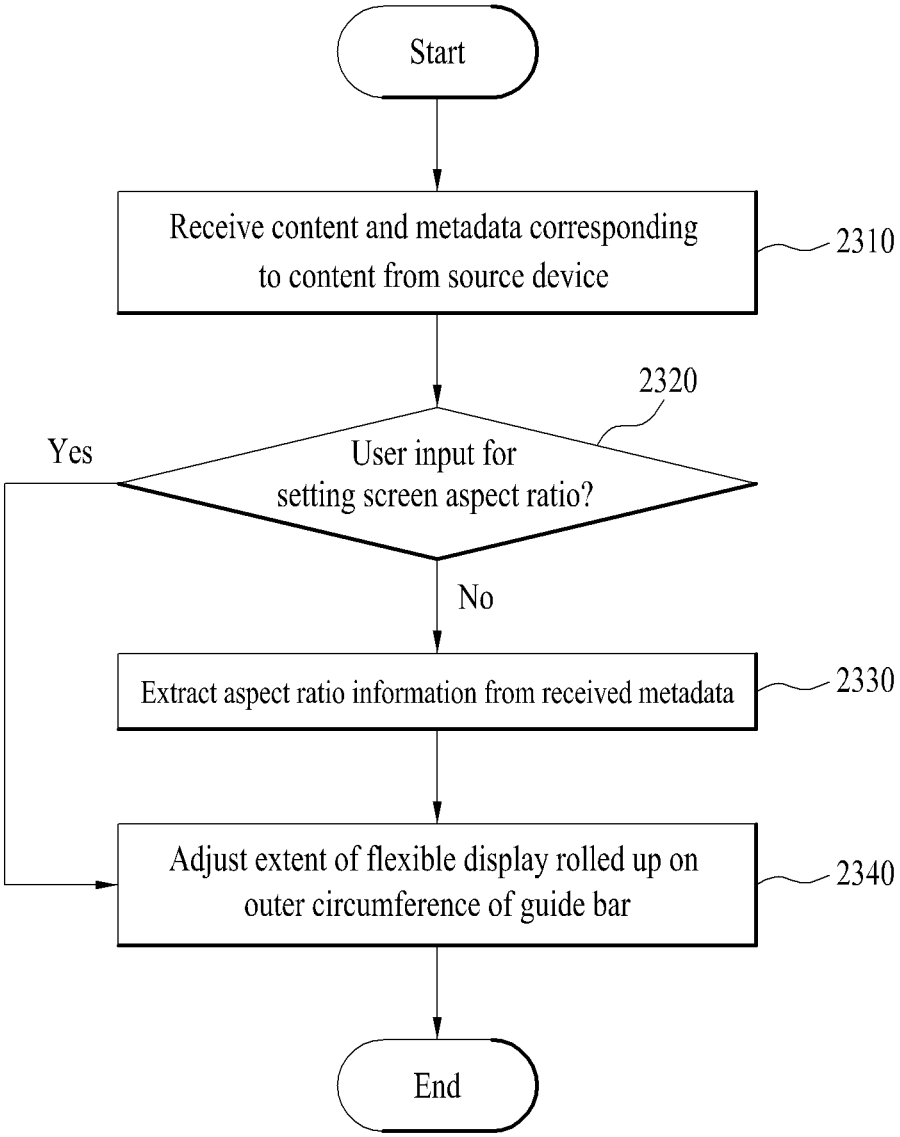
[Fig. 21]


2100
2110
2120
2130
2130
S
SPORTLIVE
SERIE A
EUROPA LEAGUE
CHAMPIONS LEAGUE

[Fig. 22]


2200
2210
2220
2230
2230
SPORTLIVE
SERIE A
UEFA EUROPA LEAGUE
UEFA CHAMPIONS LEAGUE

[Fig. 23]


Start
Receive content and metadata corresponding to content from source device
2310
2320
User input for setting screen aspect ratio?
Yes
No
Extract aspect ratio information from received metadata
2330
Adjust extent of flexible display rolled up on outer circumference of guide bar
2340
End

MULTIMEDIA DEVICE HAVING FLEXIBLE DISPLAY AND CONTROLLING METHOD THEREOF

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

CROSS-REFERENCE TO RELATED APPLICATIONS

This Application is a Reissue of U.S. Pat. No. 9,860,474 issued on Jan. 2, 2018, which is the National Phase of PCT International Application No. PCT/KR2013/008153 filed on Sep. 10, 2013, which claims the priority benefit under 35 U.S.C. § 119(a) to Korean Patent Application No. 10-2013-0065936 filed in the Republic of Korea on Jun. 10, 2013.

TECHNICAL FIELD

The present invention relates to a multimedia device and controlling method thereof, and more particularly, to a multimedia device including a flexible display and controlling method thereof. Although the present invention is suitable for a wide scope of applications, it is particularly suitable for rolling up the flexible display. For example, the multimedia device may include one of a network TV, a smart TV, a hybrid broadcast broadband television (HBBTV), and internet TV, a web TV, an internet protocol television (IPTV) and the like.

BACKGROUND ART

Generally, a multimedia device is equipped with a function of receiving and processing a user-viewable broadcast image. Recently, analog broadcasting tends to be replaced by digital broadcasting in many countries including Republic of Korea and the like.

Digital broadcasting means the broadcasting of transmitting digital video and audio signals. Since the digital broadcasting is stronger against external noise than the analog broadcasting, the digital broadcasting has data loss less than that of the analog broadcasting. The digital broadcasting is more advantageous than the analog broadcasting in error correction. The digital broadcasting has resolution higher than that of the analog broadcasting. And, the digital broadcasting provides a screen image clearer than that of the analog broadcasting. Moreover, the digital broadcasting is capable of interactive services unlike the analog broadcasting. Recently, there are many ongoing discussions on a smart TV in which an image display device function and a multimedia device function are integrated or combined with each other.

Meanwhile, hard types of displays have been mainly used. However, since it is impossible to change an exterior shape of a hard type display, a blank is left on top, bottom, right and/or left side of a screen depending on an aspect ratio of a content displayed on the display, whereby immersion in the content is disturbed. Recently, a flexible display, which can be bent or curved, is ready to be commercialized.

SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to a multimedia device and controlling method thereof that may

substantially obviate one or more of the problems due to limitations and disadvantages of the related art.

An object of the present invention is to provide a multimedia device and controlling method thereof, by which a solution for adjusting a screen region in a display to fit into an optimized aspect ratio of a content can be provided.

[Another object of the present invention is to provide a multimedia device and controlling method thereof, by which a solution for adjusting a height of a display to fit into a user's eye height can be provided.

A further object of the present invention is to provide a method of utilizing a display in a standby mode of a multimedia device.

Technical tasks obtainable from the present invention are non-limited the above mentioned effect. And, other unmentioned technical tasks s can be clearly understood from the following description by those having ordinary skill in the technical field to which the present invention pertains.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims thereof as well as the appended drawings.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, a multimedia device according to one embodiment of the present invention includes a guide bar, a flexible display configured to be rolled up on an outer circumference of the guide bar, the flexible display having a first region rolled up on the outer circumference of the guide bar and a second region not rolled up on the outer circumference of the guide bar, a receiving unit configured to receive a content and metadata corresponding to the content from a source device, and a control unit adjusting a vertical width of the second region of the flexible display in accordance with a preset condition.

To further achieve these and other advantages and in accordance with the purpose of the present invention, a method of controlling a multimedia device, which includes a guide bar and a flexible display configured to be rolled up on an outer circumference of the guide bar, according to another embodiment of the present invention includes the steps of receiving a content and metadata corresponding to the content from a source device, extracting an aspect ratio information from the received metadata, and adjusting an extent of the flexible display rolled up on the outer circumference of the flexible display in accordance with the extracted aspect ratio information.

To further achieve these and other advantages and in accordance with the purpose of the present invention, a method of controlling a multimedia device, which includes a guide bar and a flexible display configured to be rolled up on an outer circumference of the guide bar, according to a further embodiment of the present invention includes the steps of receiving a content and metadata corresponding to the content from a source device, receiving a command signal for selecting an aspect ratio of a screen in the flexible display, and adjusting an extent of the flexible display rolled up on the outer circumference of the flexible display in accordance with the received command signal.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

Accordingly, the present invention provides the following effects and/or features.

First of all, according to one embodiment of the present invention, a solution for adjusting a screen region in a display to fit into an optimized aspect ratio of a content is provided.

Secondly, according to another embodiment of the present invention, a solution for adjusting a height of a display to fit into a user's eye height is provided.

Thirdly, according to a further embodiment of the present invention, a method of utilizing a display in a standby mode of a multimedia device is provided.

Effects obtainable from the present invention are non-limited the above mentioned effect. And, other unmentioned effects can be clearly understood from the following description by those having ordinary skill in the technical field to which the present invention pertains.

It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. The above and other aspects, features, and advantages of the present invention will become more apparent upon consideration of the following description of preferred embodiments, taken in conjunction with the accompanying drawing figures as follows.

FIG. **1**a is a diagram for one example of a multimedia device including a flexible display according to one embodiment of the present invention.

FIG. **1**b is a diagram of a portion of a guide bar included in the multimedia device shown in FIG. **1**a.

FIG. **2** is a diagram of component modules of a multimedia device according to one embodiment of the present invention.

FIG. **3** is a detailed diagram of component modules of a control unit shown in FIG. **2**.

FIG. **4** is a diagram for another example of component modules of a multimedia device including a flexible display according to one embodiment of the present invention.

FIG. **5** is a diagram for a further example of component modules of a multimedia device including a flexible display according to one embodiment of the present invention.

FIG. **6** is a diagram of an exterior of a remote controller configured to control a multimedia device including a flexible display according to one embodiment of the present invention.

FIG. **7** is a detailed diagram of inner component modules of a remote controller configured to control a multimedia device including a flexible display according to one embodiment of the present invention.

FIG. **8** is a diagram of a multimedia device according to one embodiment of the present invention.

FIG. **9** is a diagram of a multimedia device according to another embodiment of the present invention.

FIG. **10** is a diagram for one example of a GUI displayed on a screen in a multimedia device according to another embodiment of the present invention.

FIG. **11** is a diagram of a multimedia device according to another embodiment of the present invention.

FIG. **12** is a diagram of a multimedia device according to another embodiment of the present invention.

FIG. **13** is a diagram of a multimedia device according to another embodiment of the present invention.

FIG. **14** is a diagram of a multimedia device according to another embodiment of the present invention.

FIG. **15** and FIG. **16** are diagrams of a multimedia device according to another embodiment of the present invention.

FIG. **17** is a diagram of a multimedia device according to another embodiment of the present invention.

FIG. **18** is a diagram of a multimedia device according to a further embodiment of the present invention.

FIG. **19** is a diagram of a multimedia device according to another further embodiment of the present invention.

FIG. **20** is a diagram to describe one example of adjusting a height of a multimedia device according to one embodiment of the present invention.

FIG. **21** is a diagram for one example of a multimedia device having a sensor according to one embodiment of the present invention.

FIG. **22** is a diagram for another example of a multimedia device having a sensor according to one embodiment of the present invention.

FIG. **23** is a flowchart for a method of controlling a multimedia device according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

As used herein, the suffixes 'module', 'unit' and 'part' are used for elements in order to facilitate the disclosure only. Therefore, significant meanings or roles are not given to the suffixes themselves and it is understood that the 'module', 'unit' and 'part' can be used together or interchangeably.

Meanwhile, a display device described in the present specification is an intelligent network TV additionally equipped with a computer supportive function. In particular, the display device fully supports a broadcast receiving function and has an internet function and the like added thereto. Hence, the display device can have such a facilitated interface as a handwritten input device, a touchscreen, a space remote controller and the like. And, the display device is connected to internet and computer with the support of wired/wireless internet function and can perform functions of email, web browsing, banking, game and the like. For the various function, a standardized universal operation system (OS) can be used.

And, since various applications can be freely added to or deleted from a universal OS kernel, a display device mentioned in the description of the present invention can perform various kinds of user-friendly functions.

Moreover, although reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings, the present invention may be non-limited by the preferred embodiments of the present invention.

First of all, although terminologies used in the present specification are selected from general terminologies used currently and widely in consideration of functions in the

present invention, they may be changed in accordance with intentions of technicians engaged in the corresponding fields, customs, advents of new technologies and the like. Occasionally, some terminologies may be arbitrarily selected by the applicant(s). In this case, the meanings of the arbitrarily selected terminologies shall be described in the corresponding part of the detailed description of the invention. Therefore, terminologies used in the present specification need to be construed based on the substantial meanings of the corresponding terminologies and the overall matters disclosed in the present specification rather than construed as simple names of the terminologies.

FIG. **1**a is a diagram for one example of a multimedia device including a flexible display according to one embodiment of the present invention. FIG. **1**b is a diagram of a portion of a guide bar included in the multimedia device shown in FIG. **1**a. One example of a multimedia device including a flexible display according to one embodiment of the present invention is described with reference to FIG. **1**a and FIG. **1**b as follows.

Referring to FIG. **1**a, a multimedia device **100** according to one embodiment of the present invention includes a guide bar **110** and a flexible display **120**.

The guide bar **110** is configured in a rod shape having a length direction. For instance, the guide bar **110** may be formed in a cylindrical shape. Yet, no limitations are put on the shape of the guide bar **110**. And, the multimedia device **100** may further include a housing configured to enclose an outside of the guide bar **110**.

The flexible display **120** is supported by the guide bar **110** and can be rolled up on an outer circumference of the guide bar **110**. A size of a screen **122** of the flexible display **120** can be adjusted depending on a size of a portrait length of the flexible display **120** wound on the outer circumference of the guide bar **110**. In particular, if an extent of the flexible display **120** rolled up on the outer circumference of the guide bar **110** increases, the size of the screen **122** decreases correspondingly. If an extent of the flexible display **120** rolled up on the outer circumference of the guide bar **110** decreases, the size of the screen **122** increases correspondingly. In this case, the screen **122** means a part of the flexible display **120**, on which video data, image data, text data and the like are displayed. In particular, the screen **122** may be situated within a region of the flexible display **120** failing to be rolled up on the outer circumference of the guide bar **110**.

In case that a user does not use the multimedia device **100** for long term, the flexible display **120** is facilitated to be stored in a manner of being fully rolled up on the outer circumference of the guide bar **110**.

A motor (not shown in the drawing) is built in the guide bar **110** to roll up the flexible display **120** on the outer circumference of the guide bar **110**. Once the motor starts to rotate, the guide bar **110** connected to the motor rotates to adjust an extent of rolling up the flexible display **120** supported by the guide bar **110** on the outer circumference of the guide bar **110**. Referring to FIG. **1**b, the guide bar **110** may include a first part **111** configured to support the flexible display **120**, a second part **112** provided to both end portions of the first part **111** in a manner of having a motor built therein, and a third part **113** locked to the second part **112**. The first part **111** is locked to one end of the flexible display **120** and is designed to have the flexible display **120** rolled up on its outer circumference while the first part **111** supports the flexible display **120**. As the second part **112** having the motor built therein rotates, the first part **111** rotates together with the second part **112**. If the first part **111** rotates, it is able to adjust an extent of rolling up the flexible display **120**. The 3rd part **113** is the part locked to a string (cf. a reference number **2030** shown in FIG. **20**) that will be explained later. And, a distance detection sensor may be provided to each of a top side **114** and a bottom side **115** of the third part **113**. Conducting lines **116** including RF antenna, A/V cable, power cable and the like can be connected to the guide bar **110**.

For instance, the flexible display **120** may include an organic light emitting diode (OLED).

FIG. **2** is a diagram of component modules of a multimedia device according to one embodiment of the present invention. In the following description, component modules of a multimedia device according to one embodiment of the present invention are explained with reference to FIG. **2**. Yet, FIG. **2** shows one embodiment for clarity of the following description. If the embodiment includes other component modules as well as the former component modules shown in FIG. **2** or the former component module(s) shown in FIG. **2** is omitted in part, it may belong to the scope of the appended claims and their equivalents. Moreover, the multimedia device **200** may correspond to the former multimedia device **100** shown in FIG. **1**a. Besides, if some of the component modules shown in FIG. **2** are separated from a display unit **280** in form of STB (set-top box), it may belong to the scope of the appended claims and their equivalents.

Referring to FIG. **2**, a multimedia device **200** according to one embodiment of the present invention may include a receiving unit **205**, an external device interface unit **235**, a storage unit **240**, a user interface unit **250**, a sensor unit **260**, a control unit **270**, a display unit **[2380]***280*, an audio output unit **285**, a power supply unit **290** and a photographing unit (not shown in the drawing).

The receiving unit **205** may include a tuner **210**, a demodulator **220** and a network interface **230**. Optionally, if necessary, the receiving unit **205** can be designed to include the tuner **210** and the demodulator **220** without the network interface **230**. On the contrary, the receiving unit **205** can be designed to include the network interface **230** without the tuner **210** and the demodulator **220**.

The tuner **210** selects an RF (radio frequency) broadcast signal, which corresponds to a channel selected by a user or all of the saved channels, from RF broadcast signal received via an antenna. The demodulator **220** receives a digital IF signal (DIF) transformed by the tuner **210** and then performs a demodulating operation thereon.

The demodulator **220** performs demodulation and channel decoding and is then able to output a stream signal TS. In this case, the stream signal may include a signal in which a video signal, an audio signal and/or a data signal are multiplexed with each other. For instance, the stream signal may include an MPEG-2 TS (transport stream) in which an MPEG-2 video signal, a Dolby AC-3 audio signal and the like are multiplexed with each other. In particular, the MPEG-2 TS can include a 4-byte header and a 184-byte payload.

The stream signal outputted from the demodulator **220** can be inputted to the control unit **270**. Subsequently, the control unit **270** performs demultiplexing, video/audio signal processing and the like and then outputs a video and an audio to the display unit **280** and the audio output unit **285**, respectively. And, the display unit **280** may correspond to the flexible display shown in FIG. **1**a.

The external device interface unit **235** can connect the multimedia device **200** to an external device. To this end, the external device interface unit **235** can include an A/V input/output unit (not shown in the drawing) or a wireless communication unit (not shown in the drawing).

The external device interface unit **235** **[204]** may be connected by wire/wireless to such an external device as a DVD (digital versatile disk), a BD (Blu-ray disc) player, a game device, a camera, a camcorder, a computer (e.g., laptop, etc.) and the like. Meanwhile, the external device interface unit **235** receives an application or an application list in a neighbor external device and is then able to deliver it to the control unit **270** or the storage unit **240**.

The network interface **230** may include an Ethernet terminal and the like for an access to a wired network for example. And, for the connection to a wireless network, the network interface **230** may use such a communication protocol as WLAN (wireless LAN: Wi-Fi), Wibro (wireless broadband), Wimax (world interoperability for microwave access), HSPDA (high speed downlink packet access) and the like for example. And, the network interface **230** selects a desired application from applications open to the public via a network and is then able to receive the selected application.

The storage unit **240** may store programs for signal processing and control within the control unit **270**. And, the storage unit **240** may store a signal processed audio, video or data signal.

The storage unit **240** may perform a function for temporary storage of an audio, video or data signal inputted from the external device interface unit **235** or the network interface **230**. Moreover, the storage unit **240** may store the application or the application list inputted from the external device interface unit **235** or the network interface **230**.

The user interface unit **250** forwards a signal inputted by a user to the control unit **270**. The user interface unit **250** forwards a signal from the control unit **270** to the user. For instance, the user interface unit **[240]** *250* receives and processes a control signal for power-on/off, channel selection, screen settings or the like from the remote controller **300** by such a communication protocol as RF (radio frequency) communication protocol, infrared (IR) communication protocol and the like. And, the user interface unit **250** transmits a control signal from the control unit **270** to the remote controller **300**.

The control unit **270** may generate and output a signal for a video or audio output in a manner of demultiplexing a stream inputted via the tuner **210**, the demodulator **220** or the external device interface unit **235** or processing demultiplexed signals.

The video signal video-processed by the control unit **270** is inputted to the display unit **280** and can be then displayed as a video or image corresponding to the inputted video signal. And, the video signal video-processed by the control unit **270** can be inputted to an external output device via the external device interface unit **235**. The audio signal processed by the control unit **270** is inputted to the audio output unit **285**. And, the audio signal processed by the control unit **270** can be inputted to the external output device via the external device interface unit **235**.

The display unit **280** generates a drive signal by converting the video, data and OSD signals processed by the control unit **270**, or the video and data signals received from the external device interface unit **235** to R/G/B signals. The display unit **280** includes a flexible display that can be bent or curved. And, the display unit **280** may include OLED (organic light emitting diode). In case that a graphic user interface (GUI) for a user input is displayed on a screen of the display unit **280**, the display unit **280** can play a role as a user interface unit as well as a role an output unit.

The audio output unit **285** outputs an audio by receiving an input of stereo signal, 3.1-channel signal or 5.1-channel signal, which is audio-processed by the control unit **270**, for example. And, the audio output unit **285** may be implemented with speakers of various types.

The power supply unit **290** supplies power to the multimedia device **200** overall. In particular, the power supply unit **290** can supply the power to the control unit **270** implemented into an SOC (system on chip) type, the display unit **280** for the image or video display, and the audio output unit **285** for the audio output.

The sensor unit **260** can include at least one of an eye recognition sensor for recognizing a user's eye, a motion recognition sensor for recognizing a user's motion, a voice recognition sensor for recognizing a user's voice and the like.

The remote controller **300** transmits a user input to the user interface unit **250**. To this end, the remote controller **300** can use Bluetooth, RF (radio frequency) communication, IR communication, UWB (ultra wideband), Zigbee and the like. Particularly, the remote controller **300** shall be described in detail with reference to FIG. **6** and FIG. **7** later.

The tuner **210** receives AV data of a broadcast program. And, the tuner **210** can be replaced by a broadcast network interface.

The network interface **230** receives a content and metadata corresponding to the content from each source device. In this case, the source device means a broadcasting station, a contents provider, a service provider or the like. And, the network interface **230** can be designed as an internet network interface for example.

FIG. **3** is a detailed diagram of component modules of a control unit shown in FIG. **2**. In the following description, component modules of the control unit in the multimedia device according to one embodiment of the present invention are explained.

Referring to FIG. **3**, the control unit **270** according to one embodiment of the present invention may include a demultiplexer **271**, a video processor **272**, an OSD generator **273**, a mixer **274**, a frame rate converter **[275]** (FRC) **275** and a formatter **276**. And, the control unit **270** may further include an audio processor (not shown in the drawing) and a data processor (not shown in the drawing).

The demultiplexer **271** may demultiplex an inputted stream. The video processor **272** may perform a video processing on a demultiplexed video signal. To this end, the video processor **272** may further include a video decoder **272**a and a scaler **272**b.

The video decoder **272**a decodes the demultiplexed video signal and the scaler **272**b performs a scaling to enable resolution of the decoded video signal to be outputtable from the display unit **280**. And, the video signal decoded by the video processor **272** is inputted to the mixer **274**.

The OSD generator **273** generates an OSD signal in response to a user input or by itself. For instance, the OSD generator **273** can generate a signal for displaying various information as a graphic or text on a screen of the display unit **280** based on a control signal from the user interface unit **250**.

The mixer **274** mixes the OSD signal generated from the OSD generator **273** and the decoded video signal video-processed by the video processor **272** with each other. The mixed signal is provided to the formatter **276**. Since a decoded broadcast video signal or an external input signal and an OSD signal are mixed together, an OSD may be displayed in a manner of overlaying a broadcast video or an external input video.

The frame rate converter (FRC) **275** can convert a frame rate of an inputted video. For instance, the frame rate

converter **275** converts a frame rate to 120 or 240 Hz from 60 Hz. In case that the frame rate of 60 Hz is converted to 120 Hz, it is possible to insert a first frame between the first frame and a second frame or insert a third frame, which is predicted from the first frame and the second frame, between the first frame and the second frame. In case of converting a frame rate of 60 Hz to 240 Hz, it is possible to insert 3 frames of the same or 3 predicted frames. Meanwhile, it is possible to maintain an inputted frame rate without separate conversion.

The formatter **276** receives an input of an output signal of the frame rate converter **275** and then outputs the signal by changing a format of the signal to fit the display unit **280**. For instance, the formatter **276** can output R/G/B data signal. In this case, the R/G/B data signal may be outputted as low voltage differential signaling (LVDS) or mini-LVDS.

Particularly, a multimedia device including a flexible display according to one embodiment of the present invention is described as follows.

First of all, the display unit **280** includes a flexible display and can be rolled up on an outer circumference of a guide bar (not shown in the drawing). In the display unit **280**, a part rolled up on the outer circumference of the guide bar shall be named a first region and a part failing to be rolled up on the outer circumference of the guide bar shall be named a second region. Since the display unit **280** can be rolled up on the outer circumference of the guide bar, a size of each of the first and second regions may vary depending on an extent of the display unit **280** rolled up on the guide bar. In this case, a screen is situated within the second region failing to be rolled up on the outer circumference of the guide bar.

The receiving unit **205** receives a content and metadata corresponding to the content from a source device. In this case, the source device may include one of a broadcasting station, a contents provided, a service provider and the like. In this case, the contents may conceptionally include all contents, which include a broadcast signal, a VOD (video on demand), an application and the like, receivable from the source device. And, the metadata may include such information as a content name, a running time, an optimized resolution, an aspect ratio and the like.

The control unit **270** extracts an aspect ratio information of the content from the received metadata. In this case, the aspect ratio means a width to length ratio of a screen. Using the aspect ratio information, the control unit **270** can obtain a screen aspect ratio optimized for the received content.

In accordance with the extract aspect ratio information, the control unit **270** adjusts a vertical width of the second region of the flexible display. In particular, the control unit **270** adjusts the vertical width of the second region of the flexible display to fit the extracted aspect ratio, thereby enabling a user to watch the content on a full screen without a margin or blank. This shall be described in detail with reference to FIG. **8** and FIG. **9** later.

The adjustment of the vertical width of the second region of the flexible display is performed in a manner of adjusting an extent of the flexible display rolled up on the outer circumference of the guide bar. If the extent of the flexible display rolled up on the outer circumference of the flexible display increases, a size of the screen decreases correspondingly. If the extent of the flexible display rolled up on the outer circumference of the flexible display decreases, a size of the screen increases correspondingly. Since a horizontal width of the flexible display is already determined depending on a product, it is able to adjust a size of the screen by adjusting the vertical width of the flexible display.

Meanwhile, since a hard type display is used according to the related, a blank is left on top, bottom, right and/or left side of a screen depending on an aspect ratio of a screen. Hence, it may cause a problem that user's immersion is disturbed. Yet, according to the present invention, a size of a screen is controlled in a manner that a vertical width of a second region of a flexible display is adjusted depending on an aspect ratio optimized for a content, whereby a user can watch the content on a full screen without blanks or margins.

Occasionally, a user may desire to watch a content at an aspect ratio of a screen preferred by the user instead of watching the content at an aspect ratio indicated by an information of a received metadata. In this case, the control unit **270** generates a GUI for receiving a command signal for selecting an aspect ratio of a screen and then controls the generated GUI to be displayed on the flexible display. In particular, the OSD generator **273** in the control unit **270** generates a GUI signal for aspect ratio selection and then delivers the GUI signal to the display unit **280**. If so, the GUI is displayed on the display unit **280**. The control unit **270** adjusts the vertical width of the second region of the flexible display in response to a screen aspect ratio inputted via the GUI. This shall be described in detail with reference to FIG. **10** later.

The storage unit **240** may store a function or a lookup table for determining the vertical width of the second region in accordance with the screen aspect ratio in advance. In response to the screen aspect ratio, the control unit **270** detects the function by accessing the storage unit **240** and then determines the vertical width of the second region in accordance with the detected function. Alternatively, in response to the screen aspect ratio, the control unit **270** detects a value in the lookup table by accessing the storage unit **240** and then determines the vertical width of the second region in accordance with the detected value in the lookup table. The control unit **270** detects a width of the second region in a current state and is then able to determine whether to further roll up the flexible display on the outer circumference of the guide bar or release a rolled part of the flexible display from the outer circumference of the guide bar in accordance with the determined width of the second region.

The control unit **270** can determine whether caption data (subtitle image or text data), OSD data, widget application data or the like exists except video data included in the received content. For clarity, the caption data (subtitle image or text data), the OSD data, the widget application data or the like except video data shall be named subdata.

If a command signal for displaying the video data and the subdata separately is received through the received content itself or a user input, the control unit **270** partitions a screen within the flexible display and is then able to control the video data and the subdata to be displayed on a first partitioned region and a second partitioned region, respectively, in response to the received command signal. The OSD generator **273** in the control unit **270** converts the subdata to an OSD signal and is then able to deliver it to the second partitioned region. In this case, an aspect ratio of the screen may mean the aspect ratio of the first partitioned region for displaying the video data. Hence, the control unit **270** adjusts a vertical width of the second region of the flexible display to match a size of the first partitioned region to the aspect ratio. This shall be described in detail with reference to FIGS. **11** to **14** later.

In case that at least two contents are received by the receiving unit **205**, the control unit **270** partitions a screen within the flexible display into a plurality of partitioned

regions and then controls video data of different contents to be displayed on a plurality of the partitioned regions, respectively. According to an embodiment, the receiving unit **205** may include a plurality of tuners **210**.

According to an embodiment, the video data in the content received by the receiving unit **205** may be displayed on the first partitioned region within the screen of the flexible display and a video data within a content included in a storage medium owned by a user may be displayed on the second partitioned region within the screen of the flexible display. In this case, the storage medium may include the storage unit **240** of the multimedia device **200** or an external storage medium (e.g., USB memory, etc.) connected to the multimedia device **200** via the external device interface unit **235**. This shall be described in detail with reference to FIGS. **15** to **17** later.

While the multimedia device **200** is in the state of the standby mode, a light source of the display unit **280** is turned on in part to play a role as an illumination. If the multimedia device **200** is in the state of the standby mode, it may mean that a user does not use a unique function (e.g., a contents view, a search via internet, etc.) of the multimedia device **200**. This shall be described in detail with reference to FIG. **18** later.

In case that the multimedia device **200** is paired via network with such a device as a user's mobile phone, a home phone, an indoor thermometer and the like, the multimedia device **200** receives informations from the devices via the internal device interface (i.e., the network interface **230**) or the external device interface unit **235** and then displays the received informations on the display unit **280**, thereby play a role in guiding informations. This shall be described in detail with reference to FIG. **19** later.

The sensor unit **260** can include at least one of an eye recognition sensor for recognizing a user's eye, a motion recognition sensor for recognizing a user's motion, a voice recognition sensor for recognizing a user's voice and the like.

In particular, the sensor unit **260** recognizes a user's eye using the eye recognition sensor and the control unit **270** is then able to adjust a height of the flexible display to enable a screen of the flexible display to fit a user's eye height. This shall be described in detail with reference to FIG. **21** later.

The sensor unit **260** recognizes a user's motion using the motion recognition sensor and the control unit **270** is then able to adjust a height of the flexible display to enable a screen of the flexible display to be situated at a user-desired height. And, the storage unit **240** can store a control signal matching each user's motion. This shall be described in detail with reference to FIG. **22** later.

The sensor unit **260** recognizes a user's voice using the voice recognition sensor and the control unit **270** is then able to adjust a height of the flexible display to enable a screen of the flexible display to be situated at a user-desired height. And, the storage unit **240** can store a control signal matching each user's voice.

FIG. **4** is a diagram for another example of component modules of a multimedia device including a flexible display according to one embodiment of the present invention. In the following description, another example of component modules of a multimedia device including a flexible display according to one embodiment of the present invention is explained with reference to FIG. **4**. A multimedia device **400** shown in FIG. **4** corresponds to the former multimedia device shown in FIGS. **1** to **3**.

Referring to FIG. **4**, a multimedia device **400** may include a network interface **401**, a TCP/IP manager **402**, a service delivery manager **403**, a demultiplexer (Demux) **405**, a PSI & (PSIP and/or SI) decoder **404**, an audio decoder **406**, a video decoder **407**, a display module (Display A/V and OSD Module) **408**, a service control manager **409**, a service discovery manager **410**, a metadata manager **412**, an SI & Metadata DB **411**, a UI manager **414**, a service manager **413** and the like. Yet, the scope of the appended claims and their equivalents may be non-limited by the components shown in FIG. **4**. And, it is possible to add or delete module(s) in the necessity for those skilled in the art.

First of all, the network interface **401** receives packets from a network and transmits packets to the network. In particular, the network interface **401** receives a service, a content and the like from a service provider via the network. And, the network interface **401** corresponds to the receiving unit **205** shown in FIG. **2**.

The TCP/IP manager **402** manages a packet received by the multimedia device **400** and a packet transmitted by the IPTV **400**. In particular, the TCP/IP manager **402** manages a packet delivery from a source to a destination. The TCP/IP manager **402** sorts the received packets to correspond to an appropriate protocol and then transmits the sorted packets to the service delivery manager **405**, the service discovery manager **410**, the service control manager **409** and the metadata manager **412**.

The service delivery manager **403** is responsible for a control of the received service data. For instance, in case of controlling real-time streaming data, the service delivery manager **403** can use RTP/RTCP. In case of transmitting the real-time streaming data using RTP, the service delivery manager **403** parses the received data packet by the RTP and then transmits the parsed data packet to the demultiplexer **405** or saves the parsed data packet in the SI & Metadata DB **411**. And, the service delivery manager **403** feeds back the network received data to a service side, which provides a service, using the RTCP.

The demultiplexer (Demux) **405** demultiplexes the received packets into audio data, video data, PSI (program specific information) data and the like and then transmits the demultiplexed data to the audio decoder **406**, the video decoder **407** and the PSI (PSIP and/or SI) decoder **404**, respectively.

The PSI & (PSIP and/or SI) decoder **404** decodes such service information as PSI (program specific information) and the like for example. In particular, the PSI & (PSIP and/or SI) decoder **404** receives a PSI section, a PSIP (program and service information protocol) section, an SI (service information) section and the like, which are demultiplexed by the demultiplexer **405**, and then decodes the received sections.

Moreover, the PSI & (PSIP and/or SI) decoder **404** creates a database for the service information by decoding the received sections and then saves the database for the service information in the SI & Metadata DB **411**. In this case, an aspect ratio information of a content may be included in the decoded service information.

The audio decoder **406** and the video decoder **407** decode the video data and the audio data, which are received from the demultiplexer **405**, respectively. Subsequently, audio data decoded by the audio decoder **406** and video data decoded by the video decoder **407** are provided to a user through the display module (Display AN and OSD Module) **408**.

The UI manager **414** and the service manager **413** manage overall states of the multimedia device **400**, provide a user interface, and also manage other managers.

The UI manager **414** provides a GUI (graphic user interface) for a user using an OSD (on screen display) and the like. The UI manager **414** receives a key input from the user and then performs a receiver operation in response to the received input. For instance, if the UI manager **414** receives a key input for a channel selection from the user, the UI manager **414** transmits a corresponding key input signal to the service manager **413**.

The service manager **413** controls such a manager associated with a service as the service delivery manager **403**, the service discovery manager **410**, the service control manager **409**, the metadata manager **412** and the like.

The service manager **413** creates a channel map and then selects a channel in response to the key input received from the user interface manager **414** using the channel map. The service manager **413** receives a service information of a channel from the PSI & (PSIP and/or SI) decoder **404** and then configures an audio/video PID (packet identifier) of the selected channel in the demultiplexer **405**.

The service discovery manager **410** provides information necessary to select a service provider that provides a service. In case of receiving a signal related to the channel selection from the service manager **413**, the service discovery manager **410** searches services using the information.

The service control manager **409** is responsible for a selection and control of a service. For instance, if a user selects a live broadcasting service of the same existing broadcasting system, the service control manager **409** uses IGMP, RTSP or the like. In case of selecting such a service as a VOD (video on demand) service and the like, the service control manager **409** performs the selection and control of the service using the RTSP. The RTSP protocol can provide a trick mode for a real-time streaming. And, the service control manager **409** can initialize and manage a session through an IMC gate using IMS (IP multimedia subsystem) and SIP (session initiation protocol). The above protocols are provided for example and other protocols are available depending on examples of implementations.

The metadata manager **412** manages metadata associated with a service and saves the metadata in the SI & Metadata DB **411**.

The SI & Metadata DB **411** stores the service information decoded by the PSI & (PSIP and/or SI) decoder **404**, the metadata managed by the metadata manager **412** and the information necessary to select a service provided by the service discovery manager **410**. And, setup data for the system and the like can be saved in the SI & Metadata DB **411**.

The SI & Metadata DB **411** can be implemented using a nonvolatile RAM (NVRAM), a flash memory and/or the like. Meanwhile, the IG **450** includes a gateway in which functions necessary to access an IMS based IPTV service are collected.

FIG. **5** is a diagram for a further example of component modules of a multimedia device including a flexible display according to one embodiment of the present invention. In the following description, a further example of component modules of a multimedia device including a flexible display according to one embodiment of the present invention is explained with reference to FIG. **5**. A multimedia device **500** shown in FIG. **5** corresponds to the former multimedia device shown in FIGS. **1** to **4**.

Referring to FIG. **5**, for example, a multimedia device **500** may include a broadcast interface **501**, a section filter **502**, an AIT filter **503**, an application data processor **504**, a broadcast data processor **511**, a media player **506**, an internet protocol processor **507**, an internet interface **508**, a run time module **509** and the like. Yet, the scope of the appended claims and their equivalents may be non-limited by the components shown in FIG. **5**. And, it is possible to add or delete module(s) in the necessity for those skilled in the art. And, the media player **506** may correspond to the display unit **280** shown in FIG. **2**.

Through the broadcast interface **501**, AIT (application information table) data, real-time broadcast content, application data and stream event are received. Meanwhile, the real-time broadcast content can be named a linear A/V content. The broadcast interface **501** corresponds to the receiving unit **205** shown in FIG. **2**.

The section filter **502** performs section filtering on the 4 kinds of data received via the broadcast interface **501** and then transmits the AIT data, the linear A/V content and the stream event & application data to the AIT filter **503**, the broadcast data processor **511** and the application data processor **504**, respectively.

Meanwhile, through the internet interface **508**, a non-linear A/V content and application data are received. In particular, the non-linear A/V content may include a COD (content on demand) application for example. And, the internet interface **508** corresponds to the receiving unit **205** shown in FIG. **2**.

The non-linear A/V content is transmitted to the media player **506**, while the application data is transmitted to the runtime module **509**.

Moreover, the runtime module **509** may include an application manager and a browser, as shown in FIG. **5**, for example. The application manager controls a life cycle for an interactive application using the AIT data for example. And, the browser performs a function of displaying and processing the interactive application.

FIG. **6** is a diagram of an exterior of a remote controller configured to control a multimedia device including a flexible display according to one embodiment of the present invention. In the following description, an exterior of a remote controller configured to control a multimedia device including a flexible display according to one embodiment of the present invention is explained with reference to FIG. **6**. And, the multimedia device may correspond to the multimedia device shown in FIGS. **1** to **5**.

Referring to FIG. **6** (a), a pointer **615** corresponding to a remote controller **300** is displayed on a screen **610** in a flexible display for example.

A user is able to move or rotate the remote controller **300** in top and bottom directions, right and left directions [FIG. **6** (b)] and front and rear directions [FIG. **6** (c)]. The pointer **615** displayed on the screen **610** in the flexible display responds to a motion of the remote controller **300**. Since the pointer **615** is displayed by being shifted in response to a motion of the remote controller **300** in a 3D space, the remote controller **300** may be named a space remote controller.

In the example shown in FIG. **6** (b) , if a user moves the remote controller **300** in the left direction, the pointer **615** displayed on the screen **610** within the flexible display moves in the left direction in response to the motion of the remote controller **300**.

Information on the motion of the remote controller **300** sensed by a sensor of the remote controller **300** is transmitted to the multimedia device. Subsequently, the multimedia device can calculate coordinates of the pointer **615** from the information on the motion of the remote controller **300**. The multimedia device is then able to display the pointer **615** to correspond to the calculated coordinates.

In the example shown in FIG. **6** (c), while a specific button in the remote controller **300** is pressed, a user moves the remote controller **300** to get away from the multimedia device. Hence, a selected region in the screen **610** corresponding to the pointer **615** can be enlarged and displayed by zoom-in. On the contrary, if a user moves the remote controller **300** to get closer to the multimedia device. Hence, a selected region in the screen **610** corresponding to the pointer **615** can be reduced and displayed by zoom-out. On the other hand, if the remote controller **300** gets away from the multimedia device, a selected region may zoom out. If the remote controller **300** gets closer to the multimedia device, a selected region may zoom in.

FIG. **7** is a detailed diagram of inner component modules of a remote controller configured to control a multimedia device including a flexible display according to one embodiment of the present invention.

Referring to FIG. **7**, a remote controller **300** may include a wireless communication unit **325**, a user input unit **335**, a sensor unit **340**, an output unit **350**, a power supply unit **360**, a storage unit **370** and a control unit **380** for example.

The wireless communication unit **325** transceives signals with a multimedia device **700**. And, the multimedia device **700** may correspond to the multimedia device shown in FIGS. **1** to **5**.

According to the present embodiment, the remote controller **300** may include an RF module **321** configured to transceive signals with the multimedia device **700** by RF communication protocol. And, the remote controller **300** may include an IR module **323** configured to transceive signals with the multimedia device **700** by IR communication protocol.

According to the present embodiment, the remote controller **300** transmits a signal containing an information on a motion of the remote controller **300** and the like to the multimedia device **700** via the RF module **321**.

The remote controller **300** can receive a signal transmitted by the multimedia device **700** via the RF module **321** as well. And, the remote controller **300** can transmit a command for power-on/off, channel switching, volume adjustment or the like to the multimedia device **700** via the IR module **323** if necessary.

The user input unit **335** may include at least one of a keypad, buttons, a touchpad, a touchscreen and the like. A user is able to input a command associated with the multimedia device **700** to the remote controller **300** by manipulating the user input unit **335**. The sensor unit **340** may include at least one of a gyro sensor **341** and an acceleration sensor **343**. In particular, the gyro sensor **341** is configured to sense the information on the motion of the remote controller **300**.

For instance, the gyro sensor **341** can sense the information on an action of the remote controller **300** with reference to x-, y- and z-axes. And, the acceleration sensor **343** can sense the information on a moving speed of the remote controller **300** and the like. Meanwhile, the sensor unit **340** may further include a distance measurement sensor configured to sense a distance from the multimedia device **700**.

The output unit **350** can output a video or audio signal corresponding to the manipulation on the user input unit **335** or to the signal transmitted by the multimedia device **700**. Through the output unit **350**, a user can recognize whether the user input unit **335** is manipulated or whether the multimedia device **700** is controlled.

For instance, the output unit **350** may include at least one of an LED module **351**, which is turned on if the user input unit **335** is manipulated or a signal is transceived with the multimedia device **700** via the wireless communication unit **325**, a vibration module **353**, which generates vibration if the user input unit **335** is manipulated or a signal is transceived with the multimedia device **700** via the wireless communication unit **325**, an audio (sound) output module **355**, which outputs an audio if the user input unit **335** is manipulated or a signal is transceived with the multimedia device **700** via the wireless communication unit **325**, and a display module **357**, which outputs a video or image if the user input unit **335** is manipulated or a signal is transceived with the multimedia device **700** via the wireless communication unit **325**.

The power supply unit **360** supplies a power to the remote controller **300**. If the remote controller **300** does not move for a prescribed duration, the power supply unit **360** can save power consumption by stopping a power supply. If a prescribed key provided to the remote controller **300** is manipulated, the power supply unit **360** resumes the power supply.

The storage unit **370** can store various kinds of programs, application data and the like, which are required for controls and/or operations of the remote controller **300**. If the remote controller **300** transceives signals with the multimedia device **700** via the RF module **321** by wireless, signals are transceived on a prescribed frequency band between the remote controller **300** and the multimedia device **700**. The control unit **380** of the remote controller **300** can save information on a frequency band for transceiving signals with the multimedia device **700** paired with the remote controller **300** by wireless and the like in the storage unit **370** and is then able to refer to the saved information.

The control unit **380** controls all particulars related to the controls of the remote controller **300**. The control unit **380** can transmit a signal corresponding to a prescribed key manipulation of the user input unit **335** or a signal corresponding to a motion of the remote controller **300** sensed by the sensor unit **340** to the multimedia device **700** via the wireless communication unit **325**.

In particular, the present invention is characterized in that a user interface unit of a multimedia device according to one embodiment of the present embodiment is designed to receive a command signal from the remote controller **300** that transmits an input signal attributed to a user's motion.

FIG. **8** is a diagram of a multimedia device according to one embodiment of the present invention.

Referring to FIG. **8**, a multimedia device **800** according to one embodiment of the present invention may include a guide bar **810** and a flexible display **820** supported by the guide bar **810**. In the flexible display **820**, a part of the flexible display **820** rolled up on an outer circumference of the guide bar **810** shall be named a first region and a part of the flexible display **820** not rolled up on the outer circumference of the flexible display **820** shall be named a second region **830**. A screen is situated in the second region **830** of the flexible display **820** not rolled up on the outer circumference of the guide bar **820**.

The multimedia device **800** receives a content and metadata corresponding to the content from a source device and then extracts an aspect ratio information from the received metadata. In this case, an aspect ratio means a width to length ratio of a screen. Using the aspect ratio information, it is able to obtain an aspect ratio of a screen optimized for the received content.

The multimedia device **800** adjusts a vertical width W1 of the second region **830** of the flexible display **820** in accordance with the extracted aspect ratio information. In particular, the adjustment of the vertical width W1 of the second

region **830** is performed in a manner of adjusting an extent of rolling up the flexible display **820** on an outer circumference of the guide bar **810**.

As a result of the aspect ratio information extracted from the received metadata by the multimedia device **800**, assume that an aspect ratio of the screen optimized for the content is 21:9.

In a storage unit of the multimedia device **800**, a function or lookup table for determining the vertical width W**1** of the second region **830** may be saved in advance in accordance with the aspect ratio of the screen of the flexible display **820**.

The multimedia device **800** extracts the aspect ratio information of the screen optimized for the content and then detects the function or a value in the lookup table by accessing the storage unit. Subsequently, the multimedia device **800** determines the vertical width W**1** of the second region **830** using the detected function or value in the lookup table.

Subsequently, the multimedia device **800** detects a vertical width W**1** of the second region **830** in a current state and is then able to determine whether to decrease the vertical width W**1** of the second region **830** by rolling up the flexible display **820** on the outer circumference of the guide bar **810** or increase the vertical width W**1** of the second region **830** by unrolling the part of the flexible display **820** rolled up on the outer circumference of the guide bar **810**, depending on the determined vertical width W**1** of the second region **830**.

According to the present invention, since a size of the screen within the flexible display **820** can be adjusted to fit the aspect ratio of 21:9 optimized for the received content, a user can watch the content on a full screen without margin to increase user's immersion in the content.

FIG. **9** is a diagram of a multimedia device according to another embodiment of the present invention.

Referring to FIG. **9**, a multimedia device **900** according to another embodiment of the present invention may include a guide bar **910** and a flexible display **920** supported by the guide bar **910**. In the flexible display **920**, a part of the flexible display **920** rolled up on an outer circumference of the guide bar **910** shall be named a first region and a part of the flexible display **920** not rolled up on the outer circumference of the flexible display **920** shall be named a second region **930**. A screen is situated in the second region **930** of the flexible display **920** not rolled up on the outer circumference of the guide bar **920**.

The multimedia device **900** receives a content and metadata corresponding to the content from a source device and then extracts an aspect ratio information from the received metadata.

According to the present embodiment, assume a case that the user watches the received content shown in FIG. **9** in the course of watching the former content shown in FIG. **8**. And, assume that a result of the extraction of the aspect ratio information extracted from the received metadata by the multimedia device **900** indicates that an aspect ratio of a screen optimized for the content is 16:9.

The multimedia device **900** extracts the aspect ratio information of the screen optimized for the content and then detects the function or a value in the lookup table by accessing the storage unit. Subsequently, the multimedia device **900** determines the vertical width W**2** of the second region **930** using the detected function or value in the lookup table.

Subsequently, the multimedia device **900** detects a vertical width W**2** of the second region **930** in a current state. Since the content of the former embodiment shown in FIG. **8** is assumed as currently watched, the vertical width W**2** of the second region **930** in the current state may be equal to the vertical width W**1** shown in FIG. **8**. In particular, since the second region **930** in the current state is made to fit the aspect ratio of 21:9, as shown in FIG. **8**, the multimedia device **900** increases the vertical width W**2** of the second region **930** by unrolling the part of the flexible display **920** rolled up on the outer circumference of the guide bar **910** in accordance with the determined vertical width W**2** of the second region **930**.

Therefore, the multimedia device according to the present invention automatically adjusts a size of the screen within the flexible display depending on the aspect ratio of the screen optimized for the content despite a type of the content is changed, whereby a user can watch the content on a full screen without a margin.

FIG. **10** is a diagram for one example of a GUI displayed on a screen in a multimedia device according to another embodiment of the present invention.

Referring to FIG. **10**, a multimedia device according to another embodiment of the present invention displays a GUI **1000** for receiving a command signal for selecting an aspect ratio of a screen within a flexible display.

A user may desire to watch a content at an aspect ratio of a screen preferred by the user without using an aspect ratio information included in a received metadata. In this case, the multimedia device displays the GUI **1000** on the screen within the flexible display and then receives a user selection for an aspect ratio of the screen.

In particular, the user selects the aspect ratio of the screen in a manner of selecting one of check boxes **1011** to **1014** corresponding to various aspect ratios included in the GUI **1000**, respectively. In more particular, the user shifts a pointer **1020**, which corresponds to a motion of the remote controller **300**, to one of the check boxes **1011** to **1014** and is then able to select an aspect ratio, using the remote controler **300** described in detail with reference to FIG. **6** and FIG. **7**.

In case that the user selects a direct input menu **1014**, the user can input a width to length ratio of a screen to an input window **1030** using numerals. According to the present embodiment, a numeral pad for inputting numerals to the input window **1030** may be included in the GUI **1000**.

If a user input for an aspect ratio of a screen is made through the GUI **1000**, the multimedia device adjusts a vertical width of a second region of the flexible display in accordance with the user input instead of aspect ratio information in metadata.

Meanwhile, it may happen that an aspect ratio information optimized for a content is not included in metadata of the content received by the multimedia device. In this case, the multimedia device can adjust a vertical width of the second region of the flexible display in accordance with an aspect ratio inputted by a user.

FIG. **11** is a diagram of a multimedia device according to another embodiment of the present invention.

Referring to FIG. **11**, a multimedia device **1100** according to another embodiment of the present invention may include a guide bar **1110** and a flexible display **1120** supported by the guide bar **1110**. In the flexible display **1120**, a part of the flexible display **1120** rolled up on an outer circumference of the guide bar **1110** shall be named a first region and a part of the flexible display **1120** not rolled up on the outer circumference of the flexible display **1120** shall be named a second region **1130**. A screen is situated in the second region **1130** of the flexible display **1120** not rolled up on the outer circumference of the guide bar **1120**.

The multimedia device **1100** receives a content and metadata corresponding to the content from a source device.

The multimedia device **1100** detects whether a caption data (e.g., a subtitle image, a text data, etc.) exists except video data included in the received content.

The multimedia device **1100** determines whether a separation command signal for displaying the video data and the caption data in a manner of separating the video data and the caption data from each other is received by being included in the received content or through a user input.

In response to the received separation command signal, the multimedia device **1100** partitions a screen within the second region **1130** of the flexible display **1120** and then controls the video data and the caption data to be displayed on a first partitioned region **1131** and a second partitioned region **1132**, respectively.

In this case, an aspect ratio of the screen means an aspect ratio of the first partitioned region **1131** for displaying the video data thereon. Hence, in case of receiving the separation command signal, the multimedia device **1100** adjusts a vertical width W**3** of the second region **1130** of the flexible display **1120** to enable a size of the first partitioned region **1131** to match the aspect ratio. In particular, the multimedia device **1100** adjusts the vertical width W**3** of the second region **1130** of the flexible display **1120** in a manner of adding a vertical width W**5** for the second partitioned region **1132** by enabling the size of the first partitioned region **1131** to match the aspect ratio.

Regarding a method of determining an aspect ratio of a screen, as mentioned in the foregoing description, an aspect ratio information can be extracted from a received metadata or an aspect ratio selecting signal can be inputted by a user through a GUI.

Regarding the adjustment of the vertical width W**3** of the second region **1130** of the flexible display **1120**, a vertical width W**4** of the first partitioned region **1131** is determined using the function or value in the lookup table detected from the storage unit in accordance with the aspect ratio of the screen and the vertical width W**5** of the second partitioned region **1132** is then added to the vertical width W**4** of the first partitioned region **1131**. In this case, as the vertical width W**5** of the second partitioned region **1132**, a preset value may be saved in the storage unit to prepare for a case of a presence of caption data.

According to the present invention, if there is a caption data to be displayed in a manner of being separated from a video data, a screen region is facilitated to increase in a manner of unrolling the flexible display **1120** rolled up on the outer circumference of the guide bar **1110** and the video data and the caption data are separately displayed. Therefore, the present invention can solve the problem that an image is blocked by a caption.

FIG. **12** is a diagram of a multimedia device according to another embodiment of the present invention.

Referring to FIG. **12**, a multimedia device **1200** according to another embodiment of the present invention may include a guide bar **1210** and a flexible display **1220** supported by the guide bar **1210**. In the flexible display **1220**, a part of the flexible display **1220** rolled up on an outer circumference of the guide bar **1210** shall be named a first region and a part of the flexible display **1220** not rolled up on the outer circumference of the flexible display **1220** shall be named a second region **1230**. A screen is situated in the second region **1230** of the flexible display **1220** not rolled up on the outer circumference of the guide bar **1220**.

The multimedia device **1200** receives a content and metadata corresponding to the content from a source device.

The multimedia device **1200** detects whether a caption data (e.g., a subtitle image, a text data, etc.) exists except video data included in the received content. In doing so, the multimedia device **1200** can detect the number of caption data.

The multimedia device **1200** detects whether a caption data (e.g., a subtitle image, a text data, etc.) exists except the video data included in the received content. According to the present embodiment, assume a case that a plurality of caption data respectively consisting of a plurality of languages exist.

The multimedia device **1200** determines whether a separation command signal for displaying the video data and the caption data in a manner of separating the video data and the caption data from each other is received by being included in the received content or through a user input.

In response to the received separation command signal, the multimedia device **1200** partitions a screen within the second region **1230** of the flexible display **1220** and then controls the video data and the caption data to be displayed on a first partitioned region **1231** and a second partitioned region **1232**, respectively.

In this case, an aspect ratio of the screen means an aspect ratio of the first partitioned region **1231** for displaying the video data thereon. Hence, in case of receiving the separation command signal, the multimedia device **1200** adjusts a vertical width W**3** of the second region **1230** of the flexible display **1220** to enable a size of the first partitioned region **1231** to match the aspect ratio. In particular, the multimedia device **1200** adjusts the vertical width W**3** of the second region **1230** of the flexible display **1220** in a manner of adding a vertical width W**5** for the second partitioned region **1232** by enabling the size of the first partitioned region **1231** to match the aspect ratio.

Regarding the adjustment of the vertical width W**3** of the second region **1230** of the flexible display **1220**, a vertical width W**4** of the first partitioned region **1231** is determined using the function or value in the lookup table detected from the storage unit in accordance with the aspect ratio of the screen and the vertical width W**5** of the second partitioned region **1232** is then added to the vertical width W**4** of the first partitioned region **1231**. In this case, the vertical width W**5** of the second partitioned region **1232** is set wider than that of a case of one caption data. As the vertical width W**5** of the second partitioned region **1232**, a preset value may be saved in the storage unit to prepare for a case that the caption data consisting of a plurality of languages need to be simultaneously displayed.

According to a related art, when a content is watched in a manner that a caption in Korean and a caption in English are simultaneously displayed due to a language study or the like, it may cause a problem that user's immersion in the content is degraded due to a considerable size occupied by the caption data displayed by overlaying the screen.

According to the present invention, in case that a plurality of caption data respectively consisting of a plurality of languages exist, a screen region can be easily increased by unrolling the flexible display **1220** rolled up on the outer circumference of the guide bar **1210**. And, a plurality of the caption data are simultaneously displayed by being separated from the video data. Therefore, the present invention can solve the problem that an image is blocked by a caption.

FIG. **13** is a diagram of a multimedia device according to another embodiment of the present invention.

Referring to FIG. **13**, a multimedia device **1300** according to another embodiment of the present invention may include a guide bar **1310** and a flexible display **1320** supported by

the guide bar **1310**. In the flexible display **1320**, a part of the flexible display **1320** rolled up on an outer circumference of the guide bar **1310** shall be named a first region and a part of the flexible display **1320** not rolled up on the outer circumference of the flexible display **1320** shall be named a second region **1330**. A screen is situated in the second region **1330** of the flexible display **1320** not rolled up on the outer circumference of the guide bar **1320**.

The multimedia device **1300** receives a content and metadata corresponding to the content from a source device.

The multimedia device **1300** determines whether a partition command signal for partitioning the screen of the flexible display **1320** is received through a user input.

In response to the received partition command signal, the multimedia device **1300** partitions a screen within the second region **1330** of the flexible display **1320** and then controls a video data and a setup data to be displayed on a first partitioned region **1331** and a second partitioned region **1332**, respectively. In this case, the setup data means various kinds of data corresponding to such a signal for configuring an environment of the multimedia device **1300** as a volume control signal inputted by a user, a channel information signal, a screen brightness control signal and the like. According to an embodiment, if a control signal for displaying the setup data is detected, the multimedia device **1300** may recognize the control signal as the partition command signal.

In this case, an aspect ratio of the screen means an aspect ratio of the first partitioned region **1331** for displaying the video data thereon. Hence, in case of receiving the partition command signal, the multimedia device **1300** adjusts a vertical width W**3** of the second region **1330** of the flexible display **1320** to enable a size of the first partitioned region **1331** to match the aspect ratio. In particular, the multimedia device **1300** adjusts the vertical width W**3** of the second region **1330** of the flexible display **1320** in a manner of adding a vertical width W**5** for the second partitioned region **1332** by enabling the size of the first partitioned region **1331** to match the aspect ratio.

Regarding the adjustment of the vertical width W**3** of the second region **1330** of the flexible display **1320**, a vertical width W**4** of the first partitioned region **1331** is determined using the function or value in the lookup table detected from the storage unit in accordance with the aspect ratio of the screen and the vertical width W**5** of the second partitioned region **1332** is then added to the vertical width W**4** of the first partitioned region **1331**. In this case, as the vertical width W**5** of the second partitioned region **1332**, a preset value may be saved in the storage unit to prepare for a case of a presence of a user input for displaying the setup data separately.

According to the related art, when a user adjusts a volume and the like in the course of watching a content, since a setup data corresponding to a volume control signal is displayed by overlaying the video data, it may cause a problem that user's immersion in the content is degraded.

According to the present invention, since a setup data can be displayed separately from a video data in a manner of partitioning a screen within a flexible display, the present invention can solve the problem that an image is blocked by the setup data.

FIG. **14** is a diagram of a multimedia device according to another embodiment of the present invention.

Referring to FIG. **14**, a multimedia device **1400** according to another embodiment of the present invention may include a guide bar **1410** and a flexible display **1420** supported by the guide bar **1410**. In the flexible display **1420**, a part of the flexible display **1420** rolled up on an outer circumference of the guide bar **1410** shall be named a first region and a part of the flexible display **1420** not rolled up on the outer circumference of the flexible display **1420** shall be named a second region **1430**. A screen is situated in the second region **1430** of the flexible display **1420** not rolled up on the outer circumference of the guide bar **1420**.

The multimedia device **1400** receives a content and metadata corresponding to the content from a source device. According to the present embodiment, assume a case that the multimedia device **1400** receives widget application data of weather, stock market information and the like from an external server.

The multimedia device **1400** determines whether a partition command signal for partitioning the screen of the flexible display **1420** is received through a user input.

In response to the received partition command signal, the multimedia device **1400** partitions a screen within the second region **1430** of the flexible display **1420** and then controls a video data and the widget application data to be displayed on a first partitioned region **1431** and a second partitioned region **1432**, respectively.

According to the present invention, if a user intends to know the weather or stock market information by real time in the course of watching the content, a screen for displaying the widget application data can be easily secured in a manner of increasing a screen region by unrolling the flexible display **1420** rolled up on the outer circumference of the guide bar **1420**. Moreover, since a region for displaying the video data and a region for displaying the widget application data are separately provided within the content, it is advantageous in that user's immersion in the content can be maintained.

FIG. **15** and FIG. **16** are diagrams of a multimedia device according to another embodiment of the present invention.

Referring to FIG. **15**, a multimedia device **1500** according to another embodiment of the present invention may include a guide bar **1510** and a flexible display **1520** supported by the guide bar **1510**. In the flexible display **1520**, a part of the flexible display **1520** rolled up on an outer circumference of the guide bar **1510** shall be named a first region and a part of the flexible display **1520** not rolled up on the outer circumference of the flexible display **1520** shall be named a second region **1530**. A screen is situated in the second region **1530** of the flexible display **1520** not rolled up on the outer circumference of the guide bar **1520**.

The multimedia device **1500** receives a plurality of contents and a plurality of metadata respectively corresponding to a plurality of the contents from a source device. In particular, the multimedia device **1500** may receive a plurality of contents from source devices of the same kind (e.g., a case of receiving two broadcast programs from two broadcasting stations, respectively). Alternatively, the multimedia device **1500** may receive a plurality of contents from a plurality of different source devices, respectively (e.g., a case of receiving a broadcast program signal from a broadcasting station and a VOD content from an IP server).

The multimedia device **1500** determines whether a partition command signal for partitioning the screen of the flexible display **1520** is received through a user input. In case of intending to watch a plurality of contents simultaneously, a user can transmit the partition command signal to the multimedia device **1500** using a remote controller. According to the present embodiment, assume a case that a user intends to watch two contents simultaneously.

In response to the received partition command signal, the multimedia device **1400** partitions a screen within the sec-

ond region **1530** of the flexible display **1520** and then controls a video data of a first content and a video data of a second content to be displayed on a first partitioned region **1531** and a second partitioned region **1532**, respectively. In doing so, an audio data of the first content is outputted through an audio output unit built in the multimedia device **1500** and an audio data of the second content may be outputted through an external audio output device (e.g., earphones, etc.) connected via an external device interface unit of the multimedia device **1500**.

The multimedia device **1500** can determine a vertical width W**6** of the flexible display **1530**, a horizontal width W**7** of the first partitioned region **1531** and a horizontal width W**8** of the second partitioned region **1532** in accordance with an aspect ratio of a screen. In this case, the aspect ratio of the screen may include an aspect ratio included in the received content or an aspect ratio selected by a user through a GUI. In case that a user selects an aspect ratio through the GUI, the user may select aspect ratios for a plurality of contents, respectively. Alternatively, the user may select an aspect ratio for one content only and can use aspect ratio information included in the metadata for another content.

The following description is made on the assumption of a case of obtaining an information indicating that an aspect ratio optimized for a first content is 21:9 from a metadata corresponding to the first content and obtaining an information indicating that an aspect ratio optimized for a second content is 16:9 from a metadata corresponding to the second content.

First of all, based on a horizontal width rate included in the aspect ratio information of the first content and a horizontal width rate included in the aspect ratio information of the second content, the multimedia device **1500** determines the horizontal width W**7** of the first partitioned region **1531** and the horizontal width W**8** of the second partitioned region **1532**. In case of applying the same screen partition unit to each of the first content and the second content, the horizontal width W**7** of the first partitioned region **1531** and the horizontal width W**8** of the second partitioned region **1532** may correspond to a ratio of 21:16 on a total horizontal width of the flexible display **1520**.

Once the multimedia device **1500** determines the horizontal width W**7** of the first partitioned region **1531** and the horizontal width W**8** of the second partitioned region **1532**, the multimedia device **1500** determines the vertical width W**6** of the second region **1530** of the flexible display **1520**. In particular, it is able to determine the vertical width W**6** of the second region **1530** of the flexible display **1520** using an aspect ratio information corresponding to one of the first and second contents, which requires a screen having a greater vertical width. FIG. **15** shows one example of a case that each of the first and second contents needs a screen of the same vertical width. FIG. **16** shows one example of a case that the second contents needs a screen of a vertical width greater than that of a screen of the first content. In case of FIG. **16**, margins may exist on top and bottom ends of the first partitioned region **1531** for displaying the video data of the first content.

Alternatively, in the embodiment shown in FIG. **16**, when video data in the first content is displayed on a first partitioned region **1531**, the multimedia device **1500** can display the video data in the first content in a manner that a margin exists on a top or bottom side of the first partitioned region **1531** only by a preset condition. For instance, when a child intends to watch the video data in the first content, the video data in the first content may be displayed in a manner of inclining toward the bottom side in the first portioned region **1531**. The preset condition may include a condition for receiving a command signal for selecting a display region of the video data in the first content within the first partitioned region from a user or a condition for receiving a control signal outputted to the controller by a sensor configured to sense user's eye(s).

FIG. **17** is a diagram of a multimedia device according to another embodiment of the present invention.

Referring to FIG. **17**, a multimedia device **1700** according to another embodiment of the present invention may include a guide bar **1710** and a flexible display **1720** supported by the guide bar **1710**. In the flexible display **1720**, a part of the flexible display **1720** rolled up on an outer circumference of the guide bar **1710** shall be named a first region and a part of the flexible display **1720** not rolled up on the outer circumference of the flexible display **1720** shall be named a second region **1730**. A screen is situated in the second region **1730** of the flexible display **1720** not rolled up on the outer circumference of the guide bar **1720**.

The multimedia device **1700** receives a content and metadata corresponding to the content from a source device. According to the present embodiment, assume a case that a plurality of contents are received. And, assume a case that a first command signal for partitioning a screen is received from a user to watch a plurality of the contents simultaneously.

The multimedia device **1700** determines whether a caption data (e.g., a subtitle image, a text data, etc.) exists except the video data included in the received content.

The multimedia device **1700** determines whether a second command signal for displaying the video data and the caption data in a manner of separating the video data and the caption data from each other is received by being included in the received content or through a user input.

In response to the received first and second command signals, the multimedia device **1700** partitions a screen within the second region **1730** of the flexible display **1720** and then controls a video data of a first content, a video data of a second content and a video data of a third content to be displayed on a first partitioned region **1731**, a second partitioned region **1732** and a third partitioned region **1733**, respectively.

FIG. **18** is a diagram of a multimedia device according to a further embodiment of the present invention.

Referring to FIG. **18**, a multimedia device **1800** according to a further embodiment of the present invention controls a light source of a flexible display **1820** to be turned on in part in standby mode, thereby enabling the flexible display **1820** to play a role as an illumination (e.g., an indirect illumination, a mood illumination, etc.). If the multimedia device **1800** is in the standby mode, it may mean a case that a user does not use a function (e.g., a content watching, a search via internet, etc.) unique to the multimedia device **1800**. And, the user is able to adjust a vertical width of the second region **1830** of the flexible display **1820** by controlling a desired extent of the flexible display **1820** rolled up on an outer circumference of a guide bar **1810**.

FIG. **19** is a diagram of a multimedia device according to another further embodiment of the present invention.

Referring to FIG. **19**, when a multimedia device **1900** according to another further embodiment of the present invention is in standby mode, the multimedia device **1900** can play a role as an information guide in displaying information received from another indoor home device or a portable or mobile device of a user. In doing so, assume that

the multimedia device **1900** is paired with the indoor home device or the user's portable device.

The multimedia device **1900** is able to receive such information as a presence or non-presence of an absent call, a current weather information, an inner-house temperature and the like from the paired indoor home device (e.g., a phone, a thermometer, an illumination, etc.) or the paired portable device (e.g., a mobile phone, etc.) of the user. The multimedia device **1900** processes the received information into graphic data or text data and is then able to display the processed data through a flexible display **1920**. And, the user is able to adjust a vertical width of a second region **1930** of the flexible display **1920** by controlling a desired extent of the flexible display **1920** rolled up on an outer circumference of a guide bar **1910**.

FIG. **20** is a diagram to describe one example of adjusting a height of a multimedia device according to one embodiment of the present invention.

Referring to FIG. **20**, a multimedia device **2000** according to one embodiment of the present invention may include a guide bar **2010** and a flexible display **2020** supported by the guide bar **2010**.

The guide bar **2010** is installed as height-adjustable. For instance, a string **2030** may be attached to the guide bar **2010** to adjust a height of the guide bar **2010**. A user can adjust the height of the guide bar **2010** by adjusting a length of the string **2030**. Hence, the user is able to watch a content while a height of the flexible display **2020** is adjusted to fit user's eye level.

According to an embodiment, a distance detecting sensor (not shown in the drawing) may be provided to each of a top and bottom of the guide bar **2010**. If the guide bar **2010** ascends in a predetermined distance from a ceiling or descends in a predetermined distance from a ground, the distance detecting sensor senses the corresponding ascent or descent to stop the ascent or descent of the guide bar **2010**.

FIG. **21** is a diagram for one example of a multimedia device having a sensor according to one embodiment of the present invention.

Referring to FIG. **21**, a multimedia device **2100** according to one embodiment of present invention may include a guide bar **2110** and a flexible display **2120** supported by the guide bar **2110**.

The multimedia device **2100** includes a sensor S for recognizing user's eye(s). The multimedia device **2100** recognizes the user's eye through the sensor S and is then able to adjust a height of the guide bar **2110** to control the sensor S and the user's eye to be situated in parallel with each other on the same level. If the sensor S and the user's eye are situated in parallel with each other on the same level, it may mean that the sensor S and the user's eye just need to be situated in a preset error range without being exactly situated on 180° line. For instance, the height of the guide bar **2110** can be adjusted by a length of a string **2130** attached to the guide bar **2110**.

According to the present invention, the heights of the guide bar **2110** and the flexible display **2120** can be automatically adjusted to fit the user's eye level, whereby user's convenience can be enhanced.

In the description with reference to FIG. **21**, the sensor S includes a sensor configured to recognize user's eye(s). Alternatively, a sensor for recognizing a user's face is available as well. In the description with reference to FIG. **21**, the sensor S is provided to a center of a bottom end of the flexible display **2120**. Alternatively, a location of the sensor S is variable depending on an embodiment.

FIG. **22** is a diagram for another example of a multimedia device having a sensor according to one embodiment of the present invention.

Referring to FIG. **22**, a multimedia device **2200** according to one embodiment of present invention may include a guide bar **2210** and a flexible display **2220** supported by the guide bar **2210**.

The multimedia device **2200** may include a motion recognition sensor (not shown in the drawing) configured to recognize a user's motion. The multimedia device **2200** recognizes a user's motion using the motion recognition sensor and is then able to adjust a height of the guide bar **2210** in response to a control signal corresponding to the recognized motion. And, the control signal corresponding to the user's motion can be saved in a storage unit of the multimedia device **2200** in advance.

For instance, assume a case that a first motion, which is performed in a manner that a user raises a hand or arm of the user upward, is saved by matching a first control signal of lifting up the guide bar **2210**. And, assume a case that a second motion, which is performed in a manner that a user lowers down a hand or arm of the user, is saved by matching a second control signal of lifting down the guide bar **2210**.

If a user takes the first motion, the multimedia device **2200** detects the first motion through the motion recognition sensor and then adjusts a height of the flexible display **2220** by lifting up the guide bar **2210** in response to the first control signal. If a user takes the second motion, the multimedia device **2200** detects the second motion through the motion recognition sensor and then adjusts a height of the flexible display **2220** by lifting down the guide bar **2210** in response to the second control signal. For instance, the height adjustment of the guide bar **2210** can be adjusted by the length of the string **2230** attached to the guide bar **2210**.

According to the present invention, since a user can adjust the heights of the guide bar **2210** and the flexible display **2220** to fit a user's eye level by simply taking an intuitive motion, user's convenience can be enhanced.

FIG. **23** is a flowchart for a method of controlling a multimedia device according to one embodiment of the present invention.

Referring to FIG. **23**, a multimedia device receives a content and metadata corresponding to the content from a source device [S**2310**]. Subsequently, the multimedia device determines whether there is a user input for setting an aspect ratio of a screen [S**2320**]. If there is the user input for setting the aspect ratio of the screen, the multimedia device adjusts a size of the screen by adjusting an extent of a flexible display rolled up on an outer circumference of a guide bar in accordance with the inputted aspect ratio [S**2340**]. On the contrary, if there is no user input for setting the aspect ratio of the screen, the multimedia device extracts an aspect ratio information from the received metadata [S**2330**] and then adjusts a size of the screen by adjusting an extent of the flexible display rolled up on the outer circumference of the guide bar in accordance with the extracted aspect ratio information [S**2340**]. Optionally, the step of determining whether there is the user input for setting the aspect ratio of the screen may be skipped and the step S**2330** can be performed in direct, depending on an embodiment.

Although the description of the present invention is explained with reference to each of the accompanying drawings for clarity, it is possible to design new embodiment(s) by merging the embodiments shown in the accompanying drawings with each other. And, if a recording medium readable by a computer, in which programs for executing the embodiments mentioned in the foregoing

description are recorded, is designed in necessity of those skilled in the art, it may belong to the scope of the appended claims and their equivalents.

A multimedia device and operating method thereof according to the present invention may be non-limited by the configurations and methods of the embodiments mentioned in the foregoing description. And, the embodiments mentioned in the foregoing description can be configured in a manner of being selectively combined with one another entirely or in part to enable various modifications.

Meanwhile, a method of operating a multimedia device according to the present invention can be implemented with processor-readable codes in a processor-readable recording medium provided to a network device. The processor-readable medium may include all kinds of recording devices capable of storing data readable by a processor. The processor-readable medium may include one of ROM, RAM, CD-ROM, magnetic tapes, floppy discs, optical data storage devices, and the like for example and also include such a carrier-wave type implementation as a transmission via Internet. Furthermore, as the processor-readable recording medium is distributed to a computer system connected via network, processor-readable codes can be saved and executed according to a distributive system.

It will be appreciated by those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the inventions. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

Both apparatus and method inventions are mentioned in this specification and descriptions of both of the apparatus and method inventions may be complementarily applicable to each other.

The present invention relates to a multimedia device including a flexible display and controlling method thereof. Therefore, the present invention has industrial applicability.

The invention claimed is:

1. A multimedia device comprising:

a guide bar;

a flexible display configured to be rolled up on an outer circumference of the guide bar, the flexible display having a first region rolled up on the outer circumference of the guide bar and a second region not rolled up on the outer circumference of the guide bar;

a receiver configured to receive a content and metadata corresponding to the content from a source device; and

a control unit [adjusting] *configured to adjust* a vertical width of the second region of the flexible display in accordance with a preset condition,

wherein the control unit [extracts] *is configured to extract* an aspect ratio information from the received metadata and [determines] *determine* the vertical width of the second region of the flexible display in accordance with the extracted aspect ratio information,

wherein the multimedia device is configured to:

display video data in the received content on a first partitioned region of the second region, and display caption data on a second partitioned region of the second region if the caption data is included in the received metadata, and

display, in a standby mode, information received from another indoor home device, a portable device or a mobile device on the second partitioned region of the second region, and

wherein [the second partitioned region of the second region is not rolled up on the outer circumference of the guide bar in the standby mode, and] the *vertical width of the* second region is [minimized] *made smaller* in the standby mode *such that only the second partitioned region of the second region is not rolled up on the outer circumference of the guide bar*.

2. The multimedia device of claim **1**, further comprising a storage unit configured to store a function or lookup table for determining the vertical width of the second region in accordance with an aspect ratio of a screen within the second region of the flexible display,

wherein the control unit [detects] *is configured to detect* the function or a value in the lookup table by accessing the storage unit and then [determines] *determine* the vertical width of the second region of the flexible display using the detected function or value in the lookup table.

3. The multimedia device of claim **1**, further comprising a user interface configured to receive a command signal for selecting an aspect ratio of a screen within the second region of the flexible display,

wherein the control unit [determines] *is configured to determine* the vertical width of the second region of the flexible display in accordance with the received command signal.

4. The multimedia device of claim **1**, wherein the guide bar is installed to enable a height adjustment.

5. The multimedia device of claim **4**, further comprising a sensor configured to sense a user's eye,

wherein the control unit [adjusts] *is configured to adjust* a height of the guide bar to enable the sensor and the user's eye to be situated in parallel with each other on a same level.

[**6**. The multimedia device of claim **1**, wherein a screen with the second region of the flexible display comprises at least one of the first partitioned region and the second partitioned region.]

7. The multimedia device of claim [**6**] *1*, wherein if the caption data is included in the received metadata, the control unit [controls] *is configured to display* the video data in the received content and the caption data [to be displayed] on the first partitioned region and the second partitioned region, respectively.

8. The multimedia device of claim [**6**] *1*, wherein the receiver is configured to receive at least two contents, and

wherein the control unit [controls] *is configured to display* video data of the at least two contents [to be displayed] on the first partitioned region and the second partitioned region, respectively.

9. A method of controlling a multimedia device, which includes a control unit, a guide bar and a flexible display configured to be rolled up on an outer circumference of the guide bar, the method comprising:

receiving a content and metadata corresponding to the content from a source device;

extracting, via the control unit, an aspect ratio information from the received metadata;

determining, via the control unit, a vertical width of a region in the flexible display not rolled up on the outer [circumstance] *circumference* of the guide bar in accordance with the extracted aspect ratio information;

adjusting [an extent of] the flexible display rolled up on the outer circumference of the [flexible display] *guide bar* in accordance with the extracted aspect ratio information;

displaying video data in the received content on a first partitioned region of the region in the flexible display, and displaying caption data on a second partitioned region of the region in the flexible display not rolled up on the outer [circumstance] *circumference* of the guide bar if the caption data is included in the received metadata; and

displaying, in a standby mode, information received from another indoor home device, a portable device, or a mobile device on the second partitioned region of the region in the flexible display not rolled up on the outer [circumstance] *circumference* of the guide bar,

wherein the [second partitioned region is not rolled up on the outer circumference of the guide bar in the standby mode, and the region in the flexible display not rolled up on the outer circumstance of the guide bar is minimized in the standby mode] *vertical width of the region of the flexible display not rolled up on the outer circumference of the guide bar is made smaller in the standby mode such that only the second partitioned region of the region is not rolled up on the outer circumference of the guide bar.*

10. The method of claim **9**, further comprising saving a function or lookup table for determining the vertical width of the region in the flexible display not rolled up on the outer circumference of the guide bar in accordance with an aspect ratio of a screen in the flexible display in a storage unit.

11. The method of claim **10**, the adjusting the extent of the flexible display rolled up on the outer circumference of the flexible display, comprising:

detecting the function or a value in the lookup table by accessing the storage unit; and

determining the vertical width of the region in the flexible display not rolled up on the outer circumference of the guide bar using the detected function or value in the lookup table.

12. The method of claim **9**, further comprising: sensing a user's eye using a sensor; and adjusting a height of the guide bar to enable the sensor and the user's eye to be situated in parallel with each other on a same level.

13. The method of claim **9**, further comprising:

detecting the caption data from the received metadata; and

if the caption data is detected, controlling the video data of the received content and the caption data to be displayed on the first partitioned region of the region of the flexible display not rolled up on the outer circumference of the guide bar and the second partitioned region of the region of the flexible display not rolled up on the outer circumference of the guide bar, respectively.

14. The method of claim **13**, wherein at least two caption data are detected from the received metadata.

15. A method of controlling a multimedia device, which includes a control unit, a guide bar and a flexible display configured to be rolled up on an outer circumference of the guide bar, the method comprising:

receiving a content and metadata corresponding to the content from a source device;

receiving a command signal for selecting an aspect ratio of a screen in the flexible display;

extracting, via the control unit, an aspect ratio information from the received metadata;

determining, via the control unit, a vertical width of a region in the flexible display not rolled up on the outer [circumstance] *circumference* of the guide bar in accordance with the extracted aspect ratio information;

adjusting [an extent of] the flexible display rolled up on the outer circumference of the flexible display in accordance with the received command signal;

displaying video data in the received content on a first partitioned region of the region in the flexible display, and displaying caption data on a second partitioned region of the region in the flexible display not rolled up on the outer [circumstance] *circumference* of the guide bar if the caption data is included in the received metadata; and

displaying, in a standby mode, information received from another indoor home device, a portable device, or a mobile device on the second partitioned region of the region in the flexible display not rolled up on the outer [circumstance] *circumference* of the guide bar,

wherein the [second partitioned region is not rolled up on the outer circumference of the guide bar in the standby mode, and the region in the flexible display not rolled up on the outer circumstance of the guide bar is minimized in the standby mode] *vertical width of the region of the flexible display not rolled up on the outer circumference of the guide bar is made smaller in the standby mode such that only the second partitioned region of the region is not rolled up on the outer circumference of the guide bar.*

16. The method of claim **15**, further comprising saving a function or lookup table for determining the vertical width of the region in the flexible display not rolled up on the outer circumference of the guide bar in accordance with the aspect ratio of the screen in the flexible display in a storage unit.

17. The method of claim **16**, the adjusting the extent of the flexible display rolled up on the outer circumference of the flexible display, comprising:

detecting the function or a value in the lookup table by accessing the storage unit; and

determining the vertical width of the region in the flexible display not rolled up on the outer circumference of the guide bar using the detected function or value in the lookup table.

18. The method of claim **15**, further comprising:

sensing a user's eye using a sensor; and

adjusting a height of the guide bar to enable the sensor and the user's eye to be situated in parallel with each other on a same level.

19. The method of claim **15**, further comprising:

detecting the caption data from the received metadata; and

if the caption data is detected, controlling the video data of the received content and the caption data to be displayed on the first partitioned region of the region of the flexible display not rolled up on the outer circumference of the guide bar and the second partitioned region of the region of the flexible display not rolled up on the outer circumference of the guide bar, respectively.

20. A digital television comprising:

a flexible display;

a sensing unit configured to receive a user command;

a guide bar supporting the flexible display;

a motor coupled to the guide bar and configured to roll the flexible display on an outer circumference of the guide bar, the flexible display having a first region rolled on the outer circumference of the guide bar and a second region not rolled on the outer circumference of the guide bar;

a wireless communication unit configured to pair the digital television with a portable device, a mobile device or at least one indoor home device; and

a controller configured to:

in response to a first display mode, extract aspect ratio information from video data to be displayed on the flexible display, adjust a vertical width of the second region to be a first width in accordance with the extracted aspect ratio information, display the video data on a first partitioned region of the second region, and display caption data on a second partitioned region of the second region in correspondence with the displayed video data if the caption data is included with the video data, and

in response to a second display mode, adjust the vertical width of the second region to be a second width that is smaller than the first width, and display information on the second partitioned region received from the paired portable device, the mobile device or the at least one indoor home device,

wherein the vertical width of the second region of the flexible display is adjusted to be smaller in the second display mode such that only the second partitioned region of the region is not rolled on the outer circumference of the guide bar.

21. The digital television of claim 20, wherein the sensing unit further comprises at least one of an eye recognition sensor configured to recognize an eye of a user or a motion recognition sensor configured to recognize a motion of the user.

22. The digital television of claim 20, wherein the flexible display is an organic light emitting diode (OLED) display.

23. The digital television of claim 20, wherein the controller is further configured to:

turn on a light source of the flexible display in part to illuminate while the digital television is in the second display mode, and

prevent using a specific function including contents viewing in the second display mode.

24. The digital television of claim 20, wherein the wireless communication unit is further configured to receive additional information from the paired portable device, the mobile device or the at least one indoor home device while the digital television is in the second display mode, and

wherein the controller is further configured to prevent using a specific function including contents viewing in the second display mode.

25. The digital television of claim 24, wherein the controller is further configured to:

display the additional information as graphic data or text data on the flexible display.

26. A method of controlling a digital television, the method comprising:

receiving, via a sensing unit of the digital television, a user command;

pairing, via a wireless communication unit of the digital television, the digital television with a portable device, a mobile device or at least one indoor home device;

rolling a flexible display of the digital television on an outer circumference of a guide bar via a motor, wherein the flexible display has a first region rolled on the outer circumference of the guide bar and a second region not rolled on the outer circumference of the guide bar;

in response to a first display mode, extracting, via a controller, aspect ratio information from video data to be displayed on the flexible display, adjusting a vertical width of the second region to be a first width in accordance with the extracted aspect ratio information, displaying the video data on a first partitioned region of the second region, and displaying caption data on a second partitioned region of the second region in correspondence with the displayed video data if the caption data is included with the video data; and

in response to a second display mode, adjusting the vertical width of the second region to be a second width that is smaller than the first width, and displaying information on the second partitioned region received from the paired portable device, mobile device or the at least one indoor home device,

wherein the vertical width of the second region of the flexible display is adjusted to be smaller in the second display mode such that only the second partitioned region is not rolled on the outer circumference of the guide bar.

27. The method of claim 26, further comprising:

recognizing, via an eye recognition sensor of the digital television, an eye of a user; or

recognizing, via a motion recognition sensor, a motion of the user.

28. The method of claim 26, wherein the flexible display is an organic light emitting diode (OLED) display.

29. The method of claim 26, further comprising:

turning on, via the controller, a light source of the flexible display in part to illuminate while the digital television is in the second display mode; and

prevent using, via the controller, a specific function including contents viewing in the second display mode.

30. The method of claim 26, further comprising:

receiving, via the wireless communication unit, additional information from the portable device or the at least one indoor home device while the digital television is in the second display mode; and

preventing using, via the controller, a specific function including contents viewing in the second display mode.

31. The method of claim 30, further comprising:

displaying, via the controller, the additional information as graphic data or text data on the flexible display.

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