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(54) **USING A THREE-DIMENSIONAL SENSOR PANEL IN DETERMINING A DIRECTION OF A GESTURE CYCLE**

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**G06F 3/01** (2006.01)

(52) **U.S. Cl.**  
CPC ..... **G06F 3/017** (2013.01)

(58) **Field of Classification Search**  
CPC ..... G06F 3/005; G06F 3/017  
See application file for complete search history.

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(57) **ABSTRACT**

A system includes a 3D sensor panel for detecting a plurality of 3D positions corresponding to a finger movement and a controller. The controller determines that the plurality of 3D positions contain a gesture cycle by comparing a first set of positions in the plurality of 3D positions that includes at least two non-adjacent positions in the plurality of 3D positions and, upon determining that the first set of positions in the plurality of 3D positions match, determining that the plurality of positions contain the gesture cycle. the controller determines a direction of the gesture cycle based on a second set of positions in the plurality of 3D positions, where the direction is relative to the 3D sensor panel, and creates a gesture cycle record for the gesture cycle, the gesture cycle record comprising the plurality of 3D positions and the direction.

**22 Claims, 7 Drawing Sheets**

Gesture-Content Action List 451
Video/Movies/TV
Small Circle – forward / rewind
Large Circle – skip chapter/episode
Swipe – skip chapter/episode
Music/Audio
Small Circle – forward / rewind
Large Circle – skip track/playlist item
Swipe – skip track/playlist item
E-Book/Document/Web Page/Email/e-Magazine
Small Circle – scroll / flip page / forward / rewind
Large Circle – skip section/heading/chapter/book
Swipe – flip page
Wide Swipe – flip section/chapter/article
Tap – zoom
Photo Album/Gallery
Small Circle – scroll / flip page / photo
Large Circle – skip
Tap – zoom

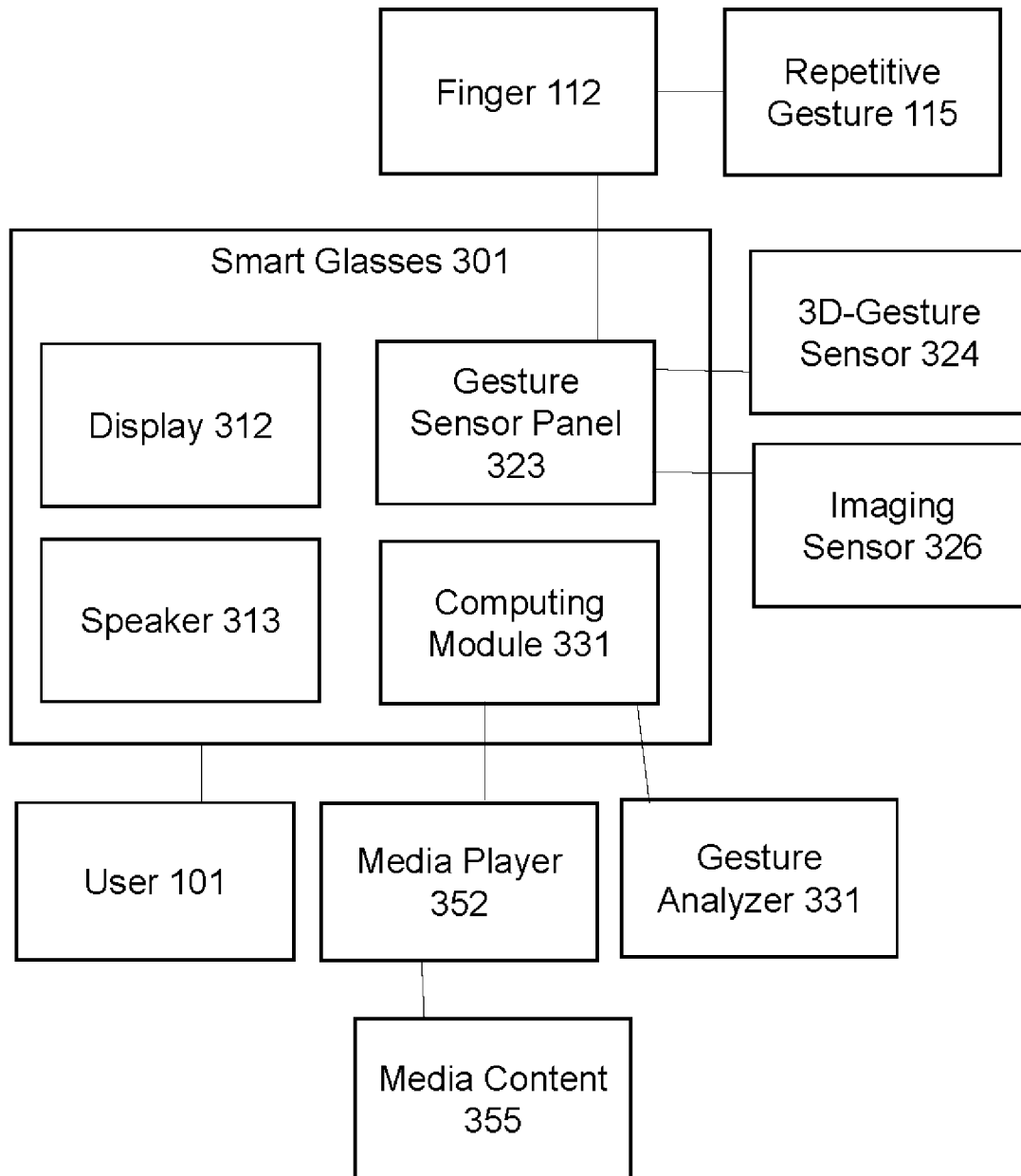


Fig. 1

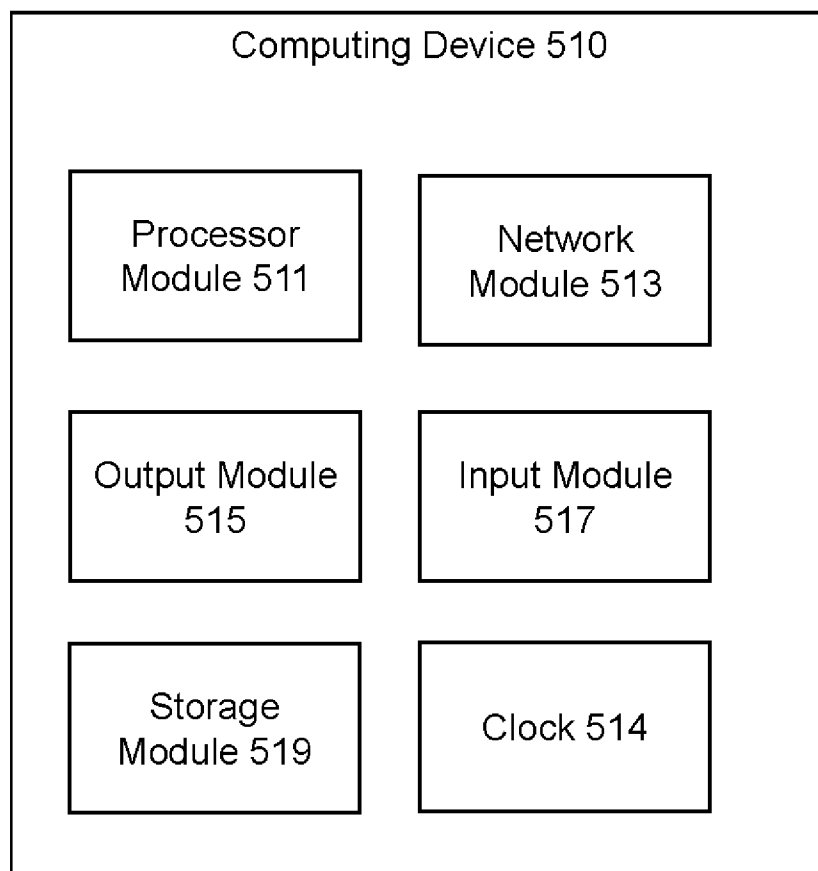


Fig. 2

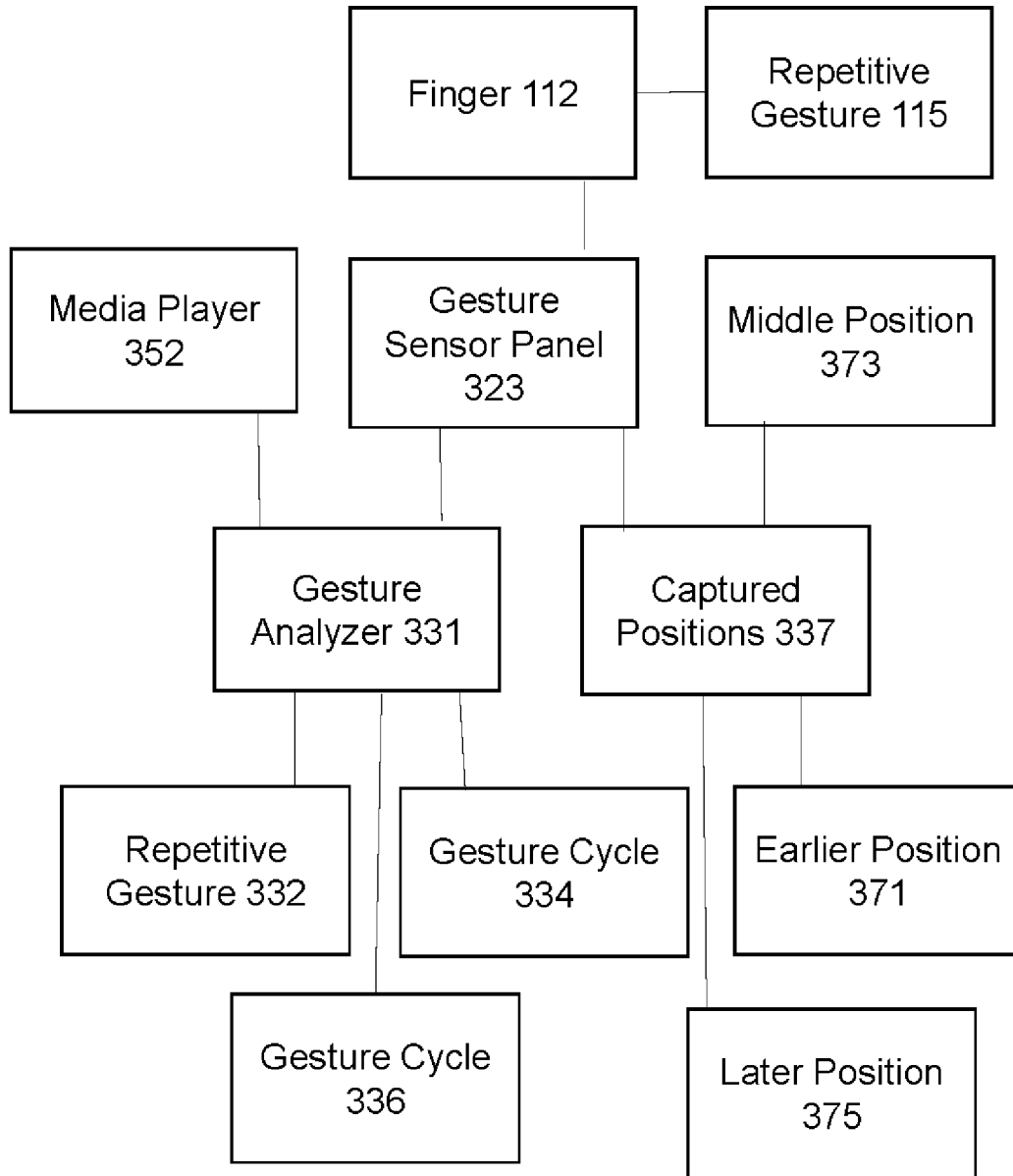


Fig. 3

Gesture Cycle 334

- Gesture Type
- Speed or Duration
- Range (x, y, z) and Span
- Orientation
- A plurality of positions
- A location

Repetitive Gesture 332

- Gesture type
- Gesture Cycles Count
- List of Gesture Cycles
- Orientation/Direction
- Location
- Mode

Fig. 4

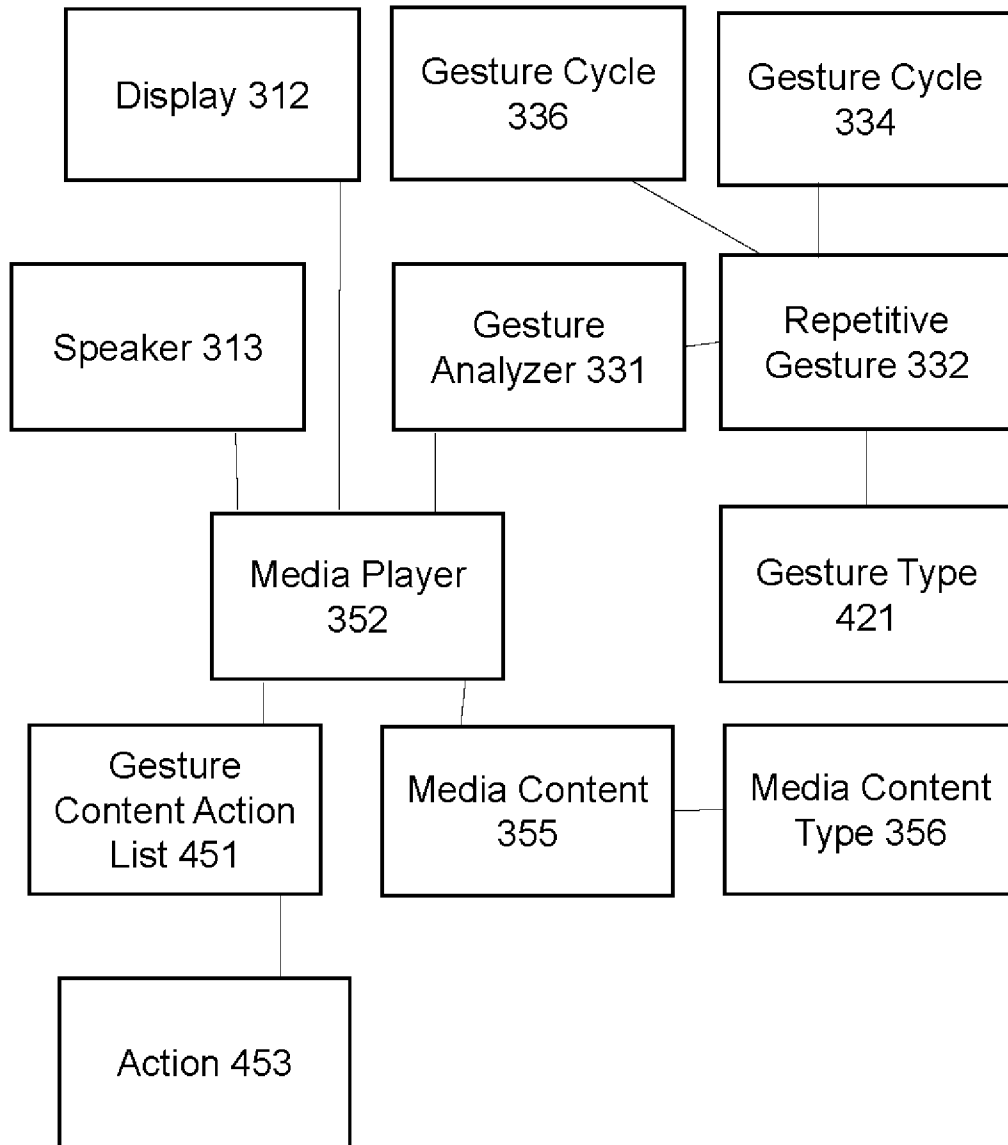


Fig. 5

## Gesture-Content Action List 451

## Video/Movies/TV

Small Circle – forward / rewind

Large Circle – skip chapter/episode

Swipe – skip chapter/episode

## Music/Audio

Small Circle – forward / rewind

Large Circle – skip track/playlist item

Swipe – skip track/playlist item

## E-Book/Document/Web Page/Email/e-Magazine

Small Circle – scroll / flip page / forward / rewind

Large Circle – skip section/heading/chapter/book

Swipe – flip page

Wide Swipe – flip section/chapter/article

Tap – zoom

## Photo Album/Gallery

Small Circle – scroll / flip page / photo

Large Circle – skip

Tap - zoom

Fig. 6

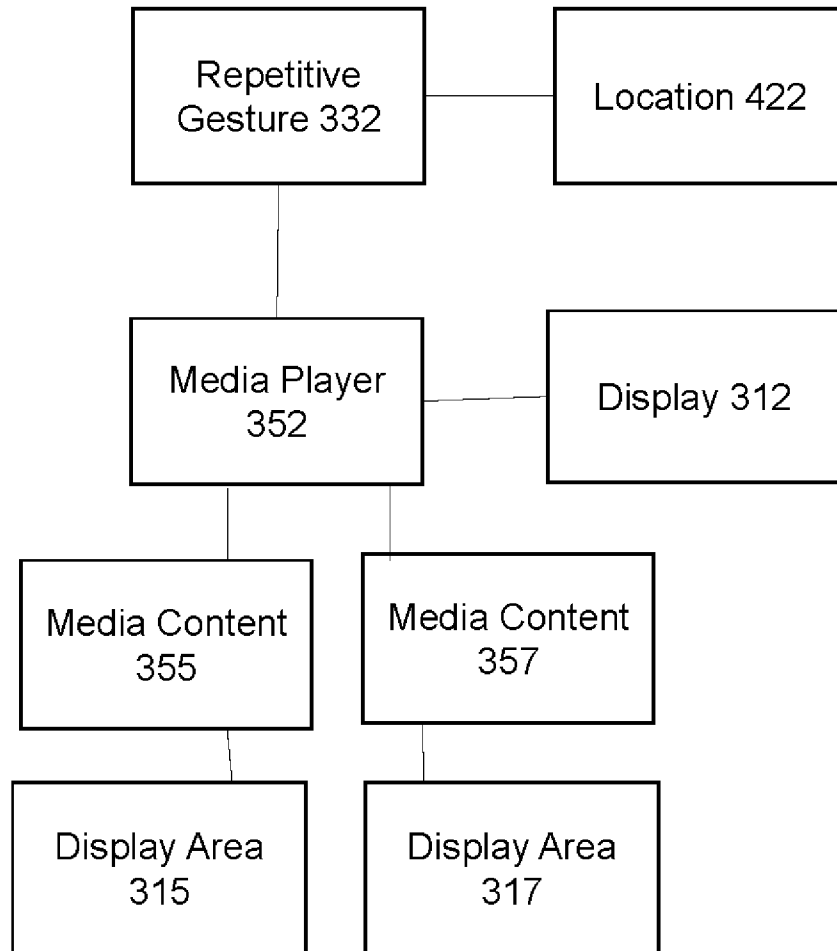


Fig. 7



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**USING A THREE-DIMENSIONAL SENSOR  
PANEL IN DETERMINING A DIRECTION OF  
A GESTURE CYCLE**

BACKGROUND OF THE INVENTION

Field

This invention relates generally to media players, and more specifically, to navigating media content using repetitive 3-D gestures.

Related Art

Users have been fascinated with virtual reality and augmented reality technologies and products. These technologies and products allow users to see something users typically do not see. Virtual or augmented reality products typically include a device or gadget, covering one or both eyes of the user so that the gadget can present an image different from what the users would normally see. Some examples are binoculars, night vision goggles, high-power magnifying glasses which allow users to see afar, very small objects, blurry objects, or objects in the dark. Other examples, such as kaleidoscopes and slide film viewers, present a different world of images from where the viewer is. These gadgets do not anticipate that viewers will interact with the presented object. Most of the gadgets have buttons, wheels, sliders or other physical control for viewers to change a slide or to adjust a setting.

Since the advances of computer video games, many iterations of HMD (head-mounted display) devices, in a form of a headset or helmet, are introduced to allow a viewer, or gamer, to play games in an immersed virtual reality manner, i.e. without seeing the physical surrounding. The newer HMD devices are similar to previous gadgets in that gamers are presented a vision different from reality in an enclosed or simulated manner. Earlier HMD headsets include Sega™ VR, and more recent HMD headsets include Oculus Rift™, HTC Vive™, Samsung Gear VR®, Microsoft™ HoloLens. These headsets require a gamer to interact with objects being displayed in order to play a game or to control the object. HoloLens uses a free hand gesture technology while the others use handheld controllers or touch pads. HoloLens allows a user to, from the user's point of view, act upon the object spatially with her hands. For example, to turn a knob, the user would hold her hand in a semi-closed manner around the knob, which is visible only through the HoloLens, and turns her hand.

However, if a user is watching a movie in such an HMD device and wants to fast forward the movie, the user may have to locate a fast forward button on the handheld controller, to move the cursor to the fast forward button using the touch pad, or to put the hand on the fast forward button on the display. The user may then have to press the fast forward button, perhaps a few times to continue fast forwarding, or to press a different button to stop fast forwarding. Since the user typically does not see her hand while wearing the HMD device, it would be a challenge for her to find the right button or to use the touch pad. In the case of HoloLens, the fast forward button would be a small object in her HoloLens visual view. It would also be a challenge for her to point correctly to the button, when there would be many other control buttons such as play, pause, rewind, and exit buttons competing for space in her HoloLens view.

In a different usage, while a user is reading an electronic document, an e-book or e-magazine, the user wants to skip

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a chapter or article. The user would flip multiple pages of the document. With a handheld controller the user is challenged, without seeing his fingers nor controller, to find the proper button or sequence of buttons to perform the flipping task. With a touch pad, the user is challenged to swipe in a proper direction on the touch pad multiple times, without seeing the touch pad nor his fingers.

In the above usage scenarios, it would be better if the device employs a better natural user interface (NUI) to recognize free hand or touchless 3D-gestures, particularly when such gestures are repeated to indicate a continuous action onto a media content.

The above scenarios illustrate the need to present a media content in conjunction with repetitive touchless 3D-gestures.

BRIEF SUMMARY OF THE INVENTION

Disclosed herein is a method for detecting a repetitive 3-D gesture and a corresponding system and a computer readable storage medium as specified in the independent claims. Embodiments of the present invention are given in the dependent claims. Embodiments of the present invention can be freely combined with each other if they are not mutually exclusive.

According to one embodiment of the present invention, in a method for detecting a repetitive three-dimensional gesture by a computing device, a three-dimensional gesture sensor detects a plurality of positions corresponding to a finger movement. The computing device determines whether the plurality of positions contain a gesture cycle by: comparing at least two non-adjacent positions in the plurality of positions; and upon determining that the at least two non-adjacent positions match, determining that the plurality of positions contain the gesture cycle. Upon determining that the plurality of positions contains the gesture cycle, the computing device creates a gesture cycle record for the gesture cycle, creates a repetitive gesture record for a repetitive gesture, and stores the gesture cycle record in the repetitive gesture record.

In one aspect of the present invention, the computing device further detect a second plurality of positions corresponding to the finger movement by the three-dimensional gesture sensor. The computing device determines whether the second plurality of positions contain a second gesture cycle by: comparing at least two non-adjacent positions in the second plurality of positions; and upon determining that the at least two non-adjacent positions match, determining that the second plurality of positions contain the second gesture cycle. Upon determining that the second plurality of positions contains the second gesture cycle, the computing device creates a second gesture cycle record for the second gesture cycle, compares the gesture cycle record and the second gesture cycle record, and upon determining that the second gesture cycle record matches the gesture cycle record, stores the second gesture cycle record in the repetitive gesture record.

In another aspect of the present invention, the gesture cycle record and the second gesture cycle record each includes one or more attributes of the gesture cycle or the second gesture cycle, and the one or more attributes of the gesture cycle or the second gesture cycle includes one or more of a group comprising: a gesture type of the gesture cycle or the second gesture cycle; a duration of the gesture cycle or the second gesture cycle; a span of the plurality of positions; an orientation of the plurality of positions; the plurality of positions; and a location of the gesture cycle or the second gesture cycle. The computing device compares

one or more of the attributes in the gesture cycle record with one or more of the attributes in the second gesture cycle record, and upon determining that the one or more of the attributes in the gesture cycle record matches the one or more of the attributes in the second gesture cycle record, determines that the second gesture cycle record matches the gesture cycle record.

In another aspect of the present invention, the computing device sends the repetitive gesture record to a media player to apply the repetitive gesture to a presentation of a media content.

In another aspect of the present invention, the media player receives the repetitive gesture record from the computing device, where the repetitive gesture record includes a gesture type. The media player retrieves the gesture type from the repetitive gesture record, determines an action associated with the gesture type, and applies the action to the presentation of the media content.

In another aspect of the present invention, the repetitive gesture record includes one or more attributes of the repetitive gesture, where the one or more attributes of the repetitive gesture includes one or more of a group comprising: a gesture type of the repetitive gesture; an orientation of the repetitive gesture; and a list of gesture cycle records comprising the gesture cycle record and a second gesture cycle record for a second gesture cycle.

In another aspect of the present invention, the action applied to the presentation of the media content is based on a change of a speed or a duration of the finger movement between the gesture cycle and the second gesture cycle.

In another aspect of the present invention, the media player includes a gesture-content action list comprising a list of associations between media content types, gesture types, and actions. The media player determines a media type of the media content and determines the action associated with the gesture type and the media type according to the list of associations.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE FIGURES

FIG. 1 illustrates an exemplary embodiment of a process to play a media content using a repetitive 3D-gesture.

FIG. 2 illustrates an embodiment of a media player computing device.

FIG. 3 illustrates an exemplary embodiment to capture a repetitive 3D gesture.

FIG. 4 illustrates an exemplary embodiment of repetitive gesture attributes.

FIG. 5 illustrates an exemplary embodiment to process an input repetitive gesture when playing a media content.

FIG. 6 illustrates an exemplary embodiment to associate repetitive gestures to media content types.

FIG. 7 illustrates an exemplary embodiment to process an input repetitive gesture when playing a plurality of media content.

#### DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 illustrates an exemplary embodiment of a process for a user to navigate presentation of a media content using a repetitive 3D-gesture. In one typical embodiment, user 101 uses smart glasses 301 to present media content 355. Media content 355 is presented to user 101 by a media player 352, which includes a plurality of computing instructions stored on a computer readable storage medium, being executed by

computing module 331 included in smart glasses 301. Presentation of media content 355 may include presentation using a display 312 and/or a speaker 313 of smart glasses 301.

In one embodiment, user 101 uses her finger 112 to perform a repetitive 3D (three dimensional or spatial) gesture 115. User 101 may use one or more fingers when performing repetitive gesture 115. In a preferred embodiment, user 101 performs the gesture 115 near smart glasses 301, for example an inch or 4-8 inches away from smart glasses 301. In one embodiment, smart glasses 301 includes gesture sensor panel 323, which may include a 3D-gesture sensor 324 to detect movement of finger 112 and repetitive gesture 115. Gesture sensor panel 323 may include an imaging sensor 326 to detect the finger 112. Gesture sensor 324 includes a touchless sensor (not shown) that can detect the finger 112 without the finger 112 touching the gesture sensor panel 323 or smart glasses 301. In one embodiment, gesture sensor 324 includes an electrode, which generates electrical signals and detects electrical signal strength of a proximity area near gesture sensor panel 323. In one embodiment, the detected electrical signal strength is used to determine a spatial position of finger 112. In one embodiment, gesture sensor 324 includes a distance sensor (not shown) which generates a signal, such as sound signal, optical signal or infrared signal, and detects reflected signals to determine a spatial position of finger 112. In one embodiment, gesture sensor 324 includes imaging sensor 326. In one embodiment, gesture sensor panel 323 includes an imaging sensor 326 to be used in conjunction with gesture sensor 324 to determine a position of finger 112.

In one embodiment, gesture sensor panel 323 is mounted onto a frame of smart glasses 301. In one embodiment, gesture sensor 324, and optionally imaging sensor 326, are placed onto a frame of smart glasses 301.

In one embodiment, as user 101 is moving finger 112 to perform repetitive gesture 115, gesture sensor panel 323 detects and captures a plurality of spatial positions of finger 112 corresponding to repetitive gesture 115.

In one embodiment, after capturing repetitive gesture 115 in a form of a plurality of spatial positions of finger 112, gesture sensor panel 323 passes captured repetitive gesture 115 to gesture analyzer 331 for processing. Gesture analyzer 331 sends analyzed repetitive gesture 115 to media player 352. In one embodiment, media player 352 receives analyzed repetitive gesture 115 and determines the action to be applied to the presentation of media content 355 based on the repetitive gesture 115. For example, repetitive gesture 115 indicates a repetitive clockwise circular motion perpendicular and outward from smart glasses 301. In one embodiment, media player 352 determines that the action to be applied is to fast forward the playing of a video of media content 355. In one embodiment, media player 352 fast forwards the playing of media content 355 faster and faster in response to repetitive gesture 115 indicating a plurality of circular motions performed in a faster and faster manner. In one embodiment, media content 355 includes a map, and repetitive gesture 115 includes a plurality of repetitive tapping motions with an initial direction of pushing outward away from the smart glasses 301. Media player 352 applies a continuously zooming out of the display of the map in media content 355 based on the repetitive gesture 115, with a zooming speed relative and corresponding to the speed of repetitive tapping motions. In one embodiment, repetitive gesture 115 includes a plurality of tapping motions with an initial direction of pulling inward towards the smart glasses

**301.** Media player **352** applies a zooming in the display of the map in media content **355** accordingly.

In one embodiment, media player **352** examines media content **355** to determine an appropriate action to apply repetitive gesture **115** to presenting media content **355**. In one embodiment, media player **352** applies different actions based on repetitive gesture **115** for different types of media content **355**. In one embodiment, media player **352** selects the action to apply to media content **355** based on different attributes of repetitive gesture **115**, such as orientation, direction, position, or motion type.

In one embodiment, media player **352** stops applying repetitive gesture **115** when finger **112** stops performing repetitive gesture **115**. In one embodiment, media player **352** continues applying repetitive gesture **115** even after finger **112** stops performing repetitive gesture **115**. Media player **352** receives another gesture, either a non-repetitive gesture or another repetitive gesture from gesture analyzer **331**, and media player **352** responds by stopping the application of repetitive gesture **115**.

FIG. 2 illustrates an exemplary embodiment of hardware components of a computing device which can be used for smart glasses. In one embodiment, computing device **510** includes a processor module **511**, an output module **515**, an input module **517**, a storage module **519** and a clock **514**. In one embodiment, computing device **510** also includes a network module **513**. In one embodiment, processor module **511** includes one or more general processors, a multi-core processor, an application specific integrated circuit based processor, a system on a chip (SOC) processor or an embedded processor. In one embodiment, output module **515** includes a display for displaying video signals, images and text, and an audio speaker to play sound signals. In one embodiment, output module **515** includes a data interface such as USB, HDMI, DVI, DisplayPort, thunderbolt connecting to a display or a speaker. In one embodiment, input module **517** includes a physical or logical keyboard, buttons, keys, or microphones. In one embodiment, input module **517** includes or connects to one or more sensors such as an optical sensor, an infrared (IR) sensor, a camera sensor, a motion sensor, a direction sensor, a proximity sensor, a gesture sensor, or other sensors that is usable by a user to provide input to computing device **510**. In one embodiment, input module **517** includes a physical panel housing one or more sensors. In one embodiment, storage module **519** includes a main memory, a hard disk drive (HDD), a solid state drive (SSD), a memory card, a ROM module, a RAM module, a USB disk, a storage compartment, a data storage component or other storage component. In one embodiment, network module **513** includes hardware and software to connect to a wireless data network such as a cellular network, a mobile network, a Bluetooth network, an NFC network, a personal area network (PAN), a WiFi network, or a LiFi network. Storage module **519** includes executable instructions which when executed by the processor module **511** of computing device **510**, implement one or more functionalities of the present invention.

In one embodiment, computer device **510** includes a clock **514**, which provides date and time information to computing device **510**.

In one embodiment, computing device **510** does not include all of the modules. In one embodiment, computing device **510** does not have network module **513** or clock **514**.

Returning to FIG. 1, smart glasses **301** includes a computing device housed in a glasses-like wearable frame. In one embodiment, smart glasses **301**, together with the included computing device, is a clip-on to a glass frame. In

one embodiment, smart glasses **301** is worn similar to a normal pair of glasses. In one embodiment, smart glasses **301** is a head-mounted device such as a helmet or a pair of goggles with head mounted trip. In one embodiment, user **101** wears smart glasses **301** in order to use smart glasses **301**.

In one embodiment, gesture sensor panel **323** includes a circuit board mounted onto smart glasses **301**, or onto a frame of smart glasses **301**. In one embodiment, display **312** is a head mounted display of smart glasses **301**. In one embodiment, display **312** has a size dimension similar to size of lenses of a pair of normal glasses. In one embodiment, display **312** includes one or two display panels, facing towards the eyes of user **101** so that user **101** can see display **312**. In one embodiment, gesture sensor panel **323** is mounted behind display **312**, facing outward from smart glasses **301**, so that gesture sensor panel **323** can detect finger **112**. In one embodiment, 3D gesture sensor **324** includes one or more electrodes placed onto gesture sensor panel **323**. In one embodiment, imaging sensor **326** is mounted onto gesture sensor panel **323**, e.g. near the center of sensor panel **323** and at about eye level of user **101**, so that imaging sensor **326** can take an image of what user **101** could be seeing. In one embodiment, speaker **313** includes a headphone, an earphone, or a bone-conducting speaker that is worn by user **101** or attached onto smart glasses **301**.

In one embodiment, media content **355** includes a video, a movie, a television show, a television series, an animation, a music video, a video playlist, a video presentation, a live tele-cast, a live feed, a streaming video, a live-streaming video, a feed obtained from a remote camera via a data network, or a live feed streaming from imaging sensor **326** or a camera attached to smart glasses **301**. In one embodiment, media content **355** includes a song, a piece of music, an audio file, a streaming audio, an audio book, a playlist of audio content, a podcast, broadcast radio, or a live feed of audio streaming obtained from a data network or from a microphone attached to smart glasses **301**. In one embodiment, media content **355** includes one or more pictures or images, a photo album, a gallery of images, or one or more animated pictures. In one embodiment, media content **355** includes a document, a web page, one or more messages or email messages, a list of documents or messages, an e-book, an electronic magazine or e-magazine, a web page, a note, or a list of notes. In one embodiment, media content **355** includes one or more of above combination of media content.

In one embodiment, media player **352** includes a plurality of computer programming instructions, which when executed, presents media content **355** over display **312** and/or speaker **313**. Media player **352** may include an e-book reader, a web browser, a web-view software, an email client, an email app, a social media messaging application, a music player, a podcast player, a video player, an application for YouTube®, Netflix®, Hulu®, Amazon Instant Video®, or other online video services, a comic book electronic reader or application, an application aggregating news and magazine articles, a notes application, a calendar application, an address book or contact application, or other applications handling media content **355**.

FIG. 3 illustrates an exemplary embodiment to capture a repetitive 3D-gesture. In one embodiment, finger **112** moves to form repetitive gesture **115**. Gesture sensor panel **323** detects movement of the finger **112** and generates a plurality of capture positions **337** corresponding to the finger's **112** movement in the repetitive gesture **115**. Gesture sensor panel **323** sends captured positions **337** to gesture analyzer

**331**. In one embodiment, gesture sensor panel **323** continuously detects finger **112** movement, captures addition positions, and includes the additional captured positions in captured positions **337**. In one embodiment, gesture sensor panel **323** makes available the captured positions **337** to gesture analyzer **331** when additional positions are captured. In one embodiment, gesture analyzer **331** requests the captured positions **337** from the gesture sensor panel **323**. Gesture analyzer **331** may send the request from time to time, periodically, or whenever it expects to receive the captured positions **337**.

Gesture analyzer **331** examines captured positions **337** and determines if captured positions **337** contains a gesture cycle **334**, as described further below. In one embodiment, captured positions **337** includes a list of a plurality of detected spatial positions of finger **112**, listed in the order that the positions are captured by gesture sensor panel **323**. In one embodiment, captured positions **337** include a 3-dimensional coordinate position of the finger **112**, indicating three coordinate values such as x-value, y-value, and z-value.

In one embodiment, gesture analyzer **331** examines captured positions **337** and determines that there is a gesture cycle when a later position **375** in captured positions **337** matches an earlier position **371** in captured positions **337**. The two matching positions are not adjacent in the captured positions **337**. For example, the earlier position **371** is in a 5<sup>th</sup> position in the captured positions **337**, while the later position **375** is in the 20<sup>th</sup> position in the captured positions **337**. When the later position **375** matches the earlier position **371**, the gesture analyzer **331** determines that the positions from the 5<sup>th</sup> position to the 20<sup>th</sup> position contain a gesture cycle. As illustrated in this example, the two matching positions are 14 positions apart. In one embodiment, gesture analyzer **331** first determines that a middle position does not match the earlier position **371**, and then matches the later position **375** to the earlier position **371**. When the later and earlier positions **371**, **375** are matched, gesture analyzer **331** determines that a gesture cycle has been detected. In one embodiment, gesture analyzer **331** creates a gesture cycle **334** record to store the detected gesture cycle. In one embodiment, gesture cycle **334** stores a plurality of positions between earlier position **371** and later position **375**, which includes middle position **373**. In one embodiment, gesture cycle **334** stores only non-matching positions, i.e., no repeat positions, except possibly later position **375**.

In one embodiment, upon detecting gesture cycle **334**, gesture analyzer **331** creates a repetitive gesture **332** record, and stores gesture cycle **334** into repetitive gesture **332**. In one embodiment, gesture analyzer **331** continues processing captured positions **337** to detect a second gesture cycle **336**, after detecting gesture cycle **334** in the same manner described above. Gesture analyzer **331** then matches gesture cycle **336** to gesture cycle **334** of repetitive gesture **332**. When gesture cycle **336** matches gesture cycle **334**, gesture analyzer **331** determines gesture cycle **336** is a repeat cycle for repetitive gesture **332**, and stores gesture cycle **336** into repetitive gesture **332**.

In one embodiment gesture analyzer **331** reports repetitive gesture **332** to media player **352**. In one embodiment, gesture analyzer **331** sends repetitive gesture **332** to media player **352** after detecting gesture cycle **334**. In one embodiment, gesture analyzer **331** sends repetitive gesture **332** to media player **352** after detecting at least two gesture cycles, such as gesture cycle **334** and gesture cycle **336**, in repetitive gesture **332**. Gesture analyzer **331** continuously examines captured positions **337** to detect any further additional

gesture cycles and matches detected additional gesture cycles to repetitive gesture **332**. Upon determining that the additional gesture cycles match repetitive gesture **332**, gesture analyzer **331** modifies repetitive gesture **332** to store the additional gesture cycles, and reports the modified repetitive gesture **332** with the additional gesture cycles to media player **352**.

In one embodiment, gesture analyzer **331** matches earlier position **371** and later position **375** by matching their corresponding x-, y-, z-coordinate values. In one embodiment, in order to determine if the gesture cycle is an X-cycle, gesture analyzer **331** does not consider the x-values of either position. Gesture analyzer **331** compares the y-value and z-value pair of later position **375** to the y-value and z-value pair of earlier position **371** to determine if the positions are close. For example, the y-value range is 0-65535 and the z-value range is 0-32767. Two positions are considered close to each other if the y-values of the two positions are within 100 units apart and the z-values are within 75 units apart, or the y-values are within 1000 units and z-values are within 1000 units. In one embodiment, the y-, z-coordinate range is divided into 5x5 cells. Two positions are close to each other when the two positions are in the same cell. In one embodiment, two positions are close to each other if they are within a pre-determined distance. Other embodiments for the y-value and z-value ranges may be (0-1023, 0-511), (1-1280, 1-800), (0-65535, 0-65535) or other ranges.

In one embodiment, gesture analyzer **331** matches earlier position **371** and later position **375** for detecting a Y-cycle by matching the x- and z-values of the two positions. In one embodiment, gesture analyzer **331** matches the two positions for detecting a Z-cycle by comparing the x- and y-values of the two positions. In one embodiment, gesture analyzer **331** matches the two position for detecting one or more of X-cycles, Y-cycles or Z-cycles simultaneously.

In one embodiment, gesture analyzer **331** divides an x-value range into two regions of space, defined as LEFT and RIGHT, and matches earlier position **371** and later position **375** for detecting a LEFT X-cycle, when both positions are within the LEFT region or a RIGHT X-cycle when both positions are in the RIGHT region. In one embodiment, gesture analyzer **331** may divide x-value range into three regions of space, defined as LEFT, CENTER and RIGHT. Gesture analyzer **331** detects a LEFT X-cycle, CENTER X-cycle or RIGHT X-cycle. Similarly, gesture analyzer **331** may divide y-value range into a plurality of regions of space, defined as UP, CENTER, DOWN, or divide z-value range into a plurality of regions of space, defined as IN, CENTER, OUT. Gesture analyzer **331** may detect a corresponding Y-cycle or Z-cycle within a y-value region or a z-value region.

In one embodiment, gesture analyzer **331** detects two different cycles by matching earlier position **371** and later position **375**, such as an X-cycle and a Z-cycle. In this embodiment, finger **112** may perform repetitive gesture **115** in a slanted or diagonal direction. In one embodiment, gesture analyzer **331** stores both detected cycles into gesture cycle **334**. In one embodiment, gesture analyzer **331** determines, using other information, to record only one cycle, such as Z-cycle, into gesture cycle **334**. In one embodiment, gesture analyzer **331** discards X-cycle after detecting gesture cycle **336**, which may be a Z-cycle, thus indicating gesture cycle **334** is a Z-cycle.

In one embodiment, gesture analyzer **331** collects additional information into gesture cycle **334**, as illustrated in FIG. 4. Gesture cycle **334** may include one or more attributes, including but not limited to a gesture type; a speed or

duration; a range or span of x-, y-, z-values; an orientation; a plurality of positions; and a location. The gesture cycle 334 is stored in a list of gesture cycles in the repetitive gesture 332. As shown in FIG. 4, repetitive gesture 332 may include one or more attributes, including but not limited to: gesture type; gesture cycle count; list of gesture cycles; orientation or direction; and location. Returning to FIG. 3, in one embodiment, gesture sensor panel 323 stores in captured positions 337 an indication of the time at which a position is captured. Gesture analyzer 331 calculates a cycle duration or speed of gesture cycle 334 using the time indications or timestamps between earlier position 371 and later position 375. In one embodiment, gesture analyzer 331 calculates the maximum span of x-values, y-values and z-values of all positions in gesture cycle 334. In one embodiment, gesture analyzer 331 calculates the directions of changes from one position to the next position in gesture cycle 334. For example, gesture cycle 334 includes a Y-cycle, and the directions of changes x-value and z-value are (+, +), (+,+), (+,+), (+,-), (+,-), (-, -), (-, -), (-,+), and (-,+), where “+” includes an increase in value and “-” indicates a decrease in value. Gesture analyzer 331 determines this as a clockwise orientation. An example of counter-clockwise orientation includes the directions of changes being (+,-), (+,-), (+,+), (+,+), (+,+), (-,+), (-,-), and (-,-). In one embodiment, gesture cycle 334 includes an X-cycle and gesture analyzer 331 determines an orientation of gesture cycle 334 by calculating the directions of changes of y- and z-values from one position to the next position, and matching the directions of changes to a pre-determine rule regarding orientation. Similarly gesture analyzer 331 calculates an orientation of a Z-cycle if gesture cycle 334 includes a Z-cycle.

In one embodiment, gesture cycle 334 includes a Z-cycle and the directions of changes of x-value and y-value are (+,+), (+,+), (-,-), and (-,-). Gesture analyzer 331 calculates the Z-cycle orientation or direction of gesture cycle 334 is LEFT-to-RIGHT. Other possible orientations or directions include RIGHT-to-LEFT, IN-to-OUT, UP-to-DOWN, DOWN-to-IN, OUT-to-IN, DIAGONAL, UP-RIGHT-to-DOWN-LEFT, UP-LEFT-to-DOWN-RIGHT, and other similar orientations. In one embodiment, gesture cycle 334 includes an orientation, such as clockwise, and a direction, such as DIAGONAL.

In one embodiment, gesture analyzer 331 determines a gesture type for gesture cycle 334. In one embodiment, gesture analyzer 331 determines the gesture type based on the span of gesture cycle 334. In one embodiment, gesture cycle 334 includes an X-cycle and the y-span is about the same as the z-span, or the ratio of y-span to z-span is between 0.75 and 1.25. Gesture analyzer 331 then determines that the gesture type is a circle. In one embodiment, gesture cycle 334 includes an X-cycle, and the y-span is zero or small but the z-span is large. Gesture analyzer 331 then determines that the gesture type is a swipe. In one embodiment, the y-span is small and the z-span is medium. Gesture analyzer 331 determines the gesture type is a tap. In one embodiment, the ratio between the y-span and z-span is between ¼ and ½, and gesture analyzer 331 determines the gesture type is an ellipse. In one embodiment, gesture analyzer 331 determines a gesture type for gesture cycle 334 when gesture cycle 334 includes a Y-cycle or a Z-cycle. In one embodiment, gesture analyzer 332 determines a gesture type to be an ellipse, a circle, a tap, or a swipe when gesture cycle 334 includes a Y-cycle or a Z-cycle. In one embodiment, gesture analyzer 331 processes gesture cycle 334 to determine other gesture types such as a knock, a push or pull.

In one embodiment, gesture analyzer 331 calculates a location of gesture cycle 334. In one embodiment, the location of gesture cycle 334 is calculated based on the first position of gesture cycle 334. In one embodiment, the location of gesture cycle 334 is calculated as a center position of gesture cycle 334, based on the plurality of positions of gesture cycle 334. In one embodiment, the location of gesture cycle 334 is calculated based on a position according to the mean x-value, y-value, and z-value of the plurality of positions of gesture cycle 334. In one embodiment, gesture analyzer 331 sets location of gesture cycle 334 as location of repetitive gesture 332.

In one embodiment, gesture analyzer 331 detects gesture cycle 336 and determines additional attributes for gesture cycle 336, such as a gesture type, speed or duration, a range and span, orientation, a plurality of positions, and a location.

In one embodiment, gesture analyzer 331 matches gesture cycle 334 and gesture cycle 336 by matching one or more attributes of the two gesture cycles. In one embodiment, the gesture types or the two orientations of the two gesture cycles do not match, and gesture analyzer 331 determines that the two gesture cycles do not match. In one embodiment, the spans of the two gesture cycles differ beyond a predetermined threshold, and gesture analyzer 331 determines that the two gesture cycles do not match. In one embodiment, the gesture types, the orientations, the spans, and optionally the locations of the two gesture cycles match, gesture analyzer 331 concludes that the two gesture cycles match.

In one embodiment, upon concluding gesture cycle 336 matches gesture cycle 334, gesture analyzer 331 adds gesture cycle 336 to the list of gesture cycles in repetitive gesture 332. In one embodiment, gesture analyzer 331 store gesture type and orientation of gesture cycle 334 as gesture type and orientation of repetitive gesture 332. In one embodiment, gesture analyzer 331 maintains a gesture cycle count for the number of gesture cycles in the list of gesture cycles and increments the count for repetitive gesture 332. In one embodiment, gesture analyzer 331 updates location of repetitive gesture 332 based on location of gesture cycle 336. In one embodiment, gesture analyzer 331 determines that the location of the repetitive gesture 332 is to be a center location between location of gesture cycle 334 and location of gesture cycle 336, or more generally, a center location among locations of the list of gesture cycles in repetitive gesture 332. In one embodiment, gesture analyzer 331 does not update location of repetitive gesture 332 and instead uses location of first gesture cycle in the list of gesture cycles as the location of repetitive gesture 332.

In one embodiment, when gesture analyzer 331 determines gesture cycle 336 does not match gesture cycle 334, gesture analyzer 331 indicates repetitive gesture 332 is completed by sending a notification to media player 352. In one embodiment, gesture analyzer 331 creates a new repetitive gesture based on gesture cycle 336. In one embodiment, repetitive gesture 332 includes a mode attribute indicating gesture analyzer 331 is continuing to detect a next gesture cycle of repetitive gesture 332. In one embodiment, gesture analyzer 331 sets the mode attribute to “DETECTING”, “0” or “NON-FINAL” when storing gesture cycle 334 into repetitive gesture 332. Upon determining gesture cycle 336 does not match gesture cycle 334, gesture analyzer 331 indicates repetitive gesture 332 is completed by setting the mode attribute to “FINAL”, “1” or “NON-DETECTING”.

FIG. 5 illustrates an exemplary embodiment to process a repetitive gesture while playing a media content. Media player 352 is presenting media content 355 onto display 312

or speaker 313. In one embodiment, gesture analyzer 331 detects repetitive gesture 332. Repetitive gesture 332 includes gesture cycle 334. In one embodiment, gesture analyzer 331 sends repetitive gesture 332 to media player 352. In one embodiment, media player 352 requests and receives repetitive gesture 332 from gesture analyzer 331.

In one embodiment, media player 352 processes repetitive gesture 332 and changes the presentation of media content 352 according to the gesture cycles in the list of gesture cycles. Media player 352 retrieves gesture type 421 of repetitive gesture 332 and determines an action 453 associated with the gesture type 421 to apply to media content 355. In one embodiment, media player 352 determines media content type 356 of media content 355. Media player 352 may retrieve media content type 356 as an attribute of media content 355, or determines media content type 356 based on a receiving mechanism of media content 355, such as a data network protocol, a file name extension, a capturing mechanism using a camera or microphone or other mechanism. In one embodiment, media player 352 includes a gesture-content action list 451 and selects action 453 from gesture-content action list 451 associated with gesture type 421 and media content type 356. FIG. 6 illustrates an embodiment of gesture-content action list 451. For example, a small circle gesture for a video media content is associated with an action of forwarding or rewinding; a swipe gesture for a video is associated with a skip of a chapter or episode; a large circle gesture for audio media content is associated with a skip of a track or a playlist item; a tap gesture for an e-magazine content is associated with a zoom in or zoom out. In one embodiment, media player 352 uses other attributes in repetitive gesture 332, such as a span of gesture cycle 334, to determine if repetitive gesture 332 is a small circle or a wide swipe gesture, in order to select an action. In one embodiment, media player 352 matches media content type 356, gesture type 421 and optionally other attributes in repetitive gesture 332 to select an action 453.

In one embodiment, media player 352 applies action 453 to the presentation of media content 355, using other attributes of repetitive gesture 332. In one embodiment, action 453 is to forward or to rewind a video of media content 355. Media player 352 retrieves orientation of repetitive gesture 332. In one embodiment, the orientation of repetitive gesture 332 is clockwise, and media player 352 fast forwards the display of the video of media content 355. In one embodiment, the orientation is counter-clockwise, and media player 352 rewinds the display of the video of media content 355. In one embodiment, media player 352 examines the duration of gesture cycle 334 of repetitive gesture 332 and determines the speed of the forwarding or rewinding action.

In one embodiment, action 453 is to scroll a list in media content 355. Media player 352 determines the direction of scrolling action using the orientation of repetitive gesture 332, and the speed of scrolling action using the duration of gesture cycle 334.

Other actions for action 453 may require different decision made by media player 352 based on orientation of repetitive gesture 332. In one embodiment, media player 352 applies action 453 according to orientation of repetitive gesture 332 and a factor based on a user preference or a content type. In one embodiment, a user preference indicates a left hand motion. Media player 352 rewinds the display of the video of media content 355 when the orientation is clockwise and forwards the display of the video when the orientation is counter-clockwise. In one embodiment, media content 355 includes a document in a right-to-left language.

Media player 352 applies action 453 to flip the document forward when the orientation of repetitive gesture 332 is from left to right.

In one embodiment, gesture analyzer 331 detects a second gesture cycle 336 for repetitive gesture 332. In one embodiment, media player 352 receives gesture cycle 336 of repetitive gesture 332 while applying action 453. Media player 352 includes gesture cycle 336 attributes in further applying action 453. In one embodiment, action 453 is to fast forward video content in media content 355. Media player 352 retrieves duration of gesture cycle 336 and determines the duration is shorter than gesture cycle 334, meaning gesture cycle 336 is performed faster than gesture cycle 334. Media player 352 applies a faster speed in forwarding the video content. For example, media player 352 applies 2 times as fast or 1.5 times as fast as current speed. In one embodiment, the duration of gesture cycle 336 is longer than the duration of gesture cycle 334, and media player 352 slows the speed of forwarding, for example half the current speed or 75% of the current speed. In one embodiment, media player 352 changes the speed of action 453 when there is a change of span of gesture cycle 336 from the span of gesture cycle 334.

In one embodiment, gesture analyzer 331 detects an end of the list of gesture cycles in repetitive gesture 332 and sends a notification to media player 352. In one embodiment, media player 352 responds to the notification by stopping the application of action 453. In one embodiment, gesture analyzer 331 does not immediately stop applying action 453, but instead slows the speed of action 453 to provide a smooth presentation of media content 355 to avoid a sudden stop of the action 453.

In one embodiment, media player 352 includes a pre-configured gesture-content action list 451. In one embodiment, media player 352 obtains gesture-content action list 451 from a storage module, media content 355, or from a source providing media content 355. In one embodiment, media player 352 obtains gesture-content action list 451 from a user of media player 352. In one embodiment, gesture-content action list 451 is pre-configured according to a user preference. For example, the action associated with a repetitive gesture may differ between a right-handed user and a left-handed user, between users of different cultures, or for users with physical impairments.

In one embodiment, media content 355 includes action 453, which may be a computer programming instruction or a computer scripting instruction embedded in media content 355. For example, media content 355 may include a JavaScript, a Java object, a visual basic script, or embedded computer instructions. Media player 352 retrieves action 453 from media content 355 and applies action 453.

In one embodiment, media player 352 is presenting a plurality of media content such as media content 355 and media content 357 as illustrated in FIG. 7. In one embodiment, media content 355 is presented on a display area 315 of display 312, and media content 357 is presented on a display area 317 of display 312. In one embodiment, media player 352 receives repetitive gesture 332 and selects a media content to apply repetitive gesture 332. In one embodiment, media content 355 is marked active and media player 352 selects media content 355 for processing repetitive gesture 332. In one embodiment, media player 352 retrieves location 422 of repetitive gesture 332 and matches location 422 to display area 315 and display area 317. In one embodiment, location 422 is inside display area 317, and media player 352 selects media content 357 to process repetitive gesture 332. In one embodiment, location 422

indicates a right side, and display area 317 is on the right side of display 312. Media player thus 352 selects media content 357. In one embodiment, location 422 indicates an outer region or a large z-value, and display area 317 is smaller than display area 315. Media player 352 thus selects media content 357. In one embodiment, location 422 indicates an inner region or a small z-value, and display area 315 is larger than display area 317. Media player 352 selects media content 355.

The following description is presented to enable one of ordinary skill in the art to make and use the present invention and is provided in the context of a patent application and its requirements. Various modifications to the embodiment will be readily apparent to those skilled in the art and the generic principles herein may be applied to other embodiments. Thus, the present invention is not intended to be limited to the embodiment shown but is to be accorded the widest scope consistent with the principles and features described herein.

Reference in this specification to “one embodiment”, “an embodiment”, “an exemplary embodiment”, or “a preferred embodiment” means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of the phrase “in one embodiment” in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. Moreover, various features are described which may be exhibited by some embodiments and not by others. Similarly, various requirements are described which may be requirements for some embodiments but not other embodiments. In general, features described in one embodiment might be suitable for use in other embodiments as would be apparent to those skilled in the art.

The flowchart and block diagrams in the Figures illustrate the architecture, functionality, and operation of possible implementations of systems, methods and computer program products according to various embodiments of the present invention. In this regard, each block in the flowchart or block diagrams may represent a module, segment, or portion of code, which comprises one or more executable instructions for implementing the specified local function(s). It should also be noted that, in some alternative implementations, the functions noted in the block may occur out of the order noted in the figures. For example, two blocks shown in succession may, in fact, be executed substantially concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, can be implemented by special purpose hardware-based systems that perform the specified functions or acts, or combinations of special purpose hardware and computer instructions.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms “a”, “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises” and/or “comprising,” when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

Although the present invention has been described in accordance with the embodiments shown, one of ordinary skill in the art will readily recognize that there could be variations to the embodiments and those variations would be within the spirit and scope of the present invention. Accordingly, many modifications may be made by one of ordinary skill in the art without departing from the spirit and scope of the appended claims.

What is claimed is:

1. A system, comprising:

a three-dimensional sensor panel for detecting a plurality of three-dimensional (3D) positions corresponding to a finger movement in a 3D space, the 3D space detectable by the 3D sensor panel and comprising a first dimension, a second dimension, and a third dimension, the first dimension comprising a range of first dimension coordinates, the range of first dimension coordinates grouped into at least a first region of space and a second region of space;

a controller; and

a non-transitory computer readable storage medium comprising computer readable program code embodied therein, wherein when executed by the controller causes the controller to:

(a) determine that the plurality of 3D positions contain a gesture cycle, comprising:

(a1) compare a set of positions in the plurality of 3D positions, the set of positions comprising at least two non-adjacent positions in the plurality of 3D positions, each of the plurality of 3D positions comprising a first dimension coordinate, a second dimension coordinate, and a third dimension coordinate; and

(a2) upon determining that the set of positions in the plurality of 3D positions match, determine that the plurality of 3D positions contain the gesture cycle;

(b) determine that the gesture cycle comprises a first dimension cycle with first dimension coordinates in the first region of space, comprising:

(b1) determine that the first dimension coordinates in the plurality of 3D positions are each in the first region of space; and

(b2) upon determining that the first dimension coordinates in the plurality of 3D positions are each in the first region of space, determine that the gesture cycle contains the first dimension cycle in the first region of space; and

(c) create a gesture cycle record for the gesture cycle, the gesture cycle record comprising information associated with the gesture cycle, the information comprising the first dimension cycle in the first region of space.

2. The system of claim 1, wherein the system comprises a pair of smart glasses, wherein the 3D sensor panel is mounted within the pair of smart glasses.

3. The system of claim 1, wherein the controller is further caused to:

(d) determine a gesture type of the gesture cycle based at least on the first dimension cycle in the first region of space; and

(e) store the gesture type in the gesture cycle record as additional information associated with the gesture cycle.

4. The system of claim 3, wherein the determine (d) comprises:

(d1) determine the gesture type of the gesture cycle based at least on the first dimension, cycle in the first region of space, a second dimension span of a second set of

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positions in the plurality of 3D positions, and a third dimension span of the second set of positions.

5. The system of claim 3, wherein the controller is further caused to:

(1) process the gesture cycle record for a media content comprising:

(f1) retrieve the gesture type from the gesture cycle;

(f2) determine an action, associated with the gesture type; and

(g) apply the action to the media content.

6. The system of claim 5, wherein the action comprises one or more of the following: forwarding of the media content; rewinding of the media content; or scrolling of the media content.

7. The system of claim 1, wherein the second dimension comprises a range of second dimension coordinates, the range of second dimension coordinates grouped into at least a third region of space and a fourth region of space, wherein the controller is further caused to:

(d) determine that the gesture cycle comprises a second dimension cycle with second dimension coordinates in the third region of space, comprising:

(d1) determine that the second dimension coordinates in the plurality of 3D positions are each in the third region of space; and

(d2) upon determining that the second dimension coordinates in the plurality of 3D positions are each in the third region of space, determine that the gesture cycle further contains the second dimension cycle in the third region of space; and

(e) store the second dimension cycle in the third region of space in the information in the gesture cycle record.

8. The system of claim 1, further comprising:

(d) determine that the plurality of 3D positions contain a second gesture cycle, comprising:

(d1) compare a second set of positions in the plurality of 3D positions, the second set of positions comprising at least two other non-adjacent positions in the plurality of 3D positions; and

(d2) upon determining that the second set of positions in the plurality of 3D positions match, determine that the plurality of 3D positions contain the second gesture cycle;

(e) determine that the second gesture cycle comprises another first dimension cycle with first dimension coordinates in the second region of space, comprising:

(e1) determine that the first dimension coordinates in the other first dimension cycle are each in the second region of space; and

(e2) upon determining that the first dimension coordinates in the other first dimension cycle are each in the second region of space, determine that the second gesture cycle contains the first dimension cycle in the second region of space; and

(c) store in the gesture cycle record information associated with the second gesture cycle, the information associated with the second gesture cycle comprising the other first dimension cycle in the second region of space.

9. A method of using a three-dimensional sensor panel in determining gesture cycle information, comprising:

(a) receiving, by a controller of a computing device, a plurality of three-dimensional (3D) positions, the plurality of 3D positions corresponding to a finger movement in a 3D space detectable by the 3D sensor panel and comprising a first dimension, a second dimension, and a third dimension, the first dimension comprising a

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range of first dimension coordinates, the range of first dimension coordinates grouped into at least a first region of space and a second region of space;

(b) determining, by the controller, that the plurality of 3D positions contain a gesture cycle, comprising:

(b1) comparing, by the controller, a set of positions in the plurality of 3D positions, the set of positions comprising at least two non-adjacent positions in the plurality of 3D positions, each of the plurality of 3D positions comprising a first dimension coordinate, a second dimension coordinate, and a third dimension coordinate; and

(b2) upon determining that the set of positions in the plurality of 3D positions match, determining, by the controller, that the plurality of 3D positions contain the gesture cycle;

(c) determining, by the controller, that the gesture cycle comprises a first dimension cycle with first dimension coordinates in the first region of space, comprising:

(c1) determining, by the controller, that the first dimension coordinates in the plurality of 3D positions are each in the first region of space; and

(c2) upon determining that the first dimension coordinates in the plurality of 3D positions are each in the first region of space, determining, by the controller, that the gesture cycle contains the first dimension cycle in the first region of space; and

(d) creating, by the controller, a gesture cycle record for the gesture cycle, the gesture cycle record comprising information associated with the gesture cycle, the information comprising the first dimension cycle in the first region of space.

10. The method of claim 9, further comprising:

(e) determining, by the controller, a gesture type of the gesture cycle based at least on the first dimension cycle in the first region of space; and

(f) storing, by the controller, the gesture type in the gesture cycle record as additional information associated with the gesture cycle.

11. The method of claim 10, wherein the determining (e) comprises:

(e1) determining, by the controller, the gesture type of the gesture cycle based at least on the first dimension cycle in the first region of space, a second dimension span of a second set of positions in the plurality of 3D positions, and a third dimension span of the second set of positions.

12. The method of claim 10, further comprising:

(g) processing, by the controller, the gesture cycle record for a media content, comprising:

(g1) retrieving the gesture type from the gesture cycle;

(g2) determining an action associated with the gesture type; and

(h) applying the action to the media content.

13. The method of claim 12, wherein the action comprises one or more of the following: forwarding of the media content; rewinding of the media content or scrolling of the media content.

14. The method of claim 9, wherein the second dimension comprises a range of second dimension coordinates, the range of second dimension coordinates grouped into at least a third region of space and a fourth region of space, further comprising:

(e) determining, by the controller, that the gesture cycle comprises a second dimension cycle with second dimension coordinates in the third region of space, comprising:



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- (e1) determining, by the controller, that the second dimension coordinates in the plurality of 3D positions are each in the third region of space; and
- (e2) upon determining that the second dimension, coordinates in the plurality of 3D positions are each in the third region of space, determining, by the controller, that the gesture cycle further contains the second dimension cycle in the third region of space; and
- (f) storing, by the controller, the second dimension cycle in the third region of space in the information in the gesture cycle record.

15. The method of claim 9, further comprising:

- (e) determining, by the controller, that the plurality of 3D positions contain a second gesture cycle, comprising:
  - (d1) comparing, by the controller, a second set of positions in the plurality of 3D positions, the second set of positions comprising at least two other non-adjacent positions in the plurality of 3D positions; and
  - (d2) upon determining that the second set of positions in the plurality of 3D positions match, determining, by the controller, that the plurality of 3D positions contain the second gesture cycle;
- (f) determining, by the controller that the second gesture cycle comprises another first dimension cycle with first dimension coordinates in the second region of space, comprising:
  - (f1) determining, by the controller that the first dimension coordinates in the other first dimension cycle are each in the second region of space; and
  - (f2) upon determining that the first dimension coordinates in the other first dimension cycle are each in the second region of space, determining, by the controller, that the second gesture cycle contains the first dimension cycle in the second region of space; and
- (g) storing, by the controller, in the gesture cycle record information associated with the second gesture cycle, the information associated with the second gesture cycle comprising the other first dimension cycle in the second region of space.

16. A non-transitory computer readable medium comprising computer readable program code embodied therein, wherein when executed by a controller causes the controller to:

- (a) receive a plurality of three-dimensional (3D) positions, the plurality of 3D positions corresponding to a finger movement in a 3D space detectable by the 3D sensor panel and comprising a first dimension, a second dimension, and a third dimension, the first dimension comprising a range of first dimension coordinates, the range of first dimension coordinates grouped into at least a first region of space and a second region of space;
- (b) determine that the plurality of 3D positions contain a gesture cycle, comprising:
  - (b1) compare a set of positions in the plurality of 3D positions, the set of positions comprising at least two non-adjacent positions in the plurality of 3D positions, each of the plurality of 3D positions comprising a first dimension coordinate, a second dimension coordinate, and a third dimension coordinate; and
  - (b2) upon determining that the set of positions in the plurality of 3D positions match, determine that the plurality of positions contain the gesture cycle;
- (c) determine that the gesture cycle comprises a first dimension cycle with first dimension coordinates in the first region of space, comprising:

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- (c1) determine that the first dimension coordinates in the plurality of 3D positions are each in the first region of space; and
- (c2) upon determining that the first dimension coordinates in the plurality of 3D positions are each in the first region of space, determine that the gesture cycle contains the first dimension cycle in the first region of space; and
- (d) create a gesture cycle record for the gesture cycle, the gesture cycle record comprising information associated with the gesture cycle, the information comprising the first dimension cycle in the first region of space.

17. The medium of claim 16, wherein the controller is further caused to:

- (e) determine a gesture type of the gesture cycle based at least on the first dimension cycle in the first region of space; and
- (f) store the gesture type in the gesture cycle record as additional information associated with the gesture cycle.

18. The medium of claim 17, wherein the determine (e) comprises:

- (e1) determine the gesture type of the gesture cycle based at least on the first dimension cycle in the first region of space, a second dimension span of a second set of positions in the plurality of 3D positions, and a third dimension span of the second set of positions.

19. The medium of claim 17, wherein the controller is further caused to:

- (g) process the gesture cycle record for a media content, comprising:
  - (g1) retrieve the gesture type from the gesture cycle;
  - (g2) determine an action associated with the gesture type; and
- (h) applying the action to the media content.

20. The medium of claim 19, wherein the action comprises one or more of the following: forwarding of the media content; rewinding of the media content; or scrolling of the media content.

21. The medium of claim 16, wherein the second dimension comprises a range of second dimension coordinates, the range of second dimension coordinates grouped into at least a third region of space and a fourth region of space, wherein the controller is further caused to:

- (e) determine that the gesture cycle comprises a second dimension cycle with second dimension coordinates in the third region of space, comprising:
  - (e1) determine that the second dimension coordinates in the plurality of 3D positions are each in the third region of space; and
  - (e2) upon determining that the second dimension coordinates in the plurality of 3D positions are each in the third region of space, determine that the gesture cycle further contains the second dimension cycle in the third region of space; and
- (f) store the second dimension cycle in the third region of space in the information in the gesture cycle record.

22. The medium of claim 16, wherein the controller is further caused to:

- (e) determine that the plurality of 3D positions contain a second gesture cycle, comprising:
  - (e1) compare a second set of positions in the plurality of 3D positions, the second set of positions comprising at least two other non-adjacent positions in the plurality of 3D positions; and

- (e2) upon determining that the second set of positions in the plurality of 3D positions match, determine that the plurality of 3D positions contain the second gesture cycle;
- (f) determine that the second gesture cycle comprises 5 another first dimension cycle with first dimension coordinates in the second region of space, comprising:
  - (f1) determine that the first dimension coordinates in the other first dimension cycle are each in the second region of space; and 10
  - (f2) upon determining that the first dimension coordinates in the other first dimension cycle are each in the second region of space, determine that the second gesture cycle contains the first dimension cycle in the second region of space; and 15
- (g) store in the gesture cycle record information associated with the second gesture cycle, the information associated with the second gesture cycle comprising the other first dimension cycle in the second region of space. 20

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