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(54) **REMOTE OBJECT SENSING IN VIDEO**

(71) Applicant: **International Business Machines Corporation**, Armonk, NY (US)

(72) Inventors: **Aleksandr Y. Aravkin**, Bronx, NY (US); **Anirban Basu**, Elmsford, NY (US); **Dimitri Kanevsky**, Ossining, NY (US); **Tara N. Sainath**, Jersey City, NJ (US)

(73) Assignee: **International Business Machines Corporation**, Armonk, NY (US)

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H04N 7/14 (2006.01)
H04N 7/15 (2006.01)

(52) **U.S. Cl.**
CPC . ***H04N 7/15*** (2013.01); ***H04N 7/147*** (2013.01)

(58) **Field of Classification Search**
CPC H04N 7/14
USPC 348/14.01, 14.04, 14.03
See application file for complete search history.

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Primary Examiner — Olisa Anwah
(74) *Attorney, Agent, or Firm* — Jeff Tang; Ryan, Mason & Lewis, LLP

(57) **ABSTRACT**

A method comprises obtaining an input comprising audio and visual data for display on a first device, receiving data associated with one or more sensory properties of one or more objects in the input, and reconstructing the one or more sensory properties at the first device based on the data received.

25 Claims, 7 Drawing Sheets

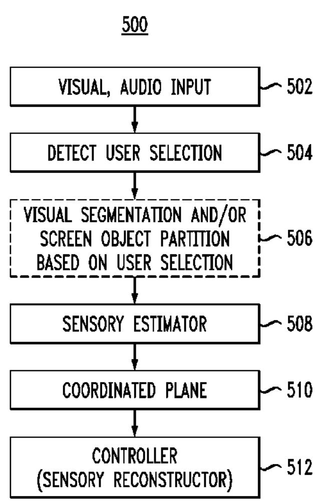


FIG. 1

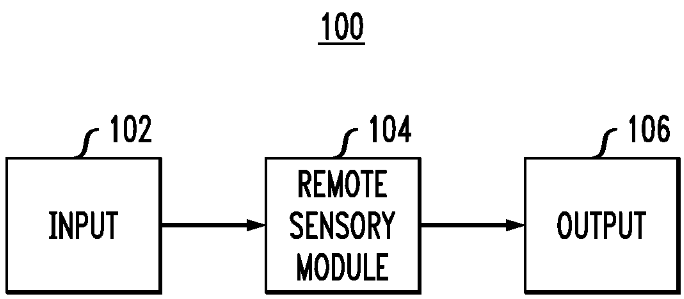

100
102
INPUT
104
REMOTE SENSORY MODULE
106
OUTPUT

FIG. 2

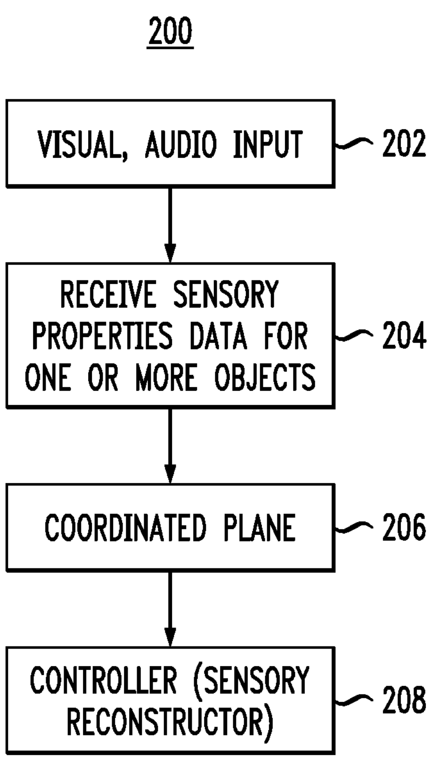

200
VISUAL, AUDIO INPUT
202
RECEIVE SENSORY PROPERTIES DATA FOR ONE OR MORE OBJECTS
204
COORDINATED PLANE
206
CONTROLLER (SENSORY RECONSTRUCTOR)
208

FIG. 3

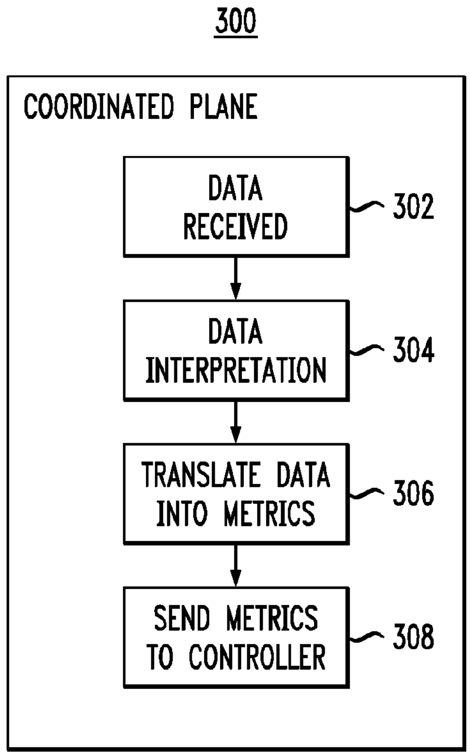

300
COORDINATED PLANE
DATA RECEIVED
302
DATA INTERPRETATION
304
TRANSLATE DATA INTO METRICS
306
SEND METRICS TO CONTROLLER
308

FIG. 4

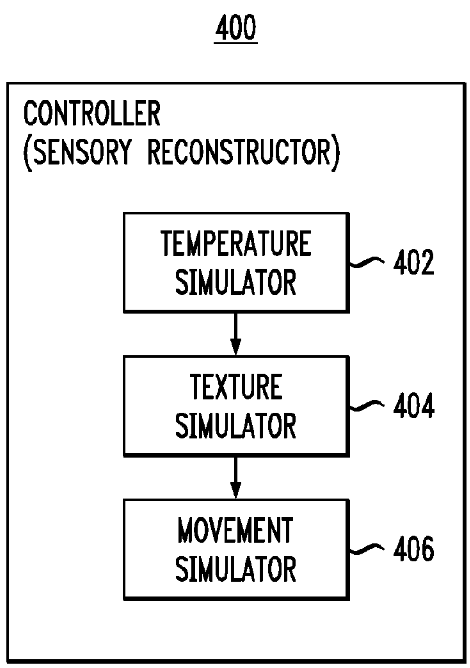

400
CONTROLLER (SENSORY RECONSTRUCTOR)
TEMPERATURE SIMULATOR
402
TEXTURE SIMULATOR
404
MOVEMENT SIMULATOR
406

FIG. 5

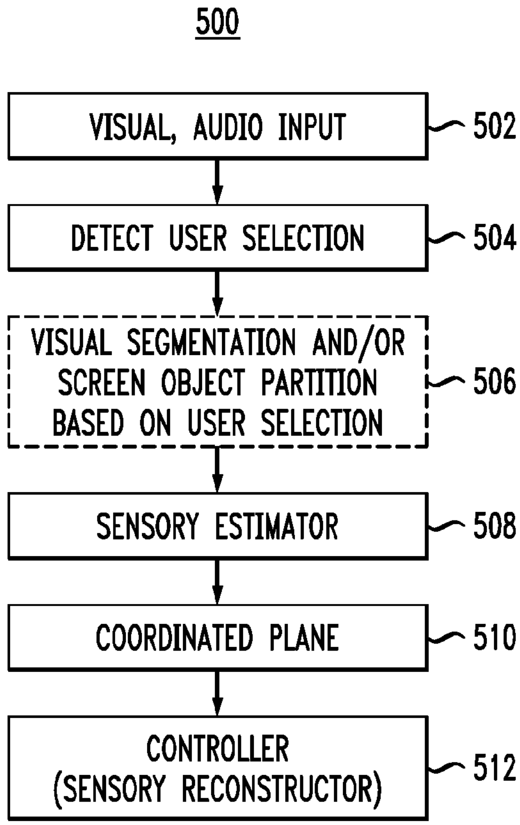

500
VISUAL, AUDIO INPUT
502
DETECT USER SELECTION
504
VISUAL SEGMENTATION AND/OR SCREEN OBJECT PARTITION BASED ON USER SELECTION
506
SENSORY ESTIMATOR
508
COORDINATED PLANE
510
CONTROLLER (SENSORY RECONSTRUCTOR)
512

FIG. 6

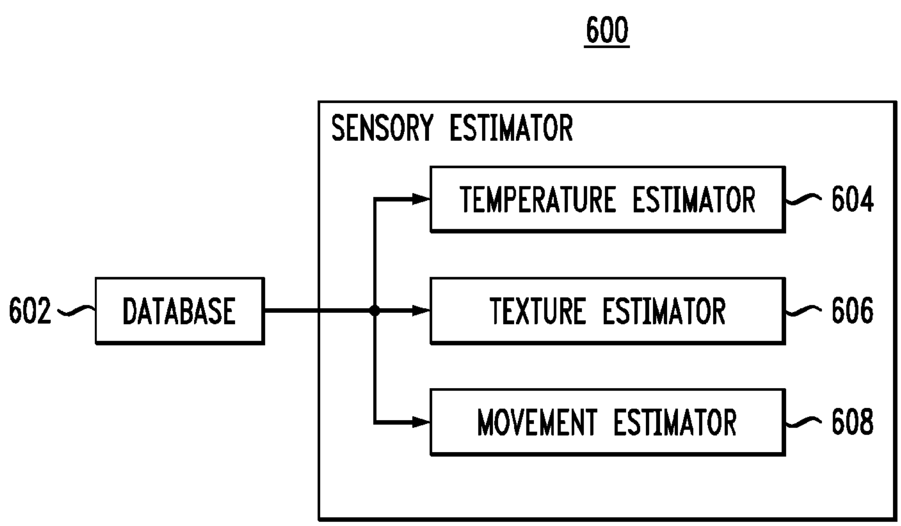

600
SENSORY ESTIMATOR
TEMPERATURE ESTIMATOR
604
602
DATABASE
TEXTURE ESTIMATOR
606
MOVEMENT ESTIMATOR
608

FIG. 7

700

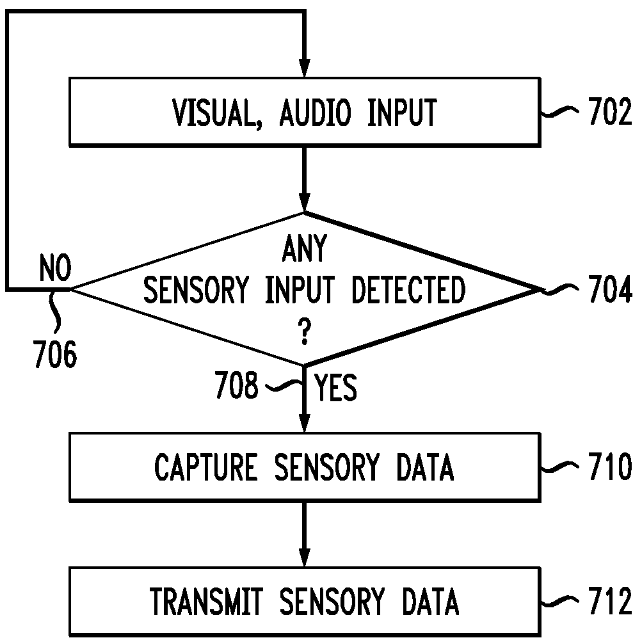

VISUAL, AUDIO INPUT
702
ANY SENSORY INPUT DETECTED ?
704
NO
706
708
YES
CAPTURE SENSORY DATA
710
TRANSMIT SENSORY DATA
712

FIG. 8A

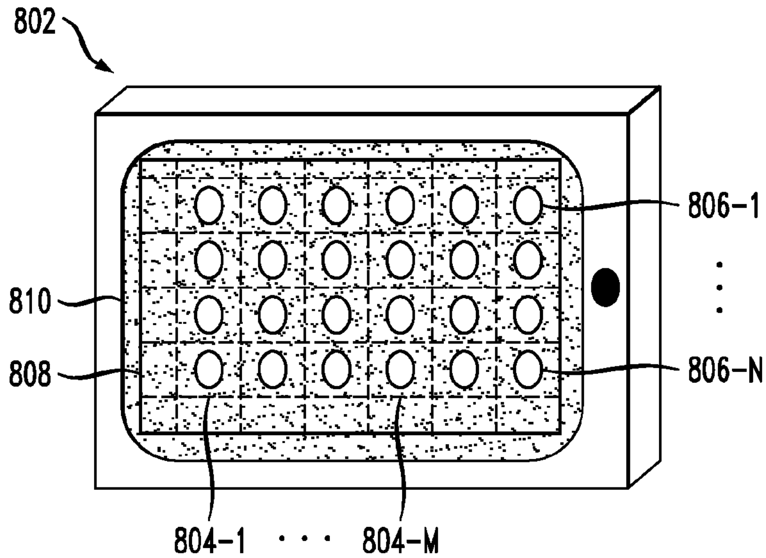


FIG. 8B

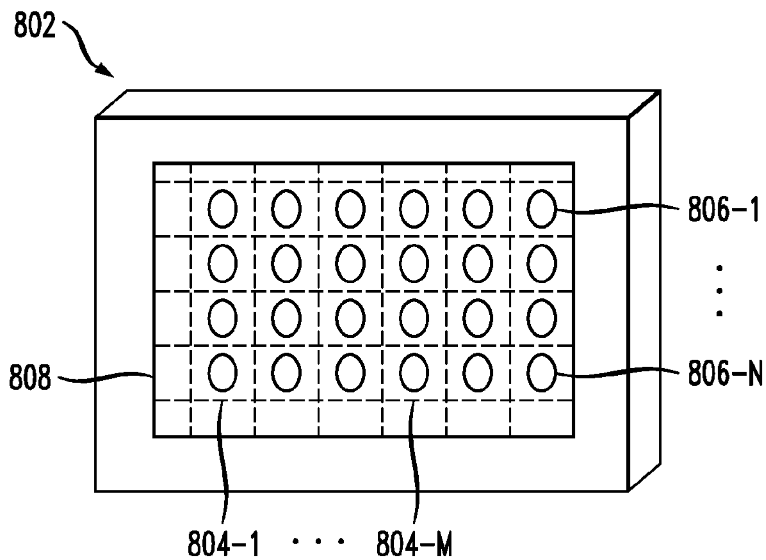


FIG. 9

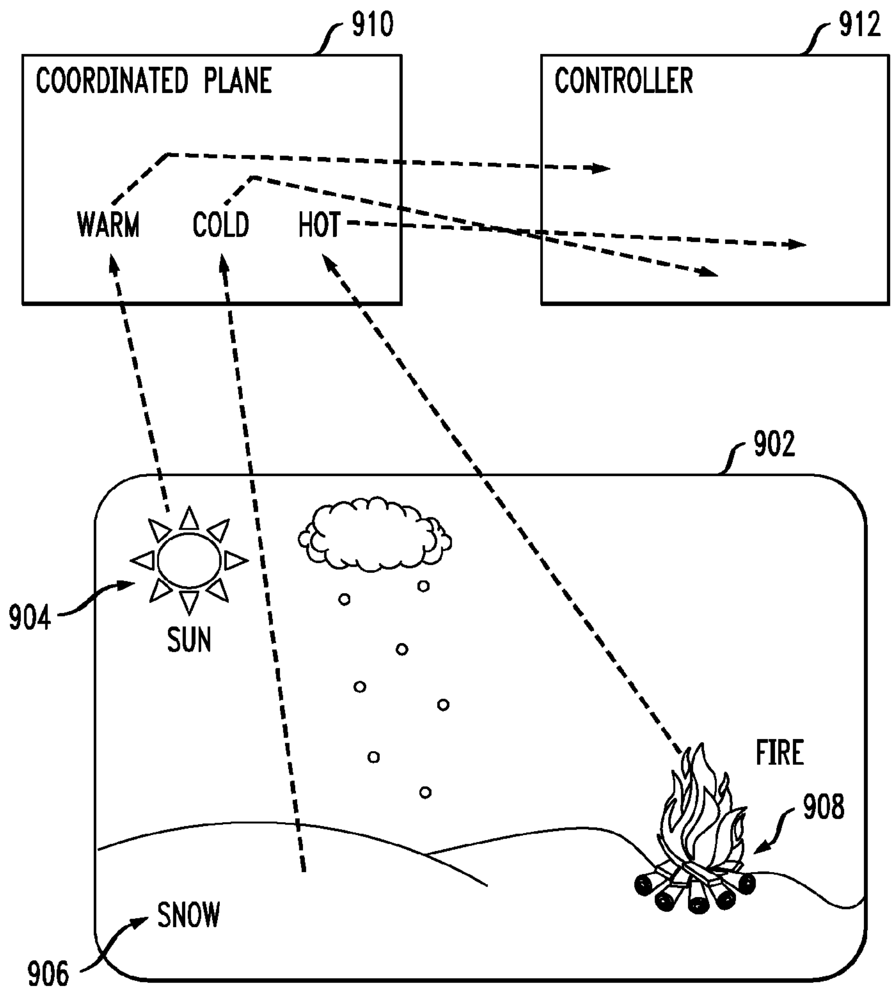
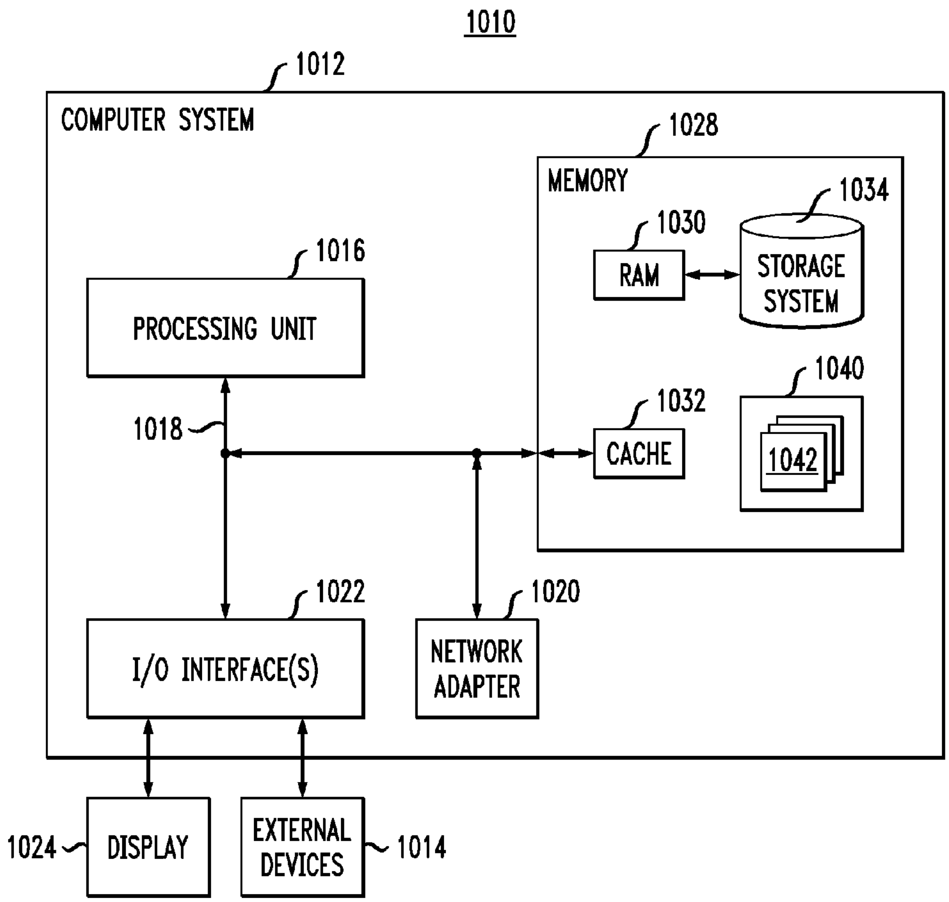

910
COORDINATED PLANE
WARM
COLD
HOT
912
CONTROLLER
902
904
SUN
FIRE
908
SNOW
906

FIG. 10


1010
1012
COMPUTER SYSTEM
1028
MEMORY
1034
1030
RAM
STORAGE SYSTEM
1016
PROCESSING UNIT
1040
1032
1018
CACHE
1042
1022
1020
I/O INTERFACE(S)
NETWORK ADAPTER
1024
DISPLAY
EXTERNAL DEVICES
1014

REMOTE OBJECT SENSING IN VIDEO

FIELD

The present application relates generally to remote object sensing and, more particularly, to techniques for replicating the sense of touch remotely.

BACKGROUND

As technology advances, more and more can be done in the virtual environment. For example, technological advances now enable new means of communication, including videotelephony and voice over IP. Communication between family members via remote means using applications such as SKYPE or FACETIME, allow for video and audio transmissions between users in real-time.

Furthermore, content available for media streaming continually expands in the virtual environment. Users can now easily send or receive videos and watch movies and shows on a user device. Communication via remote means also enable non-traditional forms of education such as distance learning. Students can now watch live or pre-recorded lectures as well as explore different subject areas using the vast media content available on the Internet. For example, a child can watch videos of lions in Africa without having to travel to Africa or even to a local zoo; a student in London can participate in a live lecture that is taking place in a New York City classroom.

SUMMARY

Embodiments of the invention provide techniques for recreating the sense of touch remotely using data received at a device.

For example, in one embodiment of the invention, a method comprises steps of obtaining an input comprising audio and visual data for display on a first device, receiving data associated with one or more sensory properties of one or more objects in the input, and reconstructing the one or more sensory properties at the first device based on the data received.

In additional embodiments of the invention, a method comprises obtaining an input comprising visual and audio data for display on a device, detecting user selection of one or more objects in the visual input, identifying the one or more selected objects and surroundings of the one or more objects, obtaining data associated with one or more sensory properties of the identified one or more objects and the surroundings, and reconstructing the one or more sensory properties associated with the identified one or more objects and the surroundings based on the data received.

In further embodiments of the invention, a method comprises obtaining an input comprising visual and audio data for display on a first device, detecting sensory input from a user of the first device, capturing data associated with the sensory input from the user of the first device, and transmitting the captured data to a second device for reconstruction of one or more sensory properties associated with the user of the first device.

In further embodiments, an apparatus comprises a memory and a processor operatively coupled to the memory. The processor is configured to obtain an input comprising audio and visual data for display on a first device, receive data associated with one or more sensory properties of one or more objects in the input, and reconstruct the one or more sensory properties at the first device based on the data received.

These and other objects, features, and advantages of the present invention will become apparent from the following detailed description of illustrative embodiments thereof, which is to be read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** depicts an overview of a remote sensing methodology according to an embodiment of the invention.

FIG. **2** depicts a remote sensory module for the remote sensing methodology of FIG. **1** according to an embodiment of the invention.

FIG. **3** depicts a coordinated plane used in the remote sensing module of FIG. **2**, according to an embodiment of the invention.

FIG. **4** depicts a controller used in the remote sensing module of FIG. **2**, according to an embodiment of the invention.

FIG. **5** depicts an additional embodiment of the remote sensory module of the remote sensing methodology of FIG. **1**, according to an embodiment of the invention.

FIG. **6** depicts a sensory estimator used in the remote sensory module of FIG. **5**, according to an embodiment of the invention.

FIG. **7** depicts a further embodiment of the remote sensory module of the remote sensing methodology of FIG. **1**.

FIG. **8**A depicts an example of a front portion of a device with a gridded interface for implementing the remote sensing methodology according to an embodiment of the invention.

FIG. **8**B depicts a back portion of the device of FIG. **8**A.

FIG. **9** depicts an exemplary application of the remote sensing methodology according to embodiments of the invention.

FIG. **10** depicts a computer system in accordance with which one or more components/steps of techniques of the invention may be implemented according to an embodiment of the invention.

DETAILED DESCRIPTION

As visual and/or auditory information is used in conventional computer technology, users demand more and more specific and realistic information. However, an essential element is still missing from existing means of virtual communication and content streaming—the sense of touch. As a result, there is a growing need to replicate the sense of touch remotely. Replicating the sense of touch would be useful in a variety of contexts. For example, if a parent wants to touch their child from work to see if the child has a fever or if there is a change in the child's body temperature. As another example, if a doctor wants to check a patient's heartbeat or other vitals remotely. As a further example, it would be desirable to interact with a visual input by "feeling around" the imagery displayed on the screen of a user device, and remotely feeling the objects and the surroundings displayed on the device (e.g., feeling the fabric of each piece of clothing while shopping online).

Illustrative embodiments of the invention provide for replicating a sense of touch by augmenting existing audio and/or visual content with a sensory dimension in the form of temperature, texture and movement. For example, embodiments of the invention augment traditional videotelephony and video recordings by conveying the sense of warmth or pressure from a hug or a hand shake, the sensation of snow, the feeling of a patient's pulse and body temperature, etc.

Illustratively, embodiments of the invention replicate a sense of touch remotely by recreating roughness and/or temperature sensation. It is believed that a combination of the three remote patterns—sense of texture, temperature and movement, would allow for a more accurate representation of the sense of touch.

FIG. **1** shows an overview of the remote sensing methodology according to illustrative embodiments of the invention. Remote sensing methodology **100** starts at block **102** in which data is obtain as input for display on a user interface such as a screen on a device. For example, the device may be a handheld device or any suitable computing or electronic device. Non-limiting examples of input can include audio and visual input such as a video, a still image, an audio clip or a live feed. Then at block **104**, a remote sensory module performs operations on the data received as input. Details of the remote sensory module **104** are further described in the context of FIGS. **2** through **7**. Finally, at block **106**, output from the remote sensory module is reproduced for the user at the user interface.

FIG. **2** shows an illustrative embodiment of the remote sensory module **104** of FIG. **1**. At block **202**, visual and/or audio input is received. The visual and/or audio input can be pre-recorded content or live streaming content. For example, the input may be a recording of a patient for the past twenty-four hours or any given duration, or a live stream of the patient in his room. As another example, the input may be a live video conference between two or more users. As a further example, the input may be captured by a visual or audio recording component on a user's device (e.g., the camera on a mobile device). At block **204**, data relating to one or more sensory properties for one or more objects in the visual and/or audio input is received. As used herein, a sensory property refers to a temperature, a texture or movement associated with the object. As used herein, an object in the visual and/or audio input refers to a person, an animal, an inanimate object (e.g., a fireplace, a car) or the background (e.g., snow, wind, book shelves). Sensory data associated with the one or more objects of the input may be received from one or more sensors on the user's device (e.g., a camera on a mobile phone, a tablet, a computer). Alternatively, sensory data associated with the one or more objects of the input may be received from a second device, such as sensory data captured by one or more sensors on the second device. As used herein, sensors may refer to infrared sensors, movement detectors, tactile sensors, etc. At block **206**, the data associated with one or more sensory properties of the one or more objects in the input are processed by the coordinated plane and sent to the controller at block **208**. The coordinated plane will be described in further detail in the context of FIG. **3** below. At block **208**, the controller coordinates and controls reconstruction and recreation of the one or more sensory properties associated with the one or more objects in the input. The reconstructed sensory properties can then be experienced by the user at a user device. Details of controller **208** will be further described in the context of FIG. **4** below.

An illustrative embodiment of the coordinated plane **206** of FIG. **2** is shown in FIG. **3**. Coordinated plane **300** includes block **302**, at which data is received. The data received corresponds to data associated with the one or more sensory properties of the one or more objects in the input previously described in the context of FIG. **2**. The data received may be in the form of temperature data, electrical signals, vibration duration and frequency, etc. At block **304**, the sensory data is organized and/or interpreted. Then at block **306**, the data is translated into metrics such that the one or more sensory properties associated with the one or more objects in the input may be replicated. The translated metrics are then sent to the controller at block **308** for reconstruction. For example, the body temperature of a person's hand may be received at block **302**, translated as the amount of heat necessary to bring the heating elements to the given temperature at blocks **304** and **306** and this translated metric is then sent to controller at block **308**. Additionally, coordinated plane **300** may include a calibration algorithm, such that calibration can be performed depending on the input. For example, if the input is that of a dessert scene, the algorithm would automatically calibrate the coordinated plane **300** to a hot climate module.

FIG. **4** shows an illustrative embodiment of the controller **208** of FIG. **2**. Controller **400** coordinates and controls reconstruction of the one or more sensory properties associated with the one or more objects in the input. Controller **400** includes a temperature simulator **402**, a texture simulator **404** and a movement simulator **406**. Temperature simulator **402** may comprise elements capable of heating and cooling, so that variations in temperature can be produced by means such as electromagnetic induction, laser and air flow. Texture simulator **404** may comprise elements capable of producing vibrations at various frequencies or materials that are capable of morphing (such as phase change materials) giving rise to a feeling of roughness. Movement simulator **406** may comprise elements capable of generating force and pressure to emulate motion or micro-accelerators and micro-sensors, Controller **400** may be implemented as software capable of controlling and activating temperature simulator **402**, texture simulator **404** and movement simulator **406** to reconstruct the sensory properties associated with the one or more objects in the input. The temperature simulator **402**, texture simulator **404** and movement simulator **406** may be located on the enclosure of a user device, such as the back of the device, the screen of the device or a case suitable for enclosing a back and/or front of the device.

As an illustrative example of the remote sensing methodology as described in FIGS. **1** to **4**, a doctor is interested in monitoring a patient for a specific duration of time. Corresponding to block **102** of FIG. **1** and **202** of FIG. **2**, a first device obtains visual and/or audio input relating to the patient for display on the first device or on a second device. Sensors on the first device, such as an infrared thermometer, a movement sensor, and a tactile sensor, can be used to monitor and record the patient's vitals or other parameters of interest. Data from the sensors can be captured and stored in a database for analysis at a later time, or it can be analyzed simultaneously at the same device, or sent to a second device for use. Sensory data to be captured and recorded can be specified by the doctor prior to monitoring the patient. Then at block **104** of FIG. and block **204** of FIG. **2**, the sensory data relating to the patient is received for processing. At block **206** of FIG. **2**, also corresponding to the coordinated plane **300** of FIG. **3**, the data is processed and sent to a controller at block **208**. At block **208** and corresponding controller **400** of FIG. **4**, the controller reconstructs and replicates the one or more sensory properties from the data received by activating and controlling the texture simulator **402**, texture simulator **404** and/or movement simulator **406**. Corresponding to block **106**, the reconstructed sensory properties can be experienced by the doctor at a user device. For example, if the doctor was interested in monitoring the patient's temperature and heart rate, the patient's temperature and heart rate would be reconstructed at the device on which the doctor is using and the doctor would feel the body heat and the pulse of the patient at a given point in time.

As another illustrative example of the remote sensing methodology as described in FIGS. **1** to **4**, a child is be at a zoo and points the camera of a mobile device at a lion (corresponding to obtaining visual and/or auditory input at blocks **102** and **202**). Infrared sensors on the mobile device can establish the lion's temperature, especially relative to the background; tactile sensors on the mobile device can capture texture so as to communicate what the lion feels like; movement detectors on the mobile device can capture the lion's periodic movement (e.g., as in pulsing). This data is received at blocks **104** and **204**. The coordinated plane of block **206** and FIG. **3** then interprets and translates the captured sensory data. The translated sensory data is then sent to the controller of block **208** (correspondingly controller **400** of FIG. **4**) for reconstruction. The reconstructed sensory properties are then experienced as the output at block **106**. Therefore, as the child looks at the lion being recorded through the camera and displayed on the mobile device, through a sensory replication interface on the mobile device, the child can also feel the lion's heat, feel its texture and its movement on an interface at his mobile device, thus giving a very realistic sense of the lion. The interface will be described in further details in the context of FIGS. **8**A and **8**B below.

FIG. **5** shows an alternative embodiment of the remote sensory module **104** of FIG. **1**. At block **502**, visual and/or audio input is obtained for display on a user device. The visual and/or audio input can be pre-recorded content or live streaming content. For example, the input may be a pre-recorded show or live streaming content from the camera of a device. At block **504**, a user may select a specific object and/or sensory property for reconstruction through the user interface of the user device. At block **506**, the user may optionally choose to segment and partition the input by duration (temporal variation) or by object/region (spatial variation). At block **508**, a sensory estimator generates or obtains data based on the user selection. The data is then sent to block **510**, where the coordinated plane (as disclosed in FIG. **3**) interprets the data and translates it into metrics for reconstruction by a controller (as disclosed in FIG. **4**) at block **512**.

FIG. **6** shows an illustrative embodiment of the sensory estimator **508** of FIG. **5**. Sensory estimator **600** includes temperature estimator **604**, texture estimator **606** and movement estimator **608**. Sensory estimator **600** interacts with database **602** to obtain sensory data for the one or more selected objects or regions. Database **602** was created at an earlier point in time with objects indexed with sensory information, much like a library having numbers and vibrations that have been translated into a lexicon or dictionary of temperatures, textures and movement that matches the physical experience of the associated object. Database **602** continually updates and expands as new information is acquired. Information in database **602** may come from the data captured by one or more devices with access to the database **602**, entered by a user (e.g., the temperature of boiling water is approximately 100° C.), as well as acquired from online resources such as the World Wide Web. Sensory estimator **600** interacts with database **602** to retrieve data related to one or more sensory properties of an object when desired or needed. For example, when a user is interested in an average temperature of a specific object or region in the input, sensory estimator **600** can obtain temperature information of the object or region for a given duration and calculate an average through temperature estimator **604**. As another example, a user may stream a pre-recorded show in which no sensory data is transmitted and associated with the input. When the user selects an object or region of interest from the input, such as an article of clothing or an animal, sensory estimator **600** interacts with database **602** to identify the object or region of interest (e.g., via an image recognition module within the database or by querying the user for identification of the object). Once the object or region of interest is identified, database **602** sends sensory information, such as temperature, texture and movement, associated with the identified object/region to the respective estimators of sensory estimator **600**. If the object is not found in database **602**, a search outside the database may be performed to identify the object. If sensory information for the object is not found in database **602**, then database **602** may identify related and similar objects (e.g., a fire pit is similar to a fireplace) and send sensory data associated with the related objects to sensory estimator **600**.

As an example of the remote sensory module as described in FIGS. **5** and **6**, in the previous example in which a doctor is interested in monitoring a patient, once visual and/or audio input is obtained for display on the user's device at block **502**, the doctor can select the parameters of interest to reconstruct. This selection is detected at block **504**. The doctor may choose to monitor how a patient's temperature evolve over time, and thus select segmentation of the input by duration corresponding to block **506**. Alternatively, the doctor may choose to partition the input by object such that in an entire room of patients, the doctor can select a specific patient or a specific section of the patient room to monitor. At block **508** and corresponding sensory estimator of FIG. **6**, the sensory estimator may obtain information associated with the one or more sensory properties of the one or more objects in the input. In the instance where the doctor wants to monitor how the patient's temperature evolve over time (e.g., the temperature change per hour for the past three hours to detect change in fever in response to a medication), sensory estimator **600** can obtain temperature information for the patient over the given duration from database **602**. Temperature estimator **604** can then calculate an average temperature for the patient for each hour of the duration of interest. Sensory estimator **600** then sends this average temperature data to coordinated plane **510**. Coordinated plane **510** interprets and translates the temperature data as described in the context of FIG. **3** above and sends the metrics to controller **512**. Controller **512** reconstructs the average temperature for each of the three hours as output for the doctor to experience at his device. For example, if the average temperature for the three hours were 101.6° F., 100.2° F. and 98.8° F., controller **512** may control the heating element(s) to reproduce the heat feel of these temperatures for the doctor to experience. The doctor can choose to experience the average temperature for each of the three hours for a length of time (e.g., five seconds per average temperature) consecutively or independently. Additionally, the controller **512** can also use the tactile and/or movement simulators to supplement the temperature feel of the patient with the pulse rate of the patient for the same duration of interest.

FIG. **7** shows an additional embodiment of the remote sensory module **104** of FIG. **1**. At block **702**, visual and/or audio input is obtained for display on a device. The visual and/or audio input is preferably live streaming content, for example, a video chat between two or more people. At block **704**, a determination is made whether sensory input is detected. For example, a mother and her child are chatting remotely via a video chat application such as SKYPE or FACETIME, the mother wants to give the child a reassuring gesture such as a pat or hand squeeze. The mother can make contact with the sensors on her device as if she is actually squeezing the child's hand or patting the child on the hand. If no sensory input is detected, then at block **706** the module returns to block **702**. If sensory input is detected at block **708**, the module proceeds to block **710** in which sensory data associated with the gestures are captured (e.g., the temperature and texture of the hand, the movement and pressure associated with the gesture). The captured data associated with the various sensory properties of the gesture is then transmitted to a device of an intended recipient at block **712** for reconstruction at the recipient's device, here, transmitted to the child's device for reconstruction. Reconstruction can be performed at the recipient's device using a remote sensory module as according to embodiments of the invention, for example, as described in the context of FIGS. **2** to **6** above.

FIGS. **8**A and **8**B show an illustrative embodiment of a device capable of implementing the remote sensing methodology **100** as shown in FIG. **1**. The device may be any handheld or portable device (e.g., smartphone, tablet, thermometer) or any other suitable device (e.g., personal computer, dashboard of an automobile). Sensors for capturing sensory data and simulators for reproducing one or more sensory properties may be placed anywhere along the enclosure of the device, for example, on the screen and/or back of a tablet or smart phones. The sensors and simulators may be part of a gridded interface spanning a desired portion of the enclosure of the device.

FIG. **8**A shows the front of a device **802**, with screen **810**. A gridded interface **808** spans at least a portion of the screen **810** of device **802**. The gridded interface **808** may be embedded into the screen **810** of device **802** or embedded into an enclosure, such as a case or cover for device **802** that covers the screen **810**. The gridded interface **808** may comprise a miniscule grid with a network of micro pipes for delivery of heating and cooling (e.g., using hot air and cold air stored within reservoirs in the device or provided as part of the gridded interface), illustrated as dashed lines **804-1** . . . **804**-M. By controlling this network of micro pipes, the controller can create an appropriate mixture of hot air and cold air to provide the appropriate temperature sensation. The number of micro pipes, M, may vary accordingly, for example, depending on the size of the device or area of desired coverage on the device. Preferably, the network of micro pipes span the entire surface of a device. The gridded interface **808** may also comprise an array of tactile and movement sensors and simulators, illustrated as ovals **806-1** . . . **806**-N. (e.g., micro motors for generating vibrations at various frequencies to simulate different textures). The number, size and arrangement of the tactile and/or movement sensors and simulators may vary accordingly, for example, depending on the size of the device. The gridded interface **808** may be activated electronically and locally by the controller module. Accordingly, through an option in the user interface, the gridded interface **808** may be activated and continuously capturing, transmitting and/or receiving sensory data, or the gridded interface **808** may be in sleep mode such that sensory data is only captured, transmitted and/or received when re-activated.

Similarly, FIG. **8**B shows the gridded interface **808** implemented on at least a portion of the back of device **802**. It is to be noted that the gridded interface described herein may be implemented in a front portion of device **802**, a back portion of device **802** or in the front and back portions of device **802**.

Alternatively, the gridded interface **808** may be implemented apart from a device as a stand-alone apparatus through which a device may be plugged in when sensory replication is desired or needed.

FIG. **9** shows an exemplary application of embodiments of the invention. A visual and/or audio input is displayed on screen **902**. Screen **902** may be a screen on any suitable device, such as a tablet or a mobile phone. As illustratively shown, displayed on screen **902** is an outdoor scene. Sensory properties, such as temperature, texture and/or movement associated with objects in the scene, such as the sun **904**, snow **906** and fire **908**, may be experienced by a user of the device.

In the instance where the scene is a live feed captured by a camera component on a device, the sensors on the device may capture sensory data associated with the objects in the scene. For example, the temperature and texture of the snow **906**, the temperature and movement of the fire **908**, along with the temperature of the sun **904** may be captured by the temperature sensor, tactile sensor and motion sensor on the device. These sensory data can then be sent to coordinated plane **910** (details of which are disclosed in the context of FIG. **3** above), which interprets and translates the received sensory data into metrics and sends the translated metrics to controller **912** (details of which are disclosed in the context of FIG. **4** above). Controller **912** then activates and coordinates the temperature, texture and movement simulators on the device to reconstruct the received sensory data into one or more sensory property associated with the sun **904**, snow **906** and fire **908**. The sensory properties can be experienced by the user on the device through the gridded interface **808** as described in FIGS. **8**A and **8**B.

A user may also chose to experience only one sensory property associated with the objects in the scene. For example, a user may choose to experience only the temperature of the objects in the scene. In that instance, infrared sensors on the device can be used to sense the temperature of the sun **904**, snow **906** and fire **908**. It should be noted that while the true temperature of the sun **904** or of the fire **908** may not be remotely sensed, the perceived temperature can readily be captured by the temperature sensors on the device. Accordingly, an exemplary output produced by the controller **912** may be a relative temperature map of the scene such that portions of the image is much warmer than the surroundings. Here, the sun **904** would be perceived as warm relative to the hot fire **908**, and the snow **906** would be cold relative to the sun **904** and fire **908**. A user would be able to touch the screen or back of the device, depending on where the gridded interface is located, to feel the temperature distribution of the scene displayed on screen **902**.

In the instance where the scene is an input from pre-recorded content in which sensory data is not transmitted along with the input (e.g., a movie), the remote sensing methodology **100** would replicate the sense of touch using a remote sensory module **500** as described in FIG. **5**. Sensory data associated with the one or more objects and the surroundings in the scene displayed on screen **902** would be obtained from a database such as database **602** of FIG. **6**. Furthermore, the user may choose to segment the input by duration or object or region. If the user selects an object for which the database may not have sensory information, such as the cloud in the scene, a sensory estimator, such as sensory estimator **600** of FIG. **6**, may estimate the texture, temperature and/or movement of the cloud.

In an alternative embodiment, screen **902** may be a window through which the scene is being viewed. The window **902** may contain a gridded interface **808**, as described in FIGS. **8**A and **8**B, embedded into the window pane. A user may, for example, perceive the temperature feel of the scene outside by touching the various regions on the window pane, which is reproduced by the simulators of the gridded interface. As such, a user may "feel" the temperature outside without having to leave the house or check the weather reports.

It should be noted that where user selection is an option, such as user selection of the object of interest or user selection of segmentation by duration, the user selection may be performed using conventional methods such as employing a stylus, a mouse or a finger to highlight the object or choice in the user interface.

Embodiments of the present invention may be a system, a method, and/or a computer program product. The computer program product may include a computer readable storage medium (or media) having computer readable program instructions thereon for causing a processor to carry out aspects of the present invention.

Accordingly, the architecture shown in FIG. **10** may be used to implement the various components/steps shown and described above in the context of FIGS. **1-9**.

The computer readable storage medium can be a tangible device that can retain and store instructions for use by an instruction execution device. The computer readable storage medium may be, for example, but is not limited to, an electronic storage device, a magnetic storage device, an optical storage device, an electromagnetic storage device, a semiconductor storage device, or any suitable combination of the foregoing. A non-exhaustive list of more specific examples of the computer readable storage medium includes the following: a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), a static random access memory (SRAM), a portable compact disc read-only memory (CD-ROM), a digital versatile disk (DVD), a memory stick, a floppy disk, a mechanically encoded device such as punch-cards or raised structures in a groove having instructions recorded thereon, and any suitable combination of the foregoing. A computer readable storage medium, as used herein, is not to be construed as being transitory signals per se, such as radio waves or other freely propagating electromagnetic waves, electromagnetic waves propagating through a waveguide or other transmission media (e.g., light pulses passing through a fiber-optic cable), or electrical signals transmitted through a wire.

Computer readable program instructions described herein can be downloaded to respective computing/processing devices from a computer readable storage medium or to an external computer or external storage device via a network, for example, the Internet, a local area network, a wide area network and/or a wireless network. The network may comprise copper transmission cables, optical transmission fibers, wireless transmission, routers, firewalls, switches, gateway computers and/or edge servers. A network adapter card or network interface in each computing/processing device receives computer readable program instructions from the network and forwards the computer readable program instructions for storage in a computer readable storage medium within the respective computing/processing device.

Computer readable program instructions for carrying out operations of the present invention may be assembler instructions, instruction-set-architecture (ISA) instructions, machine instructions, machine dependent instructions, microcode, firmware instructions, state-setting data, or either source code or object code written in any combination of one or more programming languages, including an object oriented programming language such as Smalltalk, C++ or the like, and conventional procedural programming languages, such as the "C" programming language or similar programming languages. The computer readable program instructions may execute entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider). In some embodiments, electronic circuitry including, for example, programmable logic circuitry, field-programmable gate arrays (FPGA), or programmable logic arrays (PLA) may execute the computer readable program instructions by utilizing state information of the computer readable program instructions to personalize the electronic circuitry, in order to perform aspects of the present invention.

Aspects of the present invention are described herein with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems), and computer program products according to embodiments of the invention. It will be understood that each block of the flowchart illustrations and/or block diagrams, and combinations of blocks in the flowchart illustrations and/or block diagrams, can be implemented by computer readable program instructions.

These computer readable program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks. These computer readable program instructions may also be stored in a computer readable storage medium that can direct a computer, a programmable data processing apparatus, and/or other devices to function in a particular manner, such that the computer readable storage medium having instructions stored therein comprises an article of manufacture including instructions which implement aspects of the function/act specified in the flowchart and/or block diagram block or blocks.

The computer readable program instructions may also be loaded onto a computer, other programmable data processing apparatus, or other device to cause a series of operational steps to be performed on the computer, other programmable apparatus or other device to produce a computer implemented process, such that the instructions which execute on the computer, other programmable apparatus, or other device implement the functions/acts specified in the flowchart and/or block diagram block or blocks.

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 instructions, which comprises one or more executable instructions for implementing the specified logical function(s). 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 carry out combinations of special purpose hardware and computer instructions.

One or more embodiments can make use of software running on a general-purpose computer or workstation. With reference to FIG. **10**, in a computing node **1010** there is a computer system/server **1012**, which is operational with numerous other general purpose or special purpose computing system environments or configurations. Examples of well-known computing systems, environments, and/or configurations that may be suitable for use with computer system/server **1012** include, but are not limited to, personal computer systems, server computer systems, thin clients, thick clients, handheld or laptop devices, multiprocessor systems, microprocessor-based systems, set top boxes, programmable consumer electronics, network PCs, minicomputer systems, mainframe computer systems, and distributed cloud computing environments that include any of the above systems or devices, and the like.

Computer system/server **1012** may be described in the general context of computer system executable instructions, such as program modules, being executed by a computer system. Generally, program modules may include routines, programs, objects, components, logic, data structures, and so on that perform particular tasks or implement particular abstract data types. Computer system/server **1012** may be practiced in distributed cloud computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed cloud computing environment, program modules may be located in both local and remote computer system storage media including memory storage devices.

As shown in FIG. **10**, computer system/server **1012** in computing node **1010** is shown in the form of a general-purpose computing device. The components of computer system/server **1012** may include, but are not limited to, one or more processors or processing units **1016**, a system memory **1028**, and a bus **1018** that couples various system components including system memory **1028** to processor **1016**.

The bus **1018** represents one or more of any of several types of bus structures, including a memory bus or memory controller, a peripheral bus, an accelerated graphics port, and a processor or local bus using any of a variety of bus architectures. By way of example, and not limitation, such architectures include Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISA) bus, Video Electronics Standards Association (VESA) local bus, and Peripheral Component Interconnects (PCI) bus.

The computer system/server **1012** typically includes a variety of computer system readable media. Such media may be any available media that is accessible by computer system/server **1012**, and it includes both volatile and non-volatile media, removable and non-removable media.

The system memory **1028** can include computer system readable media in the form of volatile memory, such as random access memory (RAM) **1030** and/or cache memory **1032**. The computer system/server **1012** may further include other removable/non-removable, volatile/nonvolatile computer system storage media. By way of example only, storage system **1034** can be provided for reading from and writing to a non-removable, non-volatile magnetic media (not shown and typically called a "hard drive"). Although not shown, a magnetic disk drive for reading from and writing to a removable, non-volatile magnetic disk (e.g., a "floppy disk"), and an optical disk drive for reading from or writing to a removable, non-volatile optical disk such as a CD-ROM, DVD-ROM or other optical media can be provided. In such instances, each can be connected to the bus **1018** by one or more data media interfaces. As depicted and described herein, the memory **1028** may include at least one program product having a set (e.g., at least one) of program modules that are configured to carry out the functions of embodiments of the invention. A program/utility **1040**, having a set (at least one) of program modules **1042**, may be stored in memory **1028** by way of example, and not limitation, as well as an operating system, one or more application programs, other program modules, and program data. Each of the operating system, one or more application programs, other program modules, and program data or some combination thereof, may include an implementation of a networking environment. Program modules **1042** generally carry out the functions and/or methodologies of embodiments of the invention as described herein.

Computer system/server **1012** may also communicate with one or more external devices **1014** such as a keyboard, a pointing device, a display **1024**, etc., one or more devices that enable a user to interact with computer system/server **1012**, and/or any devices (e.g., network card, modem, etc.) that enable computer system/server **1012** to communicate with one or more other computing devices. Such communication can occur via Input/Output (I/O) interfaces **1022**. Still yet, computer system/server **1012** can communicate with one or more networks such as a local area network (LAN), a general wide area network (WAN), and/or a public network (e.g., the Internet) via network adapter **1020**. As depicted, network adapter **1020** communicates with the other components of computer system/server **1012** via bus **1018**. It should be understood that although not shown, other hardware and/or software components could be used in conjunction with computer system/server **1012**. Examples include, but are not limited to, microcode, device drivers, redundant processing units, external disk drive arrays, RAID systems, tape drives, and data archival storage systems, etc.

Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various other changes and modifications may be made by one skilled in the art without departing from the scope or spirit of the invention.

What is claimed is:

1. A method, comprising:

obtaining an input comprising audio and visual data for display on a first device;

receiving data associated with one or more sensory properties of one or more user-selected objects in the input; and

reconstructing the one or more sensory properties at the first device based on the data received.

2. The method of claim **1**, wherein the one or more sensory properties comprises at least one of a temperature, a texture and a movement associated with the one or more.

3. The method of claim **1**, wherein the data is captured by one or more sensors on the first device, the one or more sensors comprising at least one of an infrared sensor and a tactile sensor.

4. The method of claim **1**, wherein the data is captured by one or more sensors on a second device, the one or more sensors comprising at least one of an infrared sensor and a tactile sensor.

5. The method of claim **1**, wherein reconstructing the one or more sensory properties comprises translating the sensory data into metrics for reconstruction.

6. The method of claim **5**, wherein a controller regulates a gridded interface to produce the one or more sensory properties based on the metrics.

7. The method of claim **6**, wherein the gridded interface comprises at least one of an array of micro pipes, a hot air reservoir, a cold air reservoir and a tactile simulator.

8. The method of claim **7**, wherein the gridded interface is located on an enclosure of the first device.

9. The method of claim **1**, wherein the input is one of pre-recorded or live.

10. The method of claim 1, further comprising segmenting the input based on user selection, wherein the input is at least one of segmented temporally and segmented spatially.

11. The method of claim 10, wherein the one or more sensory properties are reconstructed based on the user selection for at least one of a given duration and a given region of the input.

12. A method, comprising:

obtaining an input comprising visual and audio data for display on a device;

detecting user selection of one or more objects in the visual input;

identifying the one or more selected objects and surroundings of the one or more objects;

obtaining data associated with one or more sensory properties of the identified one or more objects and the surroundings; and

reconstructing the one or more sensory properties associated with the identified one or more objects and the surroundings based on the data received.

13. The method of claim 12, wherein identifying the one or more selected objects comprises one of an image recognition software and a user input.

14. The method of claim 12, wherein the data is obtained from a database comprising objects indexed with sensory information.

15. The method of claim 14, wherein the data is estimated based on historical information stored in the database.

16. The method of claim 12, wherein the sensory properties comprises at least one of a temperature, a texture and a movement associated with the one or more objects and surroundings.

17. The method of claim 12, wherein reconstructing the one or more sensory properties comprises translating the data into metrics.

18. The method of claim 17, wherein a controller regulates a gridded interface to produce the one or more sensory properties based on the metrics.

19. A method, comprising:

obtaining an input comprising visual and audio data for display on a first device;

detecting sensory input from a user of the first device with respect to one or more user-selected objects in the input;

capturing data associated with the sensory input from the user of the first device; and

transmitting the captured data to a second device for reconstruction of one or more sensory properties associated with the user of the first device.

20. The method of claim 19, wherein detecting sensory input from a user comprises detecting user contact with one or more sensors on the first device.

21. The method of claim 19, wherein capturing data associated with the sensory input comprises recording and storing data generated by the one of more sensors on the first device.

22. An apparatus, comprising:

a memory; and

a processor operatively coupled to the memory and configured to:

obtain an input comprising audio and visual data for display on a first device;

receive data associated with one or more sensory properties of one or more user-selected objects in the input; and

reconstruct the one or more sensory properties at the first device based on the data received.

23. The apparatus of claim 22, wherein a controller regulates a gridded interface to produce one or more sensory properties based on one or more metrics.

24. The apparatus of claim 23, wherein the gridded interface comprises at least one of an array of micro pipes, a hot air reservoir, a cold air reservoir and a tactile simulator.

25. The apparatus of claim 24, wherein the gridded interface is located on an enclosure of the first device.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,270,940 B1
APPLICATION NO. : 14/502110
DATED : February 23, 2016
INVENTOR(S) : Aleksandr Y. Aravkin et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims
In Claim 2, please insert --user-selected objects-- to the end of the claim.

Signed and Sealed this
Second Day of August, 2016

Michelle K. Lee
Director of the United States Patent and Trademark Office