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**Wang et al.**

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(54) **ELECTRONIC SYSTEM WITH GESTURE PROCESSING MECHANISM AND METHOD OF OPERATION THEREOF**

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***G06F 3/03*** (2006.01)

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CPC ..... ***G06F 3/017*** (2013.01); ***G06F 3/011*** (2013.01); ***G06F 3/0304*** (2013.01); ***G06F 3/0325*** (2013.01)

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See application file for complete search history.

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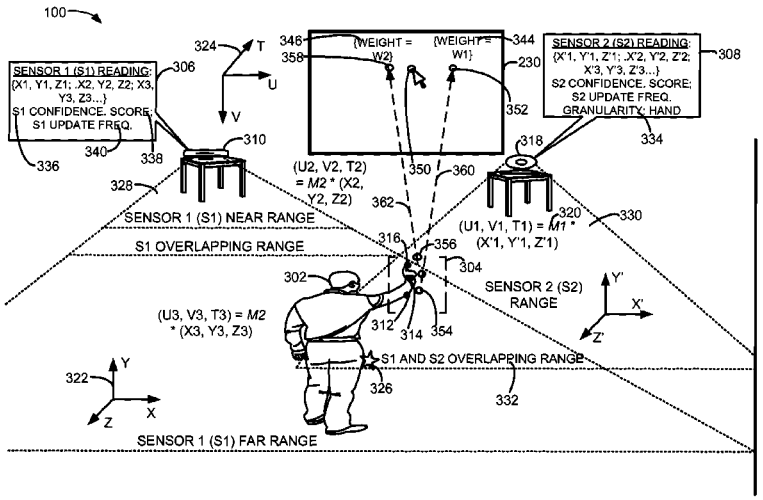
(57) **ABSTRACT**

An electronic system includes a control unit, configured to identify a first sensor reading for capturing a gesture directed at a display interface using a first range profile; identify a second sensor reading for capturing the gesture directed at the display interface using a second range profile; calculate a blended position indicator based on the first sensor reading, the second sensor reading, or a combination thereof; and a communication interface, coupled to the control unit, configured to communicate the blended position indicator by generating a cursor at the blended position indicator.

**20 Claims, 6 Drawing Sheets**



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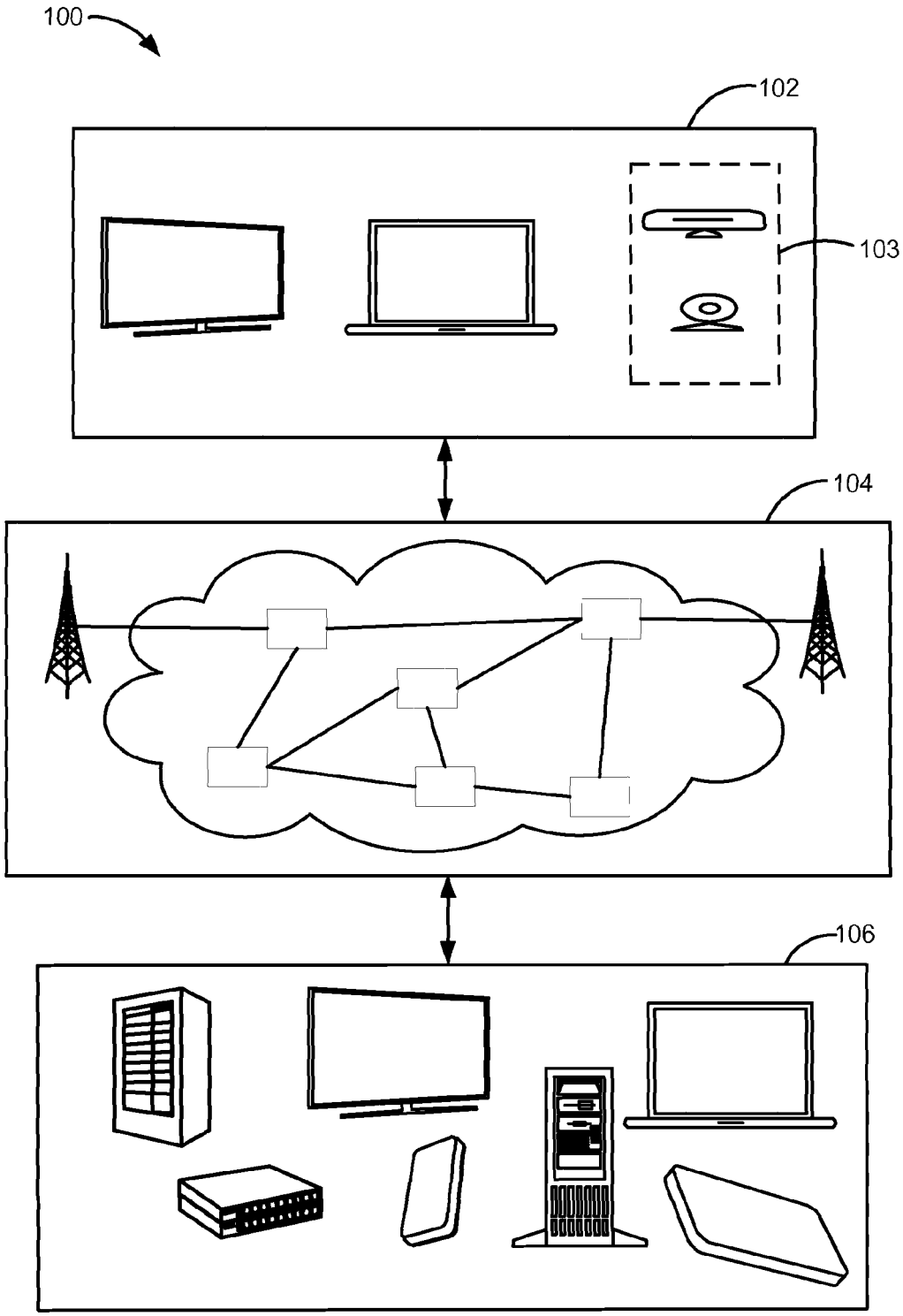


FIG. 1

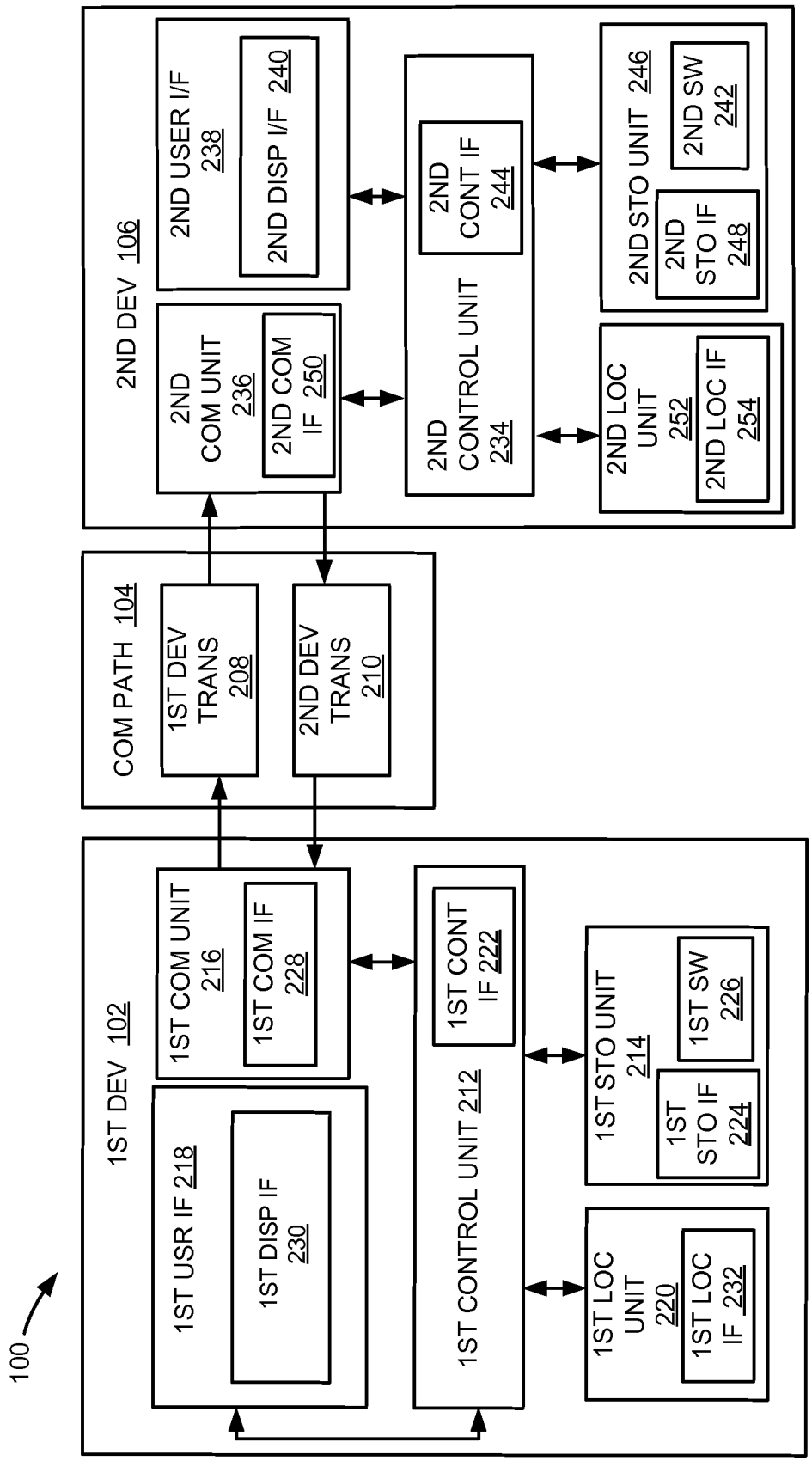
100
1ST DEV 102
1ST USR IF 218
1ST DISP IF 230
1ST COM UNIT 216
1ST COM IF 228
1ST CONTROL UNIT 212
1ST CONT IF 222
1ST STO UNIT 214
1ST STO IF 224
1ST SW 226
1ST LOC UNIT 220
1ST LOC IF 232
COM PATH 104
1ST DEV TRANS 208
2ND DEV TRANS 210
2ND DEV 106
2ND USER I/F 238
2ND DISP I/F 240
2ND COM UNIT 236
2ND COM IF 250
2ND CONTROL UNIT 234
2ND CONT IF 244
2ND STO UNIT 246
2ND STO IF 248
2ND SW 242
2ND LOC UNIT 252
2ND LOC IF 254

FIG. 2

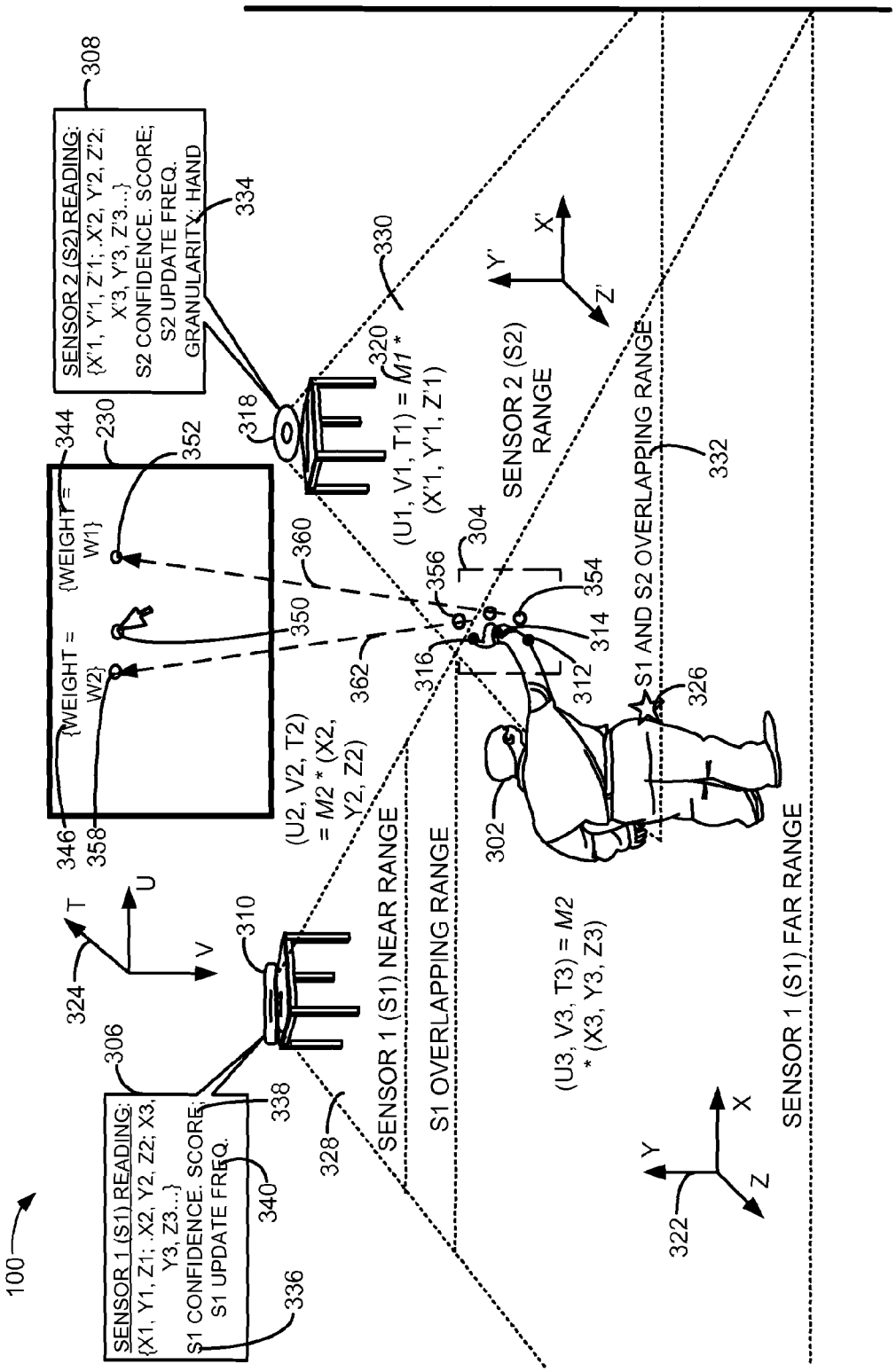
100
SENSOR 1 (S1) READING:
{X1, Y1, Z1; .X2, Y2, Z2; X3, Y3, Z3...}
S1 CONFIDENCE. SCORE;
S1 UPDATE FREQ.
306
338
340
336
SENSOR 2 (S2) READING:
{X'1, Y'1, Z'1; .X'2, Y'2, Z'2; X'3, Y'3, Z'3...}
S2 CONFIDENCE. SCORE;
S2 UPDATE FREQ.
GRANULARITY: HAND
308
334
{WEIGHT = W2}
{WEIGHT = W1}
344
230
352
346
358
360
350
362
318
320
(U1, V1, T1) = M1 * (X'1, Y'1, Z'1)
330
SENSOR 2 (S2) RANGE
304
356
354
314
312
316
(U2, V2, T2) = M2 * (X2, Y2, Z2)
S1 AND S2 OVERLAPPING RANGE
332
326
302
310
324
T
U
V
328
SENSOR 1 (S1) NEAR RANGE
S1 OVERLAPPING RANGE
(U3, V3, T3) = M2 * (X3, Y3, Z3)
SENSOR 1 (S1) FAR RANGE
322
X
Y
Z
X'
Y'
Z'

FIG. 3

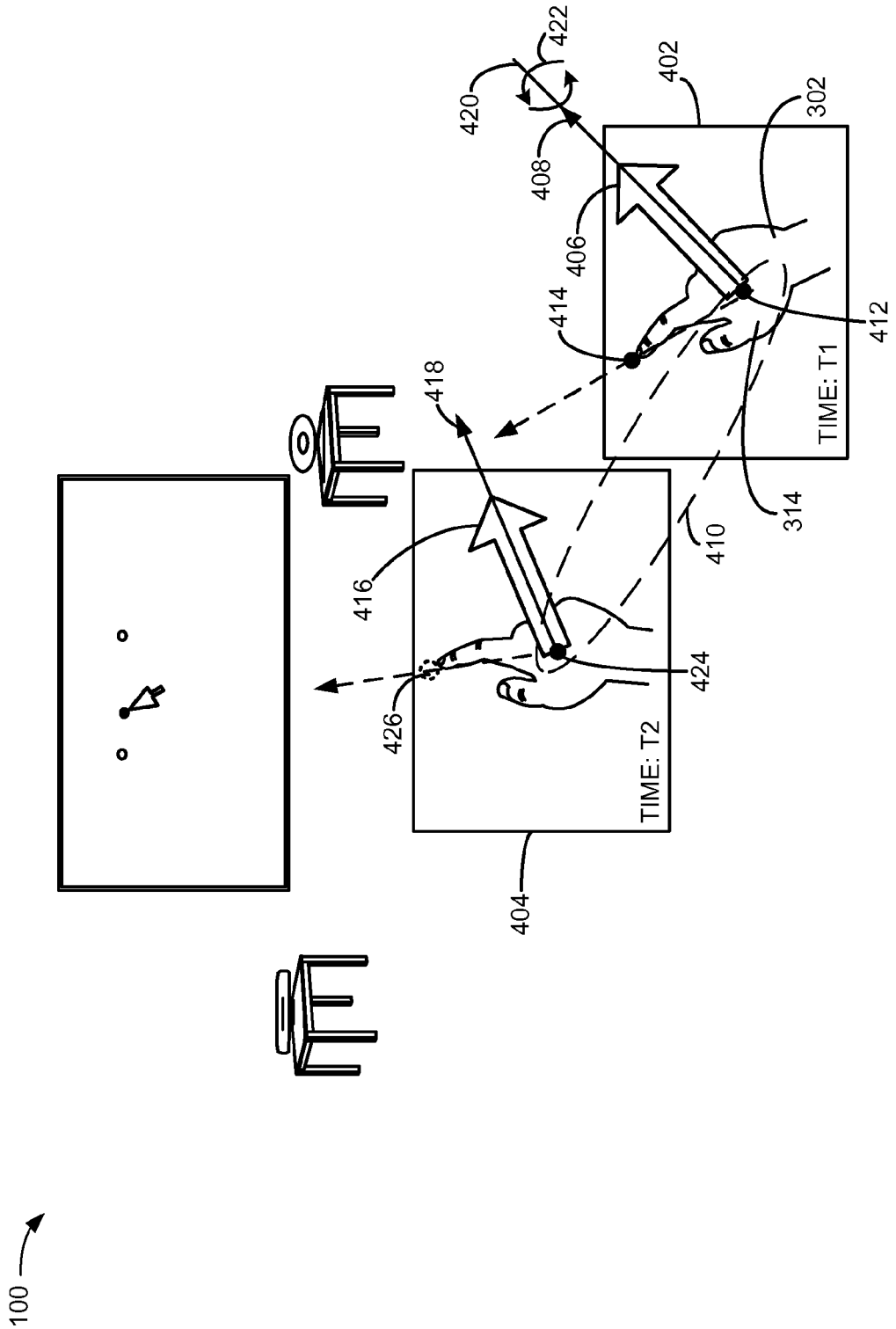
100
402
302
420
422
408
406
414
412
418
TIME: T1
314
410
416
424
426
TIME: T2
404

FIG. 4

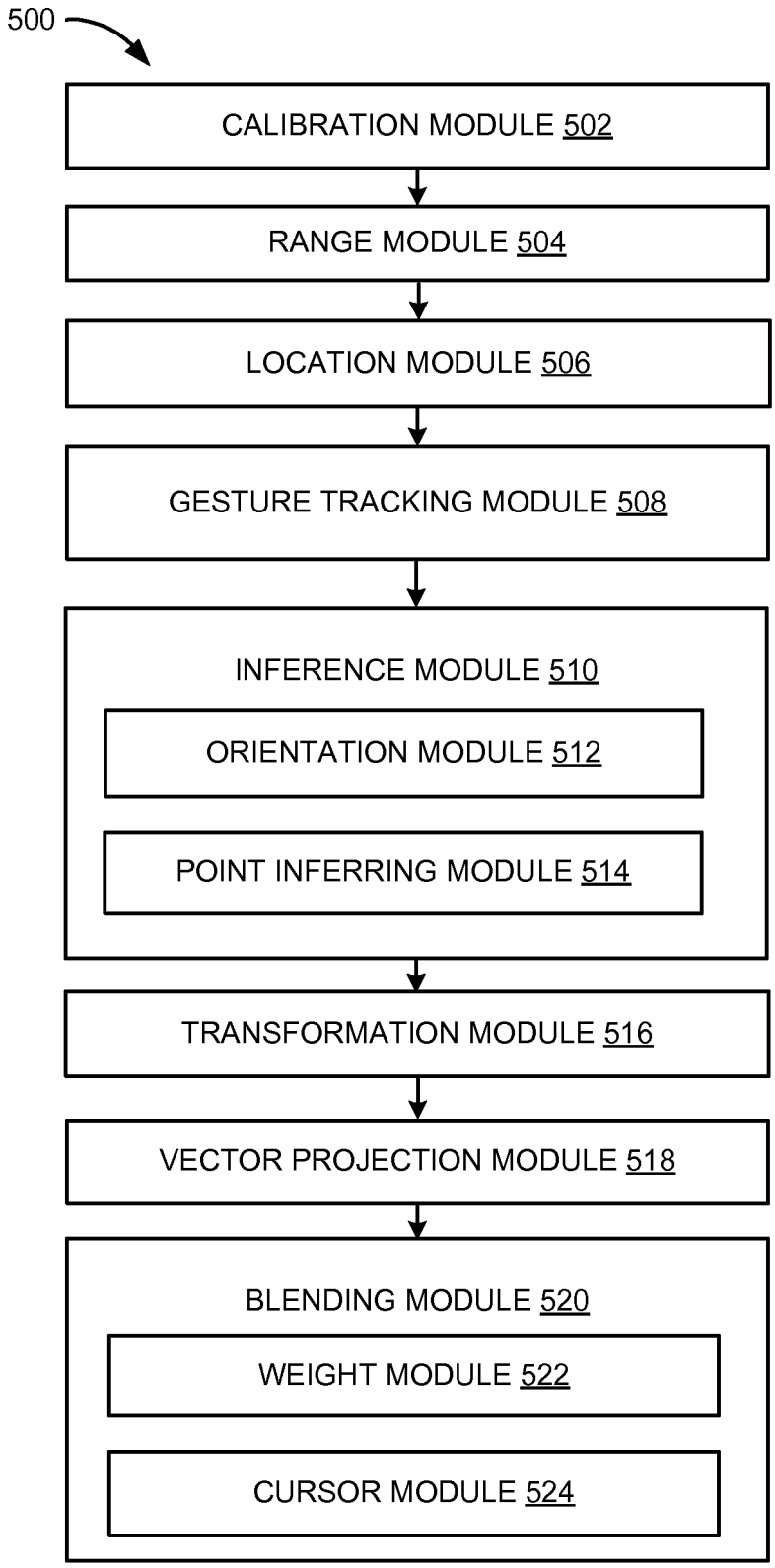
500
CALIBRATION MODULE 502
RANGE MODULE 504
LOCATION MODULE 506
GESTURE TRACKING MODULE 508
INFERENCE MODULE 510
ORIENTATION MODULE 512
POINT INFERRING MODULE 514
TRANSFORMATION MODULE 516
VECTOR PROJECTION MODULE 518
BLENDING MODULE 520
WEIGHT MODULE 522
CURSOR MODULE 524

FIG. 5

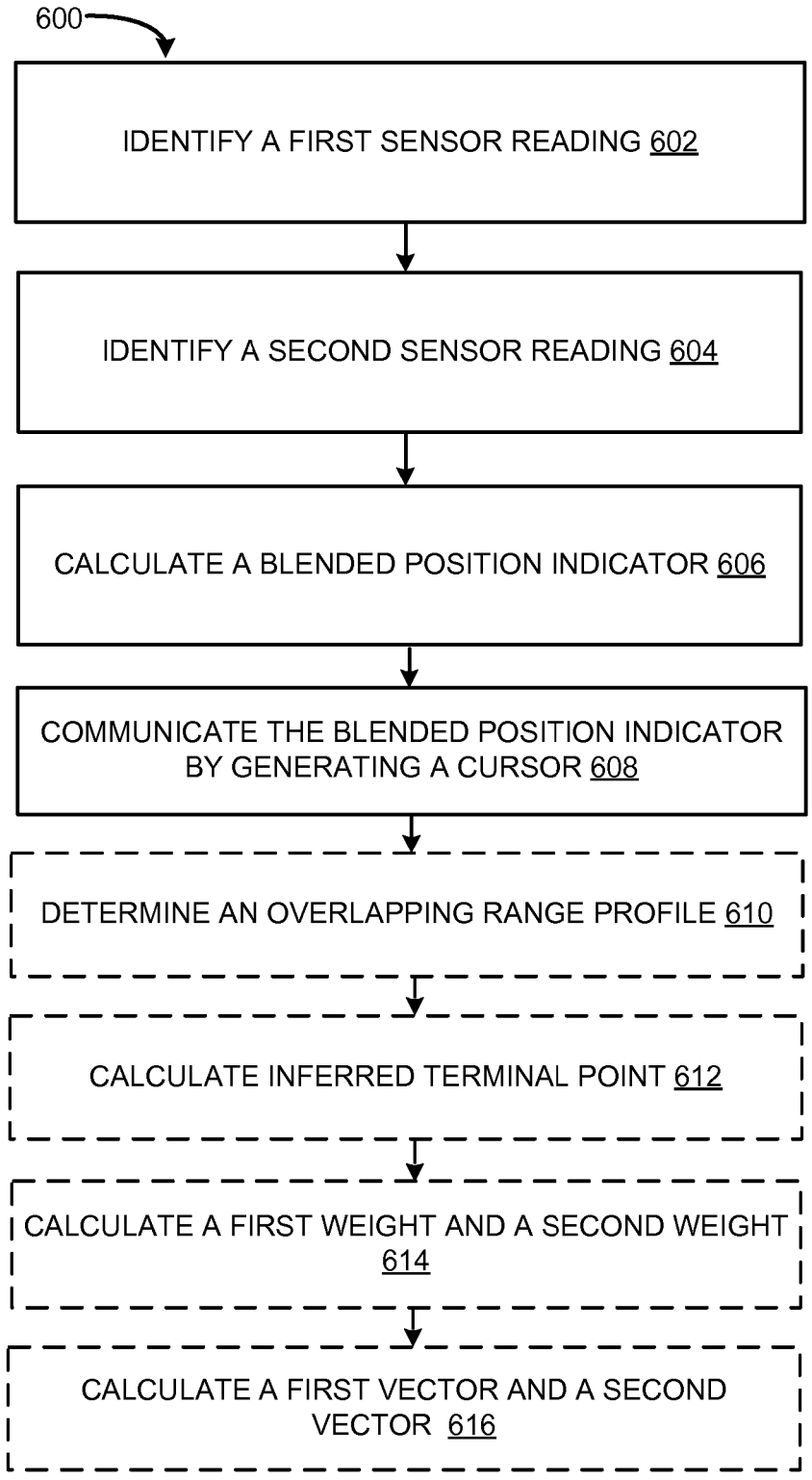
600
IDENTIFY A FIRST SENSOR READING 602
IDENTIFY A SECOND SENSOR READING 604
CALCULATE A BLENDED POSITION INDICATOR 606
COMMUNICATE THE BLENDED POSITION INDICATOR BY GENERATING A CURSOR 608
DETERMINE AN OVERLAPPING RANGE PROFILE 610
CALCULATE INFERRED TERMINAL POINT 612
CALCULATE A FIRST WEIGHT AND A SECOND WEIGHT 614
CALCULATE A FIRST VECTOR AND A SECOND VECTOR 616

FIG. 6

# ELECTRONIC SYSTEM WITH GESTURE PROCESSING MECHANISM AND METHOD OF OPERATION THEREOF

## TECHNICAL FIELD

An embodiment of the present invention relates generally to an electronic system, and more particularly to a system with a gesture processing mechanism.

## BACKGROUND

Modern consumer and industrial electronics, especially display devices such as networked-enabled displays, touch-screen displays, curved displays, and tablet devices are providing increasing levels of functionality to support modern life including facilitating user interactions with electronic devices and appliances. Research and development in the existing technologies can take a myriad of different directions.

As users become more empowered with the growth of interactions between users and devices, new and old paradigms begin to take advantage of this new technology space. There are many technological solutions to take advantage of these new device capabilities. However, user interactions with such electronic devices and appliances are often imprecise or inaccurate as a result of deficiencies in devices or systems used to track and process user gestures associated with such interactions.

Thus, a need still remains for an electronic system with a gesture processing mechanism appropriate for interactions between users and today's devices. In view of the ever-increasing commercial competitive pressures, along with growing client expectations and the diminishing opportunities for meaningful product differentiation in the marketplace, it is increasingly critical that answers be found to these problems.

Additionally, the need to reduce costs, improve efficiencies and performance, and meet competitive pressures adds an even greater urgency to the critical necessity for finding answers to these problems. Solutions to these problems have been long sought but prior developments have not taught or suggested any solutions and, thus, solutions to these problems have long eluded those skilled in the art.

## SUMMARY

An embodiment of the present invention provides an electronic system including a control unit, configured to identify a first sensor reading for capturing a gesture directed at a display interface using a first range profile; identify a second sensor reading for capturing the gesture directed at the display interface using a second range profile; calculate a blended position indicator based on the first sensor reading, the second sensor reading, or a combination thereof; and a communication interface, coupled to the control unit, configured to communicate the blended position indicator by generating a cursor at the blended position indicator.

An embodiment of the present invention provides a method of operation of an electronic system including identifying, with a control unit, a first sensor reading for capturing a gesture directed at a display interface using a first range profile; identifying a second sensor reading for capturing the gesture directed at the display interface using a second range profile; calculating a blended position indicator based on the first sensor reading, the second sensor reading, or a combination thereof; and communicating, with a communication interface coupled to the control unit, the blended position indicator by generating a cursor at the blended position indicator.

An embodiment of the present invention provides a non-transitory computer readable medium including identifying a first sensor reading for capturing a gesture directed at a display interface using a first range profile; identifying a second sensor reading for capturing the gesture directed at the display interface using a second range profile; calculating a blended position indicator based on the first sensor reading, the second sensor reading, or a combination thereof; and communicating the blended position indicator by generating a cursor at the blended position indicator.

Certain embodiments of the invention have other steps or elements in addition to or in place of those mentioned above. The steps or elements will become apparent to those skilled in the art from a reading of the following detailed description when taken with reference to the accompanying drawings.



## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an electronic system with a gesture processing mechanism in an embodiment of the present invention.

FIG. **2** is an example block diagram of the electronic system.

FIG. **3** is an example diagram of the electronic system in operation.

FIG. **4** is another example diagram of the electronic system in operation.

FIG. **5** is a control flow of the electronic system.

FIG. **6** is a flow chart of a method of operation of the electronic system in a further embodiment of the present invention.

## DETAILED DESCRIPTION

Embodiments of the present invention provide a more accurate mechanism for controlling a display interface such as the first display interface, the second display interface, or a combination thereof. More specifically, the electronic system can use a blended position indicator to approximate the direction of a gesture made by a user. The electronic system can more accurately approximate the direction of the gesture based on readings from multiple sensors rather than relying on readings from only one of the sensors.

Embodiments of the present invention can also enhance the usability of different sensors provided by different sensor vendors or manufacturers. More specifically, the electronic system can blend or combine readings from a first sensor and readings from a second sensor with different capturing capabilities and different granularity limitations. For example, the electronic system can blend or combine readings from different sensors for ensuring a user gesture is captured by the second sensor when the user gesture is outside of a capture range of the first sensor.

Embodiments of the present invention can provide an improved mechanism for controlling a display interface when the user is gesturing in a rapid or unpredictable manner. The electronic system can calculate an inferred terminal point, representing an obscured or hard to detect appendage position, based on known appendage positions, a first appendage orientation, and a second appendage orientation. The electronic system can calculate the blended position indicator based on the inferred terminal point to prevent the cursor from skipping or disappearing when an appendage position of the user is not captured by any of the sensors.

The following embodiments are described in sufficient detail to enable those skilled in the art to make and use the invention. It is to be understood that other embodiments would be evident based on the present disclosure, and that system, process, or mechanical changes may be made without departing from the scope of the present invention.

In the following description, numerous specific details are given to provide a thorough understanding of the invention. However, it will be apparent that the invention may be practiced without these specific details. In order to avoid obscuring the embodiment of the present invention, some well-known circuits, system configurations, and process steps are not disclosed in detail.

The drawings showing embodiments of the system are semi-diagrammatic, and not to scale and, particularly, some of the dimensions are for the clarity of presentation and are shown exaggerated in the drawing figures. Similarly, although the views in the drawings for ease of description generally show similar orientations, this depiction in the figures is arbitrary for the most part. Generally, the invention can be operated in any orientation.

The term "module" referred to herein can include software, hardware, or a combination thereof in the embodiment of the present invention in accordance with the context in which the term is used. For example, the software can be machine code, firmware, embedded code, and application software. Also for example, the hardware can be circuitry, processor, computer, integrated circuit, integrated circuit cores, a pressure sensor, an inertial sensor, a microelectromechanical system (MEMS), passive devices, or a combination thereof.

Referring now to FIG. **1**, therein is shown an electronic system **100** with a gesture processing mechanism in an embodiment of the present invention. The electronic system **100** includes a first device **102**, such as the display device, connected to a second device **106**, such as a server. The first device **102** can communicate with the second device **106** through a communication path **104**, such as a wireless or wired network.

For illustrative purposes, the electronic system **100** is described with the first device **102** as the display device, although it is understood that the first device **102** can be different types of devices. For example, the first device **102** can be any of a variety of mobile devices, such as a smartphone, a cellular phone, a tablet device, a laptop computer, or a combination thereof. Also, for example, the first device **102** can be any of a variety of non-mobile devices, such as a gaming console, an entertainment device, a desktop computer, a server, or a combination thereof.

As yet another example, the first device **102** can include one or more sensors **103** or a component therein. The sensors **103** can capture images, video, or visual spectra and can determine spatial locations or distances. More specifically, the sensors **103** can capture static images, video frames, visual spectra, light reflectance, infrared (IR) signatures, ultraviolet (UV) signatures, or a combination thereof. For example, the sensor **103** can include a depth sensor, a two-dimensional camera, a three-dimensional camera, a stereoscopic camera, a motion sensor, a red-green-blue (RGB) sensor, an active pixel sensor, a charge-coupled sensor, a complementary metal-oxide-semiconductor (CMOS) sensor, or a combination thereof.

For illustrative purposes, the sensors **103** are described as being integrated in the first device **102**. However, it is understood that the sensors **103** can be independent devices separate from the first device **102**. In addition, the sensors **103** can be coupled to the first device **102**, the second device **106**, or a combination thereof. For example, the sensors **103** can include a Microsoft Kinect™ sensor, a Creative Senz3D™ sensor, or a Leap Motion™ sensor.

The first device **102** can couple to the communication path **104** to communicate with the second device **106**. For illustrative purposes, the electronic system **100** is described with the second device **106** as a server, although it is understood that the second device **106** can be different types of devices. For example, the second device **106** can be any of a variety of mobile devices, such as a smartphone, a cellular phone, a tablet device, a laptop computer, or a combination thereof.

Also, the second device **106** can be any variety of devices for displaying data, information, graphics, or a combination thereof. For example, the second device **106** can be a display device such as a television, a projector device, or a monitor. The second device **106** can display an image captured by the sensors **103**.

The second device **106** can also be any of a variety of centralized or decentralized computing devices. For example, the second device **106** can be a grid computing resource, a server farm, a virtualized computing resource, a cloud computing resource, a router, a switch, a peer-to-peer distributed computing resource, or a combination thereof.

The second device **106** can be centralized in a single computer room, distributed across different rooms, distributed across different geographical locations, or embedded within a telecommunications network. For example, the second device **106** can be a particularized machine, such as a mainframe, a server, a cluster server, a rack mounted server, or a blade server, or as more specific examples, an IBM System z10™ Business Class mainframe or a HP ProLiant ML™ server. The second device **106** can couple with the communication path **104** to communicate with the first device **102**.

Also for illustrative purposes, the electronic system **100** is shown with the second device **106** and the first device **102** as end points of the communication path **104**, although it is understood that the electronic system **100** can have a different partition between the first device **102**, the second device **106**, and the communication path **104**. For example, the first device **102**, the second device **106**, or a combination thereof can also function as part of the communication path **104**.

The communication path **104** can be a variety of networks or communication mediums. For example, the communication path **104** can include wireless communication, wired communication, optical communication, or a combination thereof. Satellite communication, cellular communication, Bluetooth™, Bluetooth™ Low Energy (BLE), wireless High-Definition Multimedia Interface (HDMI), ZigBee™, Near Field Communication (NFC), Infrared Data Association standard (IrDA), wireless fidelity (WiFi), and worldwide interoperability for microwave access (WiMAX) are examples of wireless communication that can be included in the communication path **104**. Ethernet, HDMI, digital subscriber line (DSL), fiber to the home (FTTH), and plain old telephone service (POTS) are examples of wired communication that can be included in the communication path **104**.

Further, the communication path **104** can traverse a number of network topologies and distances. For example, the communication path **104** can include a direct connection, personal area network (PAN), local area network (LAN), metropolitan area network (MAN), wide area network (WAN) or any combination thereof.

Referring now to FIG. **2**, therein is shown an exemplary block diagram of the electronic system **100**. The electronic

system **100** can include the first device **102**, the communication path **104**, and the second device **106**. The first device **102** can send information in a first device transmission **208** over the communication path **104** to the second device **106**. The second device **106** can send information in a second device transmission **210** over the communication path **104** to the first device **102**.

For brevity of description in this embodiment of the present invention, the first device **102** will be described as a display device and the second device **106** will be described as a server. Embodiments of the present invention are not limited to this selection for the type of devices. The selection is an example of the embodiments of the present invention.

The first device **102** can include a first control unit **212**, a first storage unit **214**, a first communication unit **216**, a first user interface **218**, and a first location unit **220**. The first control unit **212** can include a first control interface **222**. The first control unit **212** can execute a first software **226** to provide the intelligence of the electronic system **100**. The first control unit **212** can be implemented in a number of different manners.

For example, the first control unit **212** can be a processor, an embedded processor, a microprocessor, a hardware control logic, a hardware finite state machine (FSM), a digital signal processor (DSP), or a combination thereof. The first control interface **222** can be used for communication between the first control unit **212** and other functional units in the first device **102**. The first control interface **222** can also be used for communication that is external to the first device **102**.

The first control interface **222** can receive information from the other functional units or from external sources, or can transmit information to the other functional units or to external destinations. The external sources and the external destinations refer to sources and destinations external to the first device **102**.

The first control interface **222** can be implemented in different ways and can include different implementations depending on which functional units or external units are being interfaced with the first control interface **222**. For example, the first control interface **222** can be implemented with a pressure sensor, an inertial sensor, a microelectromechanical system (MEMS), optical circuitry, waveguides, wireless circuitry, wireline circuitry, or a combination thereof.

The first location unit **220** can generate a location information, a heading, and a speed of the first device **102**, as examples. The first location unit **220** can be implemented in many ways. For example, the first location unit **220** can function as at least a part of a global positioning system (GPS), an inertial navigation system such as a gyroscope, an accelerometer, a magnetometer, a compass, a spectrum analyzer, a beacon, a cellular-tower location system, a pressure location system, or any combination thereof.

The first location unit **220** can include a first location interface **232**. The first location interface **232** can be used for communication between the first location unit **220** and other functional units in the first device **102**. The first location interface **232** can also be used for communication that is external to the first device **102**.

The first location interface **232** can receive information from the other functional units or from external sources, or can transmit information to the other functional units or to external destinations. The external sources and the external destinations refer to sources and destinations external to the first device **102**.

The first location interface **232** can include different implementations depending on which functional units or external units are being interfaced with the first location unit **220**. The first location interface **232** can be implemented with technologies and techniques similar to the implementation of the first control interface **222**.

The first storage unit **214** can store the first software **226**. The first storage unit **214** can also store relevant information, such as advertisements, biometric information, points of interest (POIs), navigation routing entries, reviews/ratings, feedback, or any combination thereof.

The first storage unit **214** can be a volatile memory, a nonvolatile memory, an internal memory, an external memory, or a combination thereof. For example, the first storage unit **214** can be a nonvolatile storage such as non-volatile random access memory (NVRAM), Flash memory, disk storage, or a volatile storage such as static random access memory (SRAM).

The first storage unit **214** can include a first storage interface **224**. The first storage interface **224** can be used for communication between the first storage unit **214** and other functional units in the first device **102**. The first storage interface **224** can also be used for communication that is external to the first device **102**.

The first storage interface **224** can receive information from the other functional units or from external sources, or can transmit information to the other functional units or to external destinations. The external sources and the external destinations refer to sources and destinations external to the first device **102**.

The first storage interface **224** can include different implementations depending on which functional units or external units are being interfaced with the first storage unit **214**. The first storage interface **224** can be implemented with technologies and techniques similar to the implementation of the first control interface **222**.

The first communication unit **216** can enable external communication to and from the first device **102**. For example, the first communication unit **216** can permit the first device **102** to communicate with the second device **106** of FIG. **1**, an attachment such as a peripheral device or a notebook computer, and the communication path **104**.

The first communication unit **216** can also function as a communication hub allowing the first device **102** to function as part of the communication path **104** and not limited to be an end point or terminal unit to the communication path **104**. The first communication unit **216** can include active and passive components, such as microelectronics or an antenna, for interaction with the communication path **104**.

The first communication unit **216** can include a first communication interface **228**. The first communication interface **228** can be used for communication between the first communication unit **216** and other functional units in the first device **102**. The first communication interface **228** can receive information from the other functional units or can transmit information to the other functional units.

The first communication interface **228** can include different implementations depending on which functional units are being interfaced with the first communication unit **216**. The first communication interface **228** can be implemented with technologies and techniques similar to the implementation of the first control interface **222**.

The first user interface **218** allows a user (not shown) to interface and interact with the first device **102**. The first user interface **218** can include an input device and an output device. Examples of the input device of the first user interface **218** can include a microphone, a keypad, a touch-

pad, soft-keys, a keyboard, or any combination thereof to provide data and communication inputs.

Examples of the output device of the first user interface **218** can include a first display interface **230**. The first display interface **230** can include a display, a projector, a video screen, a speaker, or any combination thereof.

The first control unit **212** can operate the first user interface **218** to display information generated by the electronic system **100**. The first control unit **212** can also execute the first software **226** for the other functions of the electronic system **100**, including receiving location information from the first location unit **220**. The first control unit **212** can further execute the first software **226** for interaction with the communication path **104** via the first communication unit **216**.

The second device **106** can be optimized for implementing the various embodiments in a multiple device embodiment with the first device **102**. The second device **106** can provide the additional or higher performance processing power compared to the first device **102**. The second device **106** can include a second control unit **234**, a second communication unit **236**, a second user interface **238**, and a second location unit **252**.

The second user interface **238** allows the user to interface and interact with the second device **106**. The second user interface **238** can include an input device and an output device.

Examples of the input device of the second user interface **238** can include a microphone, a keypad, a touchpad, soft-keys, a keyboard, or any combination thereof to provide data and communication inputs.

Examples of the output device of the second user interface **238** can include a second display interface **240**. The second display interface **240** can include a display, a projector, a video screen, a speaker, or any combination thereof.

The second location unit **252** can generate a location information, a heading, and a speed of the first device **102**, as examples. The second location unit **252** can be implemented in many ways. For example, the second location unit **252** can function as at least a part of a global positioning system (GPS), an inertial navigation system such as a gyroscope, an accelerometer, a magnetometer, a compass, a spectrum analyzer, a beacon, a cellular-tower location system, a pressure location system, or any combination thereof.

The second location unit **252** can include a second location interface **254**. The second location interface **254** can be used for communication between the second location unit **252** and other functional units in the second device **106**. The second location interface **254** can also be used for communication that is external to the second device **106**.

The second location interface **254** can receive information from the other functional units or from external sources, or can transmit information to the other functional units or to external destinations. The external sources and the external destinations refer to sources and destinations external to the second device **106**.

The second location interface **254** can include different implementations depending on which functional units or external units are being interfaced with the second location unit **252**. The second location interface **254** can be implemented with technologies and techniques similar to the implementation of the second control interface **244**.

The second control unit **234** can execute a second software **242** to provide the intelligence of the second device **106** of the electronic system **100**. The second software **242** can operate in conjunction with the first software **226**. The second control unit **234** can provide additional performance compared to the first control unit **212**.

The second control unit **234** can operate the second user interface **238** to display information. The second control unit **234** can also execute the second software **242** for the other functions of the electronic system **100**, including operating the second communication unit **236** to communicate with the first device **102** over the communication path **104**.

The second control unit **234** can be implemented in a number of different manners. For example, the second control unit **234** can be a processor, an embedded processor, a microprocessor, a hardware control logic, a hardware finite state machine (FSM), a digital signal processor (DSP), or a combination thereof.

The second control unit **234** can include a second controller interface **244**. The second controller interface **244** can be used for communication between the second control unit **234** and other functional units in the second device **106**. The second controller interface **244** can also be used for communication that is external to the second device **106**.

The second controller interface **244** can receive information from the other functional units or from external sources, or can transmit information to the other functional units or to external destinations. The external sources and the external destinations refer to sources and destinations external to the second device **106**.

The second controller interface **244** can be implemented in different ways and can include different implementations depending on which functional units or external units are being interfaced with the second controller interface **244**. For example, the second controller interface **244** can be implemented with a pressure sensor, an inertial sensor, a microelectromechanical system (MEMS), optical circuitry, waveguides, wireless circuitry, wireline circuitry, or a combination thereof.

A second storage unit **246** can store the second software **242**. The second storage unit **246** can also store the relevant information, such as advertisements, biometric information, points of interest, navigation routing entries, reviews/ratings, feedback, or any combination thereof. The second storage unit **246** can be sized to provide the additional storage capacity to supplement the first storage unit **214**.

For illustrative purposes, the second storage unit **246** is shown as a single element, although it is understood that the second storage unit **246** can be a distribution of storage elements. Also for illustrative purposes, the electronic system **100** is shown with the second storage unit **246** as a single hierarchy storage system, although it is understood that the electronic system **100** can have the second storage unit **246** in a different configuration. For example, the second storage unit **246** can be formed with different storage technologies forming a memory hierarchal system including different levels of caching, main memory, rotating media, or off-line storage.

The second storage unit **246** can be a volatile memory, a nonvolatile memory, an internal memory, an external memory, or a combination thereof. For example, the second storage unit **246** can be a nonvolatile storage such as non-volatile random access memory (NVRAM), Flash memory, disk storage, or a volatile storage such as static random access memory (SRAM).

The second storage unit **246** can include a second storage interface **248**. The second storage interface **248** can be used for communication between the second storage unit **246** and other functional units in the second device **106**. The second storage interface **248** can also be used for communication that is external to the second device **106**.

The second storage interface **248** can receive information from the other functional units or from external sources, or can transmit information to the other functional units or to external destinations. The external sources and the external destinations refer to sources and destinations external to the second device **106**.

The second storage interface **248** can include different implementations depending on which functional units or external units are being interfaced with the second storage unit **246**. The second storage interface **248** can be implemented with technologies and techniques similar to the implementation of the second controller interface **244**.

The second communication unit **236** can enable external communication to and from the second device **106**. For example, the second communication unit **236** can permit the second device **106** to communicate with the first device **102** over the communication path **104**.

The second communication unit **236** can also function as a communication hub allowing the second device **106** to function as part of the communication path **104** and not limited to be an end point or terminal unit to the communication path **104**. The second communication unit **236** can include active and passive components, such as microelectronics or an antenna, for interaction with the communication path **104**.

The second communication unit **236** can include a second communication interface **250**. The second communication interface **250** can be used for communication between the second communication unit **236** and other functional units in the second device **106**. The second communication interface **250** can receive information from the other functional units or can transmit information to the other functional units.

The second communication interface **250** can include different implementations depending on which functional units are being interfaced with the second communication unit **236**. The second communication interface **250** can be implemented with technologies and techniques similar to the implementation of the second controller interface **244**.

The first communication unit **216** can couple with the communication path **104** to send information to the second device **106** in the first device transmission **208**. The second device **106** can receive information in the second communication unit **236** from the first device transmission **208** of the communication path **104**.

The second communication unit **236** can couple with the communication path **104** to send information to the first device **102** in the second device transmission **210**. The first device **102** can receive information in the first communication unit **216** from the second device transmission **210** of the communication path **104**. The electronic system **100** can be executed by the first control unit **212**, the second control unit **234**, or a combination thereof.

For illustrative purposes, the second device **106** is shown with the partition having the second user interface **238**, the second storage unit **246**, the second control unit **234**, and the second communication unit **236**, although it is understood that the second device **106** can have a different partition. For example, the second software **242** can be partitioned differently such that some or all of its function can be in the second control unit **234** and the second communication unit **236**. Also, the second device **106** can include other functional units not shown in FIG. **2** for clarity.

The functional units in the first device **102** can work individually and independently of the other functional units. The first device **102** can work individually and independently from the second device **106** and the communication path **104**.

The functional units in the second device **106** can work individually and independently of the other functional units. The second device **106** can work individually and independently from the first device **102** and the communication path **104**.

For illustrative purposes, the electronic system **100** is described by operation of the first device **102** and the second device **106**. It is understood that the first device **102** and the second device **106** can operate any of the modules and functions of the electronic system **100**. For example, the first device **102** is described to operate the first location unit **220**, although it is understood that the second device **106** can also operate the first location unit **220**. As an additional example, the second device **106** is described to operate the second location unit **252**, although it is understood that the first device **102** can also operate the second location unit **252**.

Referring now to FIG. **3**, therein is shown an example diagram of the electronic system **100** in operation. FIG. **3** depicts a user **302** undertaking a gesture **304** for controlling the first display interface **230**. The gesture **304** represents a motion or positioning of an appendage of the user **302** as captured by a device such as the first device **102** of FIG. **1**, the second device **106** of FIG. **1**, or a combination thereof. The gesture **304** can include a pointing gesture, a directive gesture, a thumbs-up gesture, an open palm gesture, or a combination thereof. More specifically, the gesture **304** can represent the motion or positioning of the appendage of the user **302** as captured by one or more of the sensors **103** of FIG. **1**.

The electronic system **100** can capture the gesture **304** based on a first sensor reading **306**, a second sensor reading **308**, or a combination thereof. The first sensor reading **306** is data or information received or retrieved from one of the sensors **103** concerning a gesture made by the user **302**. The first sensor reading **306** can be data or information received or retrieved from a first sensor **310**. The first sensor reading **306** can be data or information received or retrieved from the first sensor **310** at one particular moment in time or over a period of time.

The first sensor **310** can be an instance of the sensors **103** for capturing images, video, or visual spectra and determining spatial locations or distances. For example, the first sensor **310** can include a Microsoft Kinect™ sensor, a Creative Senz3D™ sensor, or a Leap Motion™ sensor.

The first sensor reading **306** can capture an elbow position **312**, a hand position **314**, a fingertip position **316**, or a combination thereof. The elbow position **312** is a spatial position or coordinate for representing an elbow of the user **302**. For example, the elbow position **312** can be the spatial position or coordinate of an elbow joint of the user **302** as the user **302** undertakes the gesture **304**.

The hand position **314** is a spatial position or coordinate for representing a hand of the user **302**. For example, the hand position **314** can be the spatial position or coordinate of a palm, a wrist, or an opisthenar of the user **302** as the user **302** undertakes the gesture **304**. The fingertip position **316** is a spatial position or coordinate for representing a fingertip of the user **302**.

The second sensor reading **308** can be data or information received or retrieved from another one of the sensors **103** concerning the gesture made by the user **302**. The second sensor reading **308** can be data or information received or retrieved from a second sensor **318** different from the first sensor **310**. The first sensor reading **306** can be data or information received or retrieved from the second sensor **318** at one particular moment in time or over a period of time.

The second sensor **318** can also be an instance of the sensors **103** for capturing images, video, or visual spectra and determining spatial locations or distances. For example, the second sensor **318** can include the Microsoft Kinect™ sensor, the Creative Senz3D™ sensor, or the Leap Motion™ sensor.

The first sensor reading **306**, the second sensor reading **308**, or a combination thereof can include coordinates of the gesture **304** in a sensor coordinate system **322**. More specifically, the first sensor reading **306**, the second sensor reading **308**, or a combination thereof can include coordinates of the elbow position **312**, the hand position **314**, the fingertip position **316**, or a combination thereof used to make the gesture **304** in the sensor coordinate system **322**.

The sensor coordinate system **322** is a coordinate system associated with one of the sensors **103**. For example, the sensor coordinate system **322** can be a coordinate system associated with the first sensor **310**, the second sensor **318**, or a combination thereof. As will be discussed below, the electronic system **100** can calculate a transformation matrix **320** to transform the coordinates of the gesture **304** in the sensor coordinate system **322** to a uniform coordinate system **324**.

The transformation matrix **320** is an array for mapping a spatial position of a point in one coordinate system into another coordinate system. The transformation matrix **320** can be an array of numbers or expressions for changing the spatial position of a point in one coordinate system into another coordinate system. For example, the transformation matrix **320** can be an array of numbers or expression for changing the coordinates of a point in the sensor coordinate system **322** to coordinates in the uniform coordinate system **324**.

The uniform coordinate system **324** is a homogenous coordinate system for standardizing distances and positions determined using different spatial coordinates. The uniform coordinate system **324** can be a multidimensional coordinate system such as a two-dimensional coordinate system, a three-dimensional coordinate system, or a combination thereof. The uniform coordinate system **324** can include a common scheme for describing or representing locations for multiple independent devices, such as the first sensor **310** and the second sensor **318**.

The uniform coordinate system **324** can be associated with a device in the electronic system **100** such as the first display interface **230**, the second display interface **240**, or a combination thereof. For example, the uniform coordinate system **324** can be a display coordinate system where the origin of the uniform coordinate system **324** is a screen corner of the display interface.

The user **302** can undertake the gesture **304** from a user location **326**. The user location **326** is a geographic location of the user **302**. For example, the user location **326** can include a GPS coordinate, a three-dimensional coordinate, a room or enclosure location, or a combination thereof. The user location **326** can also include a position of the user **302** relative to one or more of the devices in the electronic system **100**. For example, the user location **326** can include a position of the user **30** relative to the first display interface **230**, the first sensor **310**, the second sensor **318**, or a combination thereof.

The first sensor **310** can include a first range profile **328**, a second range profile **330**, or a combination thereof. The first range profile **328** is a region where an object or appendage can be captured by the first sensor **310**, the second sensor **318**, or a combination thereof. The first range profile **328** can be a region within a field of view of the first sensor **310**, the second sensor **318**, or a combination thereof. The first range profile **328** can be a region where an object or appendage above a threshold size can be captured by the first sensor **310**, the second sensor **318**, or a combination thereof.

The first range profile **328** can be based on a granularity or sensitivity of the first sensor **310** or the second sensor **318**. The first range profile **328** can further be based on an ambient environment surrounding the first sensor **310** or the second sensor **318**, including a lighting condition. The first range profile **328** can further be based on a location of the first sensor **310** or the second sensor **318** relative to other objects, an angle of orientation of the first sensor **310** or the second sensor **318**, or a combination thereof.

For example, the first range profile **328** can be the region where appendages larger than a threshold size can be captured by the first sensor **310** or the second sensor **318**. As a more specific example, the first range profile **328** can be the region where appendages larger than a hand can be captured by the first sensor **310** or the second sensor **318**.

The second range profile **330** can be an additional region extending beyond the first range profile **328**. The second range profile **330** can also be a region where an object or appendage can be captured by one of the sensors **103** other than the sensor associated with the first range profile **328**. For example, the first range profile **328** can be associated with the first sensor **310**, in this example, the second range profile **330** can be a region where an appendage of the user **302** can be captured by the second sensor **318**.

When the first range profile **328** and the second range profile **330** are both associated with either the first sensor **310** or the second sensor **318**, the second range profile **330** can be an additional region extending beyond the first range profile **328**.

When the first range profile **328** is associated with the first sensor **310** and the second range profile **330** is associated with the second sensor **318**, the second range profile **330** can be a region where an object or appendage can be captured by the second sensor **318**. The second range profile **330** can be a region within a field of view of the second sensor **318**. The second range profile **330** can also be a region where an object or appendage above a threshold size can be captured by the second sensor **318**.

For example, the first range profile **328** can be the region within the field of view of the first sensor **310** where appendages larger than or equal to an average human hand can be captured by the first sensor **310**. In this example, the second range profile **330** can be the region where appendages larger than or equal to an average human fingertip can be captured by the second sensor **318**.

The first range profile **328** and the second range profile **330** can overlap to produce an overlapping range profile **332**. The overlapping range profile **332** is a region included in or encompassing the first range profile **328** and the second range profile **330**.

When the first range profile **328** and the second range profile **330** both refer to regions covered by either the first sensor **310** or the second sensor **318**, the overlapping range profile **332** can be a smaller instance of the total region covered by either the first sensor **310** or the second sensor **318**. In addition, when the first range profile **328** refers to the region covered by the first sensor **310** and the second range profile **330** refers to the region covered by the second sensor **318**, the overlapping range profile **332** can be a region of intersection between the first range profile **328** and the second range profile **330**.

The electronic system **100** can also identify a granularity limitation **334** associated with the first range profile **328**, the second range profile **330**, or a combination thereof. The granularity limitation **334** is a minimum size threshold for an object or appendage of the user **302** can be captured by the sensors **103**. The granularity limitation **334** can be based on an object or appendage size such as the size of a torso, arm, hand, or fingertip. The granularity limitation **334** can also be based on a two-dimensional area such as 5, 10, or 20 square inches.

As depicted in FIG. **3**, the first display interface **230** can display a cursor **348** for indicating a position of a blended position indicator **350**. The cursor **348** is a graphical icon or marker for showing the blended position indicator **350** on the first display interface **230**, the second display interface **240**, or a combination thereof.

The blended position indicator **350** is a coordinate or position on a display interface representing an estimated direction of a gesture made by the user **302** at the display interface. The blended position indicator **350** can be a coordinate or position on the first display interface **230** representing the estimated direction of the gesture **304** made by the user **302** at the first display interface **230**.

As will be discussed below, the electronic system **100** can calculate the blended position indicator **350** based on a first position indicator **352**, a second position indicator **358**, or a combination thereof. The first position indicator **352** is a coordinate or position on a display interface representing an intersection point between a first vector **360** and the display interface.

The first vector **360** is a vector representing a possible direction of the gesture **304**. The first vector **360** can be calculated from appendage positions of the user **302** captured in a sensor reading. For example, the first vector **360** can be a vector calculated from appendage positions of the user **302** captured by the first sensor reading **306**. As a more specific example, the first vector **360** can be a vector calculated from the elbow position **312** and the hand position **314** of the user **302** captured by the first sensor reading **306**.

As will be discussed below, the electronic system **100** can apply the transformation matrix **320** to the appendage positions of the user **302** to calculate a transformed origin point **354** and a transformed terminal point **356**. The transformed origin point **354** is an origination or commencement point of a vector. The transformed origin point **354** can be calculated by applying the transformation matrix **320** to an appendage position captured in a sensor reading. The transformed terminal point **356** is a directional point of a vector calculated by applying the transformation matrix **320** to an appendage position captured in a sensor reading.

The second position indicator **358** is a coordinate or position on a display interface for representing an intersection point between a second vector **362** and the display interface. The second vector **362** is another vector representing a possible direction of the gesture **304**.

For example, the second vector **362** can be a vector calculated from appendage positions of the user **302** captured by the second sensor reading **308**. As a more specific example, the second vector **362** can be a vector calculated from the hand position **314** and the fingertip position **316** of the user **302** captured by the second sensor reading **308**. The electronic system **100** can calculate the first vector **360**, the second vector **362**, or a combination thereof based on the transformed origin point **354** and the transformed terminal point **356**.

The electronic system **100** can also identify a first sensor characteristic **336** associated with the first sensor reading **306**. The first sensor characteristic **336** is an indication of the reliability and frequency of the first sensor reading **306**. The first sensor characteristic **336** can include a confidence score **338** and a sensor update frequency **340**.

The confidence score **338** is a numeric value indicating a certainty attributed to a sensor reading. For example, the confidence score **338** can be a numeric value indicating the certainty attributed to the first sensor reading **306**, the second sensor reading **308**, or a combination thereof.

The sensor update frequency **340** is a measure of the number of times one of the sensors **103** generates a sensor reading within a given amount of time. The sensor update frequency **340** can be associated with the number of readings or measurements performed by the sensor in a second, a minute, or another measure of time. For example, the sensor update frequency **340** can be the measure of the number of times the first sensor **310** generates the first sensor reading **306**, the second sensor **318** generates the second sensor reading **308**, or a combination thereof.

The electronic system **10** can identify a second sensor characteristic **342** associated with the second sensor reading **308**. The second sensor characteristic **342** is an indication of the reliability and frequency of the second sensor reading **308**. The second sensor characteristic **342** can include the confidence score **338** and the sensor update frequency **340** associated with the second sensor reading **308**.

The electronic system **100** can calculate a first weight **344** associated with the first sensor reading **306**. The first weight **344** is a multiplier for increasing or decreasing a contribution of the first sensor reading **306** to a calculation of the blended position indicator **350**. As will be discussed below, the electronic system **100** can calculate the first weight **344** based on the first sensor characteristic **336**.

The electronic system can also calculate a second weight **346** associated with the second sensor reading **308**. The second weight **346** is a multiplier for increasing or decreasing a contribution of the second sensor reading **308** to the calculation of the blended position indicator **350**. The electronic system **100** can calculate the second weight **346** based on the second sensor characteristic **342**.

Referring now to FIG. **4**, therein is shown another example diagram of the electronic system **100** in operation. FIG. **4** depicts a first sensor frame **402** and a second sensor frame **404**.

The first sensor frame **402** is an image captured by one of the sensors **103** depicting an object or subject at an initial point in time. The first sensor frame **402** can be an image of an appendage of the user **302** captured at an initial point in time. For example, the first sensor frame **402** can be captured by the first sensor **310** of FIG. **3**, the second sensor **318** of FIG. **3**, or a combination thereof.

The second sensor frame **404** is another image captured by one of the sensors **103** depicting an object or subject at a latter point in time. The second sensor frame **404** can be another image captured by one of the sensors **103** depicting the same object or subject depicted in the first sensor frame **402** at a latter point in time. More specifically, the second sensor frame **404** can be another image captured by one of the sensors **103** depicting the same appendage of the user **302** at a latter point in time. For example, the second sensor frame **404** can be captured by the first sensor **310**, the second sensor **318**, or a combination thereof.

As will be discussed below, the electronic system **100** can determine a first appendage orientation **406** based on one or more appendages depicted in the first sensor frame **402**. The

first appendage orientation **406** is an alignment or angle of one or more appendages of the user **302**. The first appendage orientation **406** can be the spatial positioning of one or more appendages used to make the gesture **304** of FIG. **3**.

The electronic system **100** can determine the first appendage orientation **406** based on a first normal vector **408**. The first normal vector **408** is a vector orthogonal to plane associated with a skin surface of the user **302**. The first normal vector **408** can be a vector orthogonal to a plane associated with an appendage surface of the user **302**. More specifically, the first normal vector **408** can be a vector orthogonal to a joint surface of the user **302**. In addition, the first normal vector **408** can be a vector orthogonal to a palm center of a hand used to make the gesture **304**.

The first sensor frame **402** can include an origination point **410** and a known terminal point **414**. The known terminal point **414** represents a point or location on a distal end of an appendage of the user **302** as recognized by the electronic system **100**. The origination point **410** represents a point or location proximal or closer to the body of the user **302** than the known terminal point **414** depicted in a sensor frame. For example, the origination point **410** can include a metacarpophalangeal joint, a proximal interphalangeal joint, or a wrist joint. Also, for example, the known terminal point **414** can include a fingertip or a distal interphalangeal joint.

The origination point **410** can include a first origin point **412**. The first origin point **412** can represent one instance of the origination point **410** proximal or closer to the body of the user **302** than the known terminal point **414** depicted in the first sensor frame **402**. For example, the first origin point **412** can be the elbow position **312** of FIG. **3** of the user **302** and the known terminal point **414** can be the hand position **314** of the user **302** as depicted in the first sensor frame **402**.

The electronic system **100** can also determine a second appendage orientation **416** based on the second sensor frame **404**. The second appendage orientation **416** is a spatial positioning of one or more appendages of the user **302**. The second appendage orientation **416** can be the spatial positioning of one or more appendages used to make the gesture **304**.

The electronic system **100** can determine the second appendage orientation **416** based on a second normal vector **418**. The second normal vector **418** is a vector orthogonal to the same appendage surface of the user **302** used to determine the first normal vector **408** at a latter point in time. The second normal vector **418** can be a vector orthogonal to the same appendage surface of the appendage used to make the gesture **304**.

As will be discussed below, the electronic system **100** can calculate an axis of rotation **420**, an angle of rotation **422**, or a combination thereof based on the first normal vector **408**, the second normal vector **418**, or a combination thereof. The axis of rotation **420** is an imaginary line for determining the rotation of a rigid object or body part. The angle of rotation **422** is a measure of how much a rigid object or body part rotates around the axis of rotation **420**. The angle of rotation **422** can be calculated in degrees or radians.

The second sensor frame **404** can include a second origin point **424**. The second origin point **424** represents another instance of the origination point **410** depicted in the second sensor frame **404**. For example, the second origin point **424** can be the hand position **314** of the user **302** as depicted in the second sensor frame **404**.

As will be discussed below, the electronic system **100** can also determine an inferred terminal point **426** based on the second origin point **424**, the first origin point **412**, the known terminal point **414**, the first appendage orientation **406**, and the second appendage orientation **416**. The inferred terminal point **426** represents an inferred distal end of an appendage of the user **302** depicted in the second sensor frame **404**. The inferred terminal point **426** can represent an inferred fingertip position of the user **302**.

Referring now to FIG. **5**, therein is shown a control flow **500** of the electronic system **100** of FIG. **1**. The electronic system **100** can include a calibration module **502**, a range module **504**, a location module **506**, a gesture tracking module **508**, an inference module **510**, a transformation module **516**, a vector projection module **518**, a blending module **520**, or a combination thereof.

The calibration module **502** can be coupled to the range module **504**. The range module **504** can be further coupled to the location module **506**, the location module **506** can be further coupled to the gesture tracking module **508**, the gesture tracking module **508** can be further coupled to the inference module **510**, the inference module **510** can be further coupled to the transformation module **516**, the transformation module **516** can be further coupled to the vector projection module **518**, and the vector projection module **518** can be further coupled to the blending module **520**.

The modules can be coupled by having the input of one module connected to the output of another module as shown in FIG. **5**. The modules can be coupled by using wired or wireless connections, the communication path **104** of FIG. **1**, instructional steps, or a combination thereof. The modules can be coupled directly, without any intervening structures other than the structure providing the direct connection. The modules can further be coupled indirectly, through a shared connection or other functional structures between the coupled modules.

The calibration module **502** is configured to calculate one or more instances of the transformation matrix **320** of FIG. **3**. The calibration module **502** can calculate the transformation matrix **320** for transforming coordinates in the sensor coordinate system **322** of FIG. **3** to coordinates in the uniform coordinate system **324** of FIG. **3**. For example, the calibration module **502** can calculate the transformation matrix **320** for transforming the coordinates of the hand position **314** of FIG. **3**, the elbow position **312** of FIG. **3**, the fingertip position **316** of FIG. **3**, or a combination thereof to their corresponding coordinates in the uniform coordinate system **324**.

The calibration module **502** can calculate different instances of the transformation matrix **320** for each of the sensors **103**. For example, the calibration module **502** can calculate one instance of the transformation matrix **320** for the first sensor **310** of FIG. **3** and another instance of the transformation matrix **320** for the second sensor **318** of FIG. **3**. In this example, the instance of the transformation matrix **320** for the first sensor **310** can be used to transform coordinates in the sensor coordinate system **322** of the first sensor **310** into the uniform coordinate system **324**. Also, in this example, the instance of the transformation matrix **320** for the second sensor **318** can be used to transform coordinates in the sensor coordinate system **322** of the second sensor **318** into the uniform coordinate system **324**.

The calibration module **502** can calculate the transformation matrix **320** by displaying an array of calibration points on a display interface such as the first display interface **230**, the second display interface **240** of FIG. **2**, or a combination thereof. The calibration module **502** can display the calibration points in a display coordinate system.

The calibration module **502** can then receive or identify a calibration gesture made by the user **302** of FIG. **3** at one of the calibration points. The calibration gesture can include

the gesture **304** of FIG. **3**, a palm gesture, an arm gesture, or a combination thereof. The user **302** can make one instance of the calibration gesture from a first position and can make another instance of the calibration gesture from a second position.

The second position can be a geographic position or location different from the first position. For example, the first position can be a left corner of a living room and the second position can be a right corner of the living room.

The calibration module **502** can receive or retrieve one or more sensor readings capturing the coordinates of the calibration gesture in the sensor coordinate system **322**. More specifically, the calibration module **502** can receive or retrieve one or more sensor readings capturing the coordinates of appendage positions used to make the calibration gesture. For example, the calibration module **502** can receive or retrieve a sensor reading from the first sensor **310** with the coordinates of the elbow position **312**, the hand position **314**, the fingertip position **316**, or a combination thereof used to make the calibration gesture. The calibration module **502** can receive or retrieve the coordinates of the appendage positions in the sensor coordinate system **322**.

The calibration module **502** can generate a first calibration vector based on the coordinates of the appendage positions in the sensor coordinate system **322**. The first calibration vector is a vector calculated in the sensor coordinate system **322** representing the direction of the calibration gesture undertaken at the first position.

The calibration module **502** can generate the first calibration vector by projecting a vector connecting two or more coordinates representing the appendage positions of the calibration gesture undertaken at the first position. The calibration module **502** can project the first calibration vector toward the display interface displaying the calibration points. The calibration module **502** can also generate a second calibration vector. The second calibration vector is a vector calculated in the sensor coordinate system **322** representing the direction of the calibration gesture undertaken at the second position.

The calibration module **502** can generate the second calibration vector for intersecting with the first calibration vector to determine an intersection point. The calibration module **502** can generate the second calibration vector by projecting a vector connecting two or more coordinates representing the appendage positions of the calibration gesture undertaken at the second position. The calibration module **502** can project the second calibration vector toward the display interface displaying the calibration points.

The calibration module **502** can then determine the intersection point for representing an intersection between the first calibration vector and the second calibration vector. The calibration module **502** can determine the coordinates of the intersection point in the sensor coordinate system **322**. The calibration module **502** can use the first control unit **212** of FIG. **2**, the second control unit **234** of FIG. **2**, or a combination thereof to determine the coordinates of the intersection point in the sensor coordinate system **322**.

The calibration module **502** can calculate the transformation matrix **320** based on the coordinates of the intersection point in the sensor coordinate system **322** and the coordinates of the calibration point in the display coordinate system. The calibration module **502** can take as inputs the coordinates of the intersection point in the sensor coordinate system **322** and the coordinates of the calibration point in the display coordinate system. The calibration module **502** can calculate the transformation matrix **320** for transforming the coordinates of the intersection point in the sensor coordinate system **322** into the coordinates of the calibration point in the display coordinate system.

The calibration module **502** can use the first control unit **212**, the second control unit **234**, or a combination thereof to calculate the transformation matrix **320** using a least-squares estimation algorithm, a least-squares error minimization method, an absolute orientation least-squares error method, or a combination thereof. The calibration module **502** can calculate the transformation matrix **320** as a closed-form solution using unit quaternions.

The calibration module **502** can calculate a different instance of the transformation matrix **320** for each of the sensors **103**. The calibration module **502** can store the instances of the transformation matrix **320** in the first storage unit **214** of FIG. **2**, the second storage unit **246** of FIG. **2**, or a combination thereof.

The calibration module **502** can be part of the first software **226** of FIG. **2**, the second software **242** of FIG. **2**, or a combination thereof. The first control unit **212** can execute the first software **226**, the second control unit **234** can execute the second software **242**, or a combination thereof to calculate the transformation matrix **320**.

Moreover, the calibration module **502** can also communicate the transformation matrix **320** between devices through the first communication unit **216** of FIG. **2**, the second communication unit **236** of FIG. **2**, or a combination thereof. After calculating the transformation matrix **320**, the control flow **500** can pass from the calibration module **502** to the range module **504**.

The range module **504** is configured to determine the first range profile **328** of FIG. **3**, the second range profile **330** of FIG. **3**, or a combination thereof. The range module **504** can determine the first range profile **328**, the second range profile **330**, or a combination thereof based on the granularity or sensitivity of the first sensor reading **306** of FIG. **3**, the second sensor reading **308** of FIG. **3**, or a combination thereof.

As previously discussed, both the first range profile **328** and the second range profile **330** can be associated with one of the sensors **103** including the first sensor **310** or the second sensor **318**. For example, the first range profile **328** can represent a region where one or more appendages of the user **302** above a threshold size can be captured by the first sensor **310**. Also, in this example, the second range profile **330** can represent an additional region beyond the first range profile **328** where one or more appendages of the user **302** above a different threshold size can be captured by the first sensor **310**.

Also, as previously discussed, the second range profile **330** can be associated with one of the sensors **103** different from the sensor associated with the first range profile **328**. For example, the first range profile **328** can be associated with the first sensor **310** and the second range profile **330** can be associated with the second range profile **330**. When the second range profile **330** is associated with the second sensor **318**, the second range profile **330** can be a region where one or more appendages of the user **302** above a threshold size can be captured by the second sensor **318**.

The range module **504** can determine the first range profile **328** by receiving or retrieving one or more boundaries, distances, coordinates, or a combination thereof for demarcating the first range profile **328** from one of the sensors **103**. The range module **504** can further determine the first range profile **328** based on identifying one or more of the sensors **103**. The range module **504** can determine the first range profile **328** according to a driver associated with one of the sensors **103**, a device connected to the electronic

system **100**, or a combination thereof. In addition, the first range profile **328** can be predetermined by the electronic system **100**.

The range module **504** can determine the second range profile **330** by receiving or retrieving one or more boundaries of the second range profile **330** from one of the sensors **103**, a driver associated with one of the sensors **103**, a device connected to the electronic system **100**, or a combination thereof. In addition, the second range profile **330** can be predetermined by the electronic system **100**. The range module **504** can also determine the first range profile **328**, the second range profile **330**, or a combination thereof based on an input from the user **302**.

The range module **504** can determine the granularity limitation **334** of FIG. **3** associated with the first range profile **328**, the second range profile **330**, or a combination thereof. As previously discussed, the granularity limitation **334** is a minimum size threshold above which an object or appendage of the user **302** can be captured by the sensors **103**. For example, the granularity limitation **334** can be based on a body part size such as the size of a torso, arm, hand, or fingertip. As an additional example, the granularity limitation **334** can be based on an area such as 5, 10, or 20 square inches.

The range module **504** can determine the granularity limitation **334** by receiving or retrieving the granularity limitation **334** from the first sensor **310**, the second sensor **318**, or a combination thereof. In addition the range module **504** can determine the granularity limitation **334** by receiving or retrieving the granularity limitation **334** from the user **302** or another device in the electronic system **100**.

The range module **504** can also determine the overlapping range profile **332** of FIG. **3**. The range module **504** can determine the overlapping range profile **332** based on the first range profile **328** and the second range profile **330**. The range module **504** can determine the overlapping range profile **332** as the overlap region between the first range profile **328** and the second range profile **330**. The range module **504** can determine the overlapping range profile **332** by comparing the coordinates of the boundaries associated with the first range profile **328** and the second range profile **330**.

When the first range profile **328** is associated with the first sensor **310** and the second range profile **330** is associated with the second sensor **318**, the range module **504** can use the transformation matrix **320** associated with the first sensor **310** to transform the coordinates of the boundaries of the first range profile **328** from the sensor coordinate system **322** of the first sensor **310** into the uniform coordinate system **324**. In addition, the range module **504** can also use the transformation matrix **320** associated with the second sensor **318** to transform the coordinates of the boundaries of the second range profile **330** from the sensor coordinate system **322** of the second sensor **318** into the uniform coordinate system **324**.

The range module **504** can determine the overlapping range profile **332** by comparing the boundaries of the first range profile **328** and the boundaries of the second range profile **330** in the uniform coordinate system **324**. Moreover, when the first range profile **328** and the second range profile **330** are both associated with one of the sensors **103**, such as the first sensor **310** or the second sensor **318**, the range module **504** can determine the overlapping range profile **332** in the sensor coordinate system **322**. The range module **504** can determine the overlapping range profile **332** based on a predetermined distance below and above a location or a distance associated with a division between modes, circuitry, device portions, ranges, granularity levels, measurement confidence level, or a combination thereof.

The range module **504** can store the first range profile **328**, the second range profile **330**, the overlapping range profile **332**, or a combination thereof in the first storage unit **214**, the second storage unit **246**, or a combination thereof. The range module **504** also store the granularity limitation **334** associated with the first range profile **328**, the second range profile **330**, or a combination thereof in the first storage unit **214**, the second storage unit **246**, or a combination thereof.

The range module **504** can be part of the first software **226**, the second software **242**, or a combination thereof. The first control unit **212** can execute the first software **226**, the second control unit **234** can execute the second software **242**, or a combination thereof to determine the first range profile **328**, the second range profile **330**, the granularity limitation **334**, or a combination thereof.

Moreover, the range module **504** can also communicate the first range profile **328**, the second range profile **330**, the granularity limitation **334**, or a combination thereof between devices through the first communication unit **216**, the second communication unit **236**, or a combination thereof. After determining the first range profile **328**, the second range profile **330**, the granularity limitation **334**, or a combination thereof, the control flow **500** can pass from the range module **504** to the location module **506**.

The location module **506** is configured to determine the user location **326** of FIG. **3**. The location module **506** can determine the user location **326** based on a device location, the first sensor reading **306**, the second sensor reading **308**, or a combination thereof. The location module **306** can also determine the user location **326** based on the calibration procedure.

The location module **506** can determine the user location **326** based on the device location of a device carried by the user **302**. For example, the location module **506** can determine the user location **326** based on the device location of the first device **102**, the second device **106**, or a combination thereof carried by the user **302**. As a more specific example, the first device **102** can be a mobile device such as a cellular phone, a tablet device, or a wearable device and the location module **506** can determine the user location **326** based on the mobile device worn or held by the user **302**.

The location module **506** can determine the user location **326** based on the device location by using the first location unit **220** of FIG. **2**, the second location unit **252** of FIG. **2**, or a combination thereof. In addition, the location module **506** can determine the user location **326** based on the device location by using a multilateration (MLAT) technique or a triangulation technique using the first communication unit **216**, the second communication unit **236**, or a combination thereof. For example, the location module **506** can use the GPS component of the first location unit **220**, the Bluetooth™ component of the first communication unit **216**, or a combination thereof to determine the user location **326** based on the device location of the first device **102**.

The location module **506** can also determine the user location **326** based on the first sensor reading **306**, the second sensor reading **308**, or a combination thereof. The location module **506** can determine the user location **326** based on a distance measurement, a location estimation, a size measurement, or a combination thereof from the first sensor reading **306**, the second sensor reading **308**, or a combination thereof. For example, the location module **506** can determine the user location **326** based on the distance measurement, a location estimation, a size measurement, or

a combination thereof of a body part of the user **302** such as a torso, a head, an arm, a leg, or a combination thereof.

Once the location module **506** has determined the user location **326**, the location module **506** can also determine whether the user location **326** is within the first range profile **328**, the second range profile **330**, or the overlapping range profile **332**. The location module **506** can determine whether the user location **326** is within the first range profile **328**, the second range profile **330**, or the overlapping range profile **332** by transforming one or more coordinates of the user location **326** into the uniform coordinate system **324**.

For example, the location module **506** can interact with the transformation module **516** to transform the coordinates of the user location **326** in the sensor coordinate system **322** to the uniform coordinate system **324** using the transformation matrix **320**. The location module **506** can then determine if the user location **326** is within the first range profile **328**, the second range profile **330**, or the overlapping range profile **332** by comparing the coordinates of the user location **326** to the boundaries of the first range profile **328** and the boundaries of the second range profile **330**.

The location module **506** can be part of the first software **226**, the second software **242**, or a combination thereof. The first control unit **212** can execute the first software **226**, the second control unit **234** can execute the second software **242**, or a combination thereof to determine the user location **326**.

Moreover, the location module **506** can also communicate the user location **326** between devices through the first communication unit **216**, the second communication unit **236**, or a combination thereof. After determining the user location **326**, the control flow **500** can pass from the location module **506** to the gesture tracking module **508**.

The gesture tracking module **508** is configured to determine one or more instances of the origination point **410** of FIG. **4** and the known terminal point **414** of FIG. **4**. The gesture tracking module **508** can determine one or more instances of the origination point **410** and the known terminal point **414** based on the user location **326**, the first range profile **328**, the second range profile **330**, the first sensor reading **306**, the second sensor reading **308**, the granularity limitation **334**, or a combination thereof.

The gesture tracking module **508** can use the user location **326** to determine the presence of the user **302** in the first range profile **328**, the second range profile **330**, or the overlapping range profile **332**. As previously discussed, the first range profile **328** and the second range profile **330** can refer to coverage areas associated with different sensors. For example, the first range profile **328** can be associated with the first sensor **310** and the second range profile **330** can be associated with the second sensor **318**.

The gesture tracking module **508** can identify the first sensor reading **306** when the user location **326** is determined to be in the first range profile **328** and outside of the overlapping range profile **332**. The gesture tracking module **508** can identify the first sensor reading **306** for capturing the gesture **304** using the first sensor **310**. The first sensor **310** can capture the coordinates of the gesture **304** in the sensor coordinate system **322** of the first sensor **310**.

The gesture tracking module **508** can identify the second sensor reading **308** when the user location **326** is determined to be in the second range profile **330** and outside of the overlapping range profile **332**. The gesture tracking module **508** can identify the second sensor reading **308** for capturing the gesture **304** using the second sensor **318**. The second sensor **318** can capture the coordinates of the gesture **304** in the sensor coordinate system **322** of the second sensor **318**.

The gesture tracking module **508** can identify both the first sensor reading **306** and the second sensor reading **308** when the user location **326** is in the overlapping range profile **332**. In this instance, the overlapping range profile **332** refers to a region of intersection between the first range profile **328** associated with the first sensor **310** and the second range profile **330** associated with the second sensor **318**.

Also, as previously discussed, both the first range profile **328** and the second range profile **330** can refer to coverage areas associated with the same sensor. For example, the first range profile **328** can be associated with a near range of the first sensor **310**, and the second range profile **330** can be associated with a far range of the first sensor **310**. In this example, the gesture tracking module **508** can identify the first sensor reading **306** when the user location **326** is in any of the first range profile **328**, the second range profile **330**, or the overlapping range profile **332**.

The gesture tracking module **508** can identify the first sensor reading **306** or the second sensor reading **308** by accessing a sensor log of the first sensor **310** or the second sensor **318**, respectively. In addition, the gesture tracking module **508** can identify the first sensor reading **306** or the second sensor **318** reading by interfacing with the first sensor **310** or the second sensor **318**, respectively, through an application programming interface (API). Moreover, the gesture tracking module **508** can identify the first sensor reading **306** or the second sensor reading **308** by querying the first sensor **310** or the second sensor **318**, respectively.

The first sensor reading **306**, the second sensor reading **308**, or a combination thereof can include the coordinates of appendage positions used to make the gesture **304**. For example, the first sensor reading **306** can include the coordinates of the elbow position **312** and the coordinates of the hand position **314** in the sensor coordinate system **322**. Also, for example, the second sensor reading **308** can include the coordinates of the hand position **314** and the fingertip position **316** in the sensor coordinate system **322**.

The gesture tracking module **508** can determine one or more instances of the origination point **410** and the known terminal point **414** based on the first sensor reading **306**, the second sensor reading **308**, and the granularity limitation **334**. The gesture tracking module **508** can determine the known terminal point **414** based on a size of the appendage used to make the gesture **304** and the granularity limitation **334** of the first range profile **328**, the second range profile **330**, or a combination thereof.

The gesture tracking module **508** can further include shape templates, orders of appendage connections, or a combination thereof predetermined by the computing system **100**. The gesture tracking module **508** can use the templates, the orders, or a combination thereof to identify the known terminal point **414** as the most distal point on the user's body as recognized in the sensor readings. The gesture tracking module **508** can similarly use the templates, the orders, or a combination thereof to identify the origination point **410** as the immediately adjacent point or joint on the user's body as recognized in the sensor readings, such as a hand relative to a finger or an elbow relative to a wrist.

The gesture tracking module **508** can determine the known terminal point **414** by selecting the smallest appendage included as part of the gesture **304** corresponding to or exceeding the granularity limitation **334**. The gesture tracking module **508** can select the smallest appendage included as part of the gesture **304** from the first sensor reading **306**, the second sensor reading **308**, or a combination thereof.

For example, the user location **326** can be in the first range profile **328** and the granularity limitation **334** of the first range profile **328** can be the size of an average human hand. In this example, the gesture tracking module **508** can determine the known terminal point **414** as the coordinates of the hand of the user **302** used to make the gesture **304**.

As an additional example, the user location **326** can be in the second range profile **330** and the granularity limitation **334** of the second range profile **330** can be size of an average human fingertip. In this example, the gesture tracking module **508** can determine the known terminal point **414** as the coordinates of the fingertip of the user **302** used to make the gesture **304**.

The gesture tracking module **508** can determine the origination point **410** as an appendage of the user **302** separate from the appendage associated with the known terminal point **414**. For example, the gesture tracking module **508** can determine the origination point **410** as another appendage used to make the gesture **304** located proximal or closer to a torso or body of the user **302**. As another example, the gesture tracking module **508** can determine the origination point **410** as the next largest appendage located proximal closer to the torso or body of the user **302** and exceeding the granularity limitation **334**.

When the user location **326** is determined to be in the overlapping range profile **332**, the gesture tracking module **508** can determine multiple instances of the known terminal point **414** and the origination point **410** based on the first sensor reading **306**, the second sensor reading **308**, or a combination thereof. The gesture tracking module **508** can determine different instances of the known terminal point **414** or the origination point **410** in different sensor coordinate systems.

For example, the gesture tracking module **508** can determine one instance of the known terminal point **414** as the fingertip position **316** of the user **302** in the sensor coordinate system **322** of the first sensor **310**. In this example, the gesture tracking module **508** can also determine another instance of the known terminal point **414** as the fingertip position **316** of the user **302** in the sensor coordinate system **322** of the second sensor **318**.

The gesture tracking module **508** can also determine different instances of the known terminal point **414** or the origination point **410** based on differences in the granularity limitation **334** of the first range profile **328** and the second range profile **330**. For example, the granularity limitation **334** of the first range profile **328** can be the size of a human hand. In this example, the gesture tracking module **508** can determine one instance of the origination point **410** as the elbow of the user **302** and one instance of the known terminal point **414** as the hand of the user **302** from the first sensor reading **306**.

Also, for example, the granularity limitation **334** of the second range profile **3330** can be the size of a human fingertip. In this example, the gesture tracking module **508** can determine another instance of the origination point **410** as the hand of the user **302** and another instance of the known terminal point **414** as the fingertip of the user **302** from the second sensor reading **308**.

As previously discussed, the overlapping range profile **332** can refer to a region of overlap associated with the coverage areas for one sensor, such as the first sensor **310** or the second sensor **318**. In this instance, the gesture tracking module **508** can also determine multiple instances of the known terminal point **414** and the origination point **410** based on differences in the granularity limitation **334** of the first range profile **328** and the second range profile **330** associated with the single sensor. Also, when the overlapping range profile **332** refers to a region of overlap associated with the coverage areas for one sensor, the gesture tracking module **508** can obtain the coordinates of the appendage positions from one of the first sensor reading **306** or the second sensor reading **308**.

For example, the granularity limitation **334** of a near range representing the first range profile **328** of the first sensor **310** can be the size of a fingertip. Also, in this example, the granularity limitation **334** of a far range representing the second range profile **330** of the first sensor **310** can be the size of a hand. Continuing with this example, the gesture tracking module **508** can determine one instance of the known terminal point **414** as the fingertip position **316** and another instance of the known terminal point **414** as the hand position **314**.

The first sensor reading **306**, the second sensor reading **308**, or a combination thereof can include the confidence score **338** of FIG. **3**, the sensor update frequency **340**, or a combination thereof. The first sensor reading **306** can include the confidence score **338** associated with each appendage position captured by the first sensor **310**. In addition, the second sensor reading **308** can include the confidence score **338** associated with each appendage position captured by the second sensor **318**.

The first sensor reading **306**, the second sensor reading **308**, or a combination thereof can also include the sensor update frequency **340**. The gesture tracking module **508** can determine the sensor update frequency **340** by counting each time the first sensor **310** or the second sensor **318** undertakes a sensor reading. The gesture tracking module **508** can determine the sensor update frequency **340** based on a number of times the first sensor **310** generates the first sensor reading **306**, the number of times the second sensor **318** generates the second sensor reading **308**, or a combination thereof. The gesture tracking module **508** can further determine the sensor update frequency **340** based on a status report, a setting or a configuration, a mode or a state, or a combination thereof as reported by the corresponding sensor.

The gesture tracking module **508** can store the known terminal point **414**, the origination point **410**, the first sensor reading **306**, the second sensor reading **308**, the confidence score **338**, the sensor update frequency **340**, or a combination thereof in the first storage unit **214**, the second storage unit **246**, or a combination thereof. The gesture tracking module **508** can be part of the first software **226**, the second software **242**, or a combination thereof. The first control unit **212** can execute the first software **226**, the second control unit **234** can execute the second software **242**, or a combination thereof to determine the known terminal point **414**, the origination point **410**, or a combination thereof.

Moreover, the gesture tracking module **508** can also communicate the known terminal point **414**, the origination point **410**, or a combination thereof between devices through the first communication unit **216**, the second communication unit **236**, or a combination thereof. After determining the known terminal point **414**, the origination point **410**, or a combination thereof, the control flow **500** can pass from the gesture tracking module **508** to the inference module **510**.

The inference module **510** is configured to calculate the inferred terminal point **426** of FIG. **4**. The inference module **510** can calculate the inferred terminal point **426** for inferring an unknown appendage position not captured by the sensors **103**. For example, the inference module **510** can calculate the inferred terminal point **426** representing the fingertip position **316** of the user **302**.

The inference module **510** can calculate the inferred terminal point **426** when an appendage position is obscured or unclear in a sensor frame, not provided by the sensor, or a combination thereof. More specifically, the inference module **510** can calculate the inferred terminal point **426** when an appendage position is obscured or unclear in the second sensor frame **404** of FIG. **4**. The inference module **510** can calculate the inferred terminal point **426** in the second sensor frame **404** by analyzing the second sensor frame **404** and the first sensor frame **402** of FIG. **4**.

For example, the first sensor frame **402** can be an image captured by one of the sensors **103** depicting an appendage of the user **302** at an initial point in time. In this example, the second sensor frame **404** can be an image captured by the same instance of the sensors **103** depicting the same appendage of the user **302** at a latter point in time.

The first sensor frame **402** and the second sensor frame **404** can be included in sensor readings identified from the first sensor **310**, the second sensor **318**, or a combination thereof. More specifically, the first sensor frame **402** and the second sensor frame **404** can be included in the first sensor reading **306** associated with the first sensor **310**. In addition, the first sensor frame **402** and the second sensor frame **404** can be included in the second sensor reading **308** associated with the second sensor **318**.

The inference module **510** can interact with the gesture tracking module **508** to determine the first origin point **412** of FIG. **4** and the known terminal of FIG. **4** from the first sensor frame **402** included in the first sensor reading **306**, the second sensor reading **308**, or a combination thereof. In addition, the inference module **510** can interact with the gesture tracking module **508** to determine the second origin point **424** of FIG. **4** from the second sensor frame **404** included in the first sensor reading **306**, the second sensor reading **308**, or a combination thereof.

The inference module **510** can include an orientation module **512**, a point inferring module **514**, or a combination thereof. The orientation module **512** is configured to determine the first appendage orientation **406** of FIG. **4**, the second appendage orientation **416** of FIG. **4**, or a combination thereof. The orientation module **512** can determine the first appendage orientation **406** based on the first sensor frame **402**. The orientation module **512** can determine the second appendage orientation **416** based on the second sensor frame **404**.

The orientation module **512** can determine the first appendage orientation **406** by determining the first normal vector **408** of FIG. **4**. The orientation module **512** can determine the second appendage orientation **416** by determining the second normal vector **418** of FIG. **4**. For example, the orientation module **512** can determine the first normal vector **408**, the second normal vector **418**, or a combination thereof by determining a vector orthogonal to a palm surface, an opisthenar surface, a wrist surface, or an elbow surface of the user **302**.

Also for example, the orientation module **512** can determine the first normal vector **408**, the second normal vector **418**, or a combination thereof using one or more shape profiles or templates. Also for example, the orientation module **512** can determine the first normal vector **408**, the second normal vector **418**, or a combination thereof by receiving the normal vector readings from the corresponding sensor.

The orientation module **512** can determine the first normal vector **408** by calculating a vector orthogonal to an appendage surface depicted in the first sensor frame **402**. The orientation module **512** can determine the second normal vector **418** by calculating a vector orthogonal to the same appendage surface used to determine the first normal vector **408** in the second sensor frame **404**.

The orientation module **512** can use the first control unit **212**, the second control unit **234**, or a combination thereof to calculate the first normal vector **408**, the second normal vector **418**, or a combination thereof. The orientation module **512** can use the first control unit **212**, the second control unit **234**, or a combination thereof to calculate the first normal vector **408** or the second normal vector **418** using a contour or surface outline of the appendage depicted in the first sensor frame **402** or the second sensor frame **404**, respectively.

In addition, the orientation module **512** can use the first communication interface **228** of FIG. **2**, the second communication interface **250** of FIG. **2**, or a combination thereof to receive or retrieve the first normal vector **408**, the second normal vector **418**, or a combination thereof from the sensors **103**. For example, the first normal vector **408** and the second normal vector **418** can be included in communications received or retrieved from the first sensor **310**, the second sensor **318**, or a combination thereof.

The point inferring module **514** is configured to calculate the inferred terminal point **426**. The point inferring module **514** can calculate the inferred terminal point **426** by treating one or more appendages used to make the gesture **304** as a rigid articulating chain or object unchanging between frames or readings. The point inferring module **514** can calculate the inferred terminal point **426** based on the first origin point **412**, the second origin point **424**, the known terminal point **414**, the first appendage orientation **406**, and the second appendage orientation **416**.

The point inferring module **514** can calculate the inferred terminal point **426** by calculating the angle of rotation **422** of FIG. **4** and the axis of rotation **420** of FIG. **4**. The point inferring module **514** can calculate the angle of rotation **422** based on the first appendage orientation **406** and the second appendage orientation **416**. More specifically, the point inferring module **514** can calculate the angle of rotation **422** by taking the cross product of the first normal vector **408** and the second normal vector **418**. The angle of rotation **422** can be referred to as "$\vec{a}$", the first normal vector **408** can be referred to as "N1", and the second normal vector **418** can be referred to as "N2". The point inferring module **514** can calculate the angle of rotation **422** according to Equation 1 below.

$$\vec{a} = N1 \times N2 \quad \text{(Equation 1)}$$

The point inferring module **514** can also calculate the axis of rotation **420**. The point inferring module **514** can calculate the axis of rotation **420** by first taking the sine of the angle of rotation **422**. The sine of the angle of rotation **422** can be referred to as "S". The point inferring module **514** can calculate the axis of rotation **420** by dividing the angle of rotation **422** by the sine of the angle of rotation **422**. The axis of rotation **420** can be referred to as "$\vec{A}$". The point inferring module **514** can calculate the axis of rotation **420** according to Equation 2 below.

$$\vec{A} = \vec{a}/S \quad \text{(Equation 2)}$$

The point inferring module **514** can calculate the inferred terminal point **426** by applying a rotation formula to the first origin point **412**, the second origin point **424**, the known terminal point **414**, the angle of rotation **422**, and the axis of rotation **420**. For example, the point inferring module **514** can calculate the inferred terminal point **426** by applying

Rodrigues' rotation formula to the first origin point **412**, the second origin point **424**, the known terminal point **414**, the angle of rotation **422**, and the axis of rotation **420**.

As a more specific example, the first origin point **412** can represent coordinates of the hand position **314** depicted in the first sensor frame **402**. The coordinates of the hand position **314** representing the first origin point **412** can be referred to as "H1". In addition, the second origin point **424** can represent coordinates of the hand position **314** depicted in the second sensor frame **404**. The coordinates of the hand position **314** representing the second origin point **412** can be referred to as "H2".

Also, in this example, the known terminal point **414** can represent coordinates of the fingertip position **316** depicted in the first sensor frame **402**. The fingertip position **316** can be referred to as "F1". Moreover, "C" can refer to the cosine of the angle of rotation **422**.

Continuing with this example, the inferred terminal point **426** can be referred to as "F2". The point inferring module **514** can calculate the inferred terminal point **426** or "F2" using Equation 3 below.

$$F2=H2+(C*(F1-H1))+\vec{A}\times(S*(F1-H1))+((1-C)*\vec{A}*(\vec{A}\cdot(F1-H1))) \quad \text{(Equation 3)}$$

The inference module **510** can be part of the first software **226**, the second software **242**, or a combination thereof. The first control unit **212** can execute the first software **226**, the second control unit **234** can execute the second software **242**, or a combination thereof to calculate the inferred terminal point **426**.

Moreover, the inference module **510** can also communicate the inferred terminal point **426** between devices through the first communication unit **216**, the second communication unit **236**, or a combination thereof. After calculating the inferred terminal point **426**, the control flow **500** can pass from the inference module **510** to the transformation module **516**.

The transformation module **516** is configured to calculate one or more instances of the transformed origin point **354** of FIG. **3**, the transformed terminal point **356** of FIG. **3**, or a combination thereof. The transformation module **516** can calculate the transformed origin point **354** by transforming the coordinates of one or more instances of the origination point **410** from the sensor coordinate system **322** to the uniform coordinate system **324**.

The transformation module **516** can calculate one or more instances of the transformed origin point **354** by applying the transformation matrix **320** to the coordinates of one or more instances of the origination point **410**. More specifically, the transformation module **516** can calculate the transformed origin point **354** by multiplying the transformation matrix **320** with the coordinates of one or more instances of the origination point **410** in the sensor coordinate system **322**. The resulting instance of the transformed origin point **354** can be a set of coordinates in the uniform coordinate system **324**.

The transformation module **516** can also calculate one or more instances of the transformed terminal point **356** by transforming the coordinates of the known terminal point **414**, the inferred terminal point **426**, or a combination thereof from the sensor coordinate system **322** to the uniform coordinate system **324**. The transformation module **516** can calculate the transformed terminal point **356** by applying the transformation matrix **320** to the coordinates of the known terminal point **414**, the inferred terminal point **426**, or a combination thereof in the sensor coordinate system **322**.

More specifically, the transformation module **516** can calculate the transformed terminal point **356** by multiplying the transformation matrix **320** with the coordinates of the known terminal point **414**, the inferred terminal point **426**, or a combination thereof. The resulting instance of the transformed terminal point **356** can be a set of coordinates in the uniform coordinate system **324**.

The transformation module **516** can be part of the first software **226**, the second software **242**, or a combination thereof. The first control unit **212** can execute the first software **226**, the second control unit **234** can execute the second software **242**, or a combination thereof to calculate one or more instances of the transformed origin point **354**, the transformed terminal point **356**, or a combination thereof.

Moreover, the transformation module **516** can also communicate one or more instances of the transformed origin point **354**, the transformed terminal point **356**, or a combination thereof between devices through the first communication unit **216**, the second communication unit **236**, or a combination thereof. After calculating one or more instances of the transformed origin point **354**, the transformed terminal point **356**, or a combination thereof, the control flow **500** can pass from the transformation module **516** to the vector projection module **518**.

The vector projection module **518** is configured to determine the first position indicator **352** of FIG. **3**, the second position indicator **358** of FIG. **3**, or a combination thereof. The vector projection module **518** can determine the first position indicator **352**, the second position indicator **358**, or a combination thereof for calculating the inputs used to calculate the blended position indicator **350** of FIG. **3**.

The vector projection module **518** can determine the first position indicator **352** based on an intersection of the first vector **360** of FIG. **3** and a coordinate plane representing a screen of a display interface in the uniform coordinate system **324**. For example, the vector projection module **518** can determine the first position indicator **352** based on the intersection of the first vector **360** and the coordinate plane representing the screen of the first display interface **230** in the uniform coordinate system **324**.

The vector projection module **518** can calculate the first vector **360** for determining the first position indicator **352**. The first vector **360** can represent a possible instance of the direction of the gesture **304**.

The vector projection module **518** can calculate the first vector **360** based on the transformed origin point **354** and the transformed terminal point **356** associated with the first sensor reading **306**, the second sensor reading **308**, or a combination thereof. The transformed origin point **354** and the transformed terminal point **356** can be coordinates in the uniform coordinate system **324**.

The transformed origin point **354**, the transformed terminal point **356**, or a combination thereof can represent transformed instances of the appendage positions obtained from the first sensor reading **306**, the second sensor reading **308**, or a combination thereof. For example, the vector projection module **518** can calculate the first vector **360** based on the transformed origin point **354** representing the elbow position **312** and the transformed terminal point **356** representing the hand position **314** obtained from the first sensor reading **306**.

The vector projection module **518** can calculate the first vector **360** as a vector from the transformed origin point **354** extending through the transformed terminal point **356**. The

vector projection module **518** can then extend the length of the first vector **360** until the first vector **360** intersects with the coordinate plane representing the screen of the display interface. The vector projection module **518** can determine the first position indicator **352** as the intersection of the first vector **360** and the coordinate plane representing the screen of the display interface in the uniform coordinate system **324**.

The vector projection module **518** can determine the second position indicator **358** based on an intersection of the second vector **362** of FIG. **3** and the coordinate plane representing the screen of the display interface in the uniform coordinate system **324**. For example, the vector projection module **518** can determine the second position indicator **358** based on the intersection of the second vector **362** and the coordinate plane representing the screen of the first display interface **230** in the uniform coordinate system **324**.

The vector projection module **518** can calculate the second vector **362** for determining the second position indicator **358**. The second vector **362** can represent another possible instance of the direction of the gesture **304**. For example, the second vector **362** can represent the direction of the gesture **304** as captured by the second sensor **318**. As an additional example, the second vector **362** can represent another possible direction of the gesture **304** as captured by the first sensor **310** when the user **302** is in the overlapping range profile **332**.

The vector projection module **518** can calculate the second vector **362** based on additional instances of the transformed origin point **354** and the transformed terminal point **356**. The vector projection module **518** can calculate the second vector **362** based on the transformed origin point **354** representing the hand position **314** and the transformed terminal point **356** representing the fingertip position **316** obtained from the second sensor reading **308**. In addition, the vector projection module **518** can calculate the second vector **362** based on the transformed origin point **354** representing the hand position **314** and the transformed terminal point **356** representing the inferred terminal point **426**.

The vector projection module **518** can calculate the second vector **362** by connecting a vector from the transformed origin point **354** toward the transformed terminal point **356**. The vector projection module **518** can then extend the length of the second vector **362** until the second vector **362** intersects with the coordinate plane representing the screen of the display interface. The vector projection module **518** can determine the second position indicator **358** as the intersection of the second vector **362** and the coordinate plane representing the screen of the display interface in the uniform coordinate system **324**.

The vector projection module **518** can be part of the first software **226**, the second software **242**, or a combination thereof. The first control unit **212** can execute the first software **226**, the second control unit **234** can execute the second software **242**, or a combination thereof to determine the first position indicator **352**, the second position indicator **358**, or a combination thereof.

Moreover, the vector projection module **518** can also communicate the first position indicator **352**, the second position indicator **358**, or a combination thereof between devices through the first communication unit **216**, the second communication unit **236**, or a combination thereof. After determining the first position indicator **352**, the second position indicator **358**, or a combination thereof, the control flow **500** can pass from the vector projection module **518** to the blending module **520**.

The blending module **520** is configured to calculate the blended position indicator **350** of FIG. **3**. The blending module **520** can calculate the blended position indicator **350** for estimating the direction of the gesture **304** made by the user **302**.

The blending module **520** can include a weight module **522**, a cursor module **524**, or a combination thereof. The weight module **522** is configured to calculate the first weight **344** of FIG. **3**, the second weight **346** of FIG. **3**, or a combination thereof. The blending module **520** can calculate the blended position indicator **350** based on the first sensor reading **306**, the second sensor reading **308**, the first weight **344**, the second weight **346**, or a combination thereof.

The weight module **522** can calculate the first weight **344** of FIG. **3**, the second weight **346** of FIG. **3**, or a combination thereof. The weight module **522** can calculate the first weight **344** or the second weight **346** for increasing or decreasing the contribution of the first sensor reading **306** or the second sensor reading **308**, respectively, to the calculation of the blended position indicator **350**.

The weight module **522** can calculate the first weight **344** associated with the first sensor reading **306**. The weight module **522** can calculate the first weight **344** based on the first sensor characteristic **336** of FIG. **3**. The first sensor characteristic **336** can include the confidence score **338** of FIG. **3** and the sensor update frequency **340** of FIG. **3** associated with the first sensor **310**.

The weight module **522** can calculate the second weight **346** associated with the second sensor reading **308**. The weight module **522** can calculate the second weight **346** based on the second sensor characteristic **342** of FIG. **3**. The second sensor characteristic **342** can include the confidence score **338** and the sensor update frequency **340** associated with the second sensor **318**.

In addition, the sensor update frequency **340** can be a measure of the number of times one of the sensors **103** generates the sensor reading within a predetermined time period. For example, the sensor update frequency **340** can be a measure of the number of times the first sensor **310** generates the first sensor reading **306** within one second.

The weight module **522** can calculate the first weight **344** by identifying the confidence score **338** associated with the first sensor reading **306** and the sensor update frequency **340** associated with the first sensor **310**. The weight module **522** can identify the confidence score **338** associated with the first sensor reading **306** by receiving or retrieving the confidence score **338** from the first sensor **310**. For example, the weight module **522** can receive or retrieve the confidence score **338** associated with the appendage positions captured by the first sensor reading **306** such as the elbow position **312** and the hand position **314**.

The confidence score **338** can include a numeric value expressed as a percentage. The confidence score **338** can also be referred to as "Confidence_n" where "n" represents a sensor number such as the first sensor **310** (n=1) or the second sensor **318** (n=2).

The weight module **522** can also calculate the first weight **344** or the second weight **346** by identifying the sensor update frequency **340** associated with the first sensor **310** or the second sensor **318**, respectively. The weight module **522** can identify the sensor update frequency **340** associated with the first sensor by recording an elapsed time between the

latest instance of the first sensor reading **306** and the immediately preceding instance of the first sensor reading **306**.

The weight module **522** can also identify the sensor update frequency **340** associated with the second sensor **318** by recording or calculating the elapsed time between the latest instance of the second sensor reading **308** and the immediately preceding instance of the second sensor reading **308**. The elapsed time can be referred to as "dt_n".

The weight module **522** can calculate the first weight **344** or the second weight **346** by incrementing or decrementing a previous instance of the first weight **344** or a previous instance of the second weight **346**, respectively. The weight module **522** can increment previous instances of the first weight **344** or the second weight **346** by adding a weight enhancer to the previous instance of the first weight **344** or the second weight **346**.

The weight enhancer can be a fixed numerical value predetermined by the electronic system **100**, the sensors **103**, or a combination thereof. The weight module **522** can increment previous instances of the first weight **344** or the second weight **346** by the weight enhancer when the electronic system **100** identifies a new sensor reading from the first sensor **310** or the second sensor **318**, respectively. The weight module **522** can also multiply the confidence score **338** by the weight enhancer.

More specifically, the weight module **522** can increment the previous instance of the first weight **344** by the weight enhancer when the gesture tracking module **508** identifies a new instance of the first sensor reading **306** from the first sensor **310**. In addition, the weight module **522** can increment the previous instance of the second weight **346** by the weight enhancer when the gesture tracking module **508** identifies a new instance of the second sensor reading **308** from the second sensor **318**.

The first weight **344** or the second weight **346** can be referred to as "Weight_n", the previous instance of the first weight **344** or the second weight **346** can be referred to as "PreviousWeight_n", and the weight enhancer can be referred to as "dW". The weight module **522** can calculate the first weight **344** or the second weight **346** by incrementing previous instances of the first weight **344** or the second weight **346**, respectively, according to Equation 4 below.

$$\text{Weight\_}n=\text{PreviousWeight\_}n+(dW*\text{Confidence\_}n) \quad \text{(Equation 4)}$$

The weight module **522** can also calculate the first weight **344**, the second weight **346**, or a combination thereof by decrementing weights associated with all other sensors not providing a sensor reading. For example, the electronic system **100** can receive only the first sensor reading **306** from the first sensor **310** at a particular moment in time. In this example, the electronic system **100** can increment the first weight **344** of the first sensor **310** while decrementing the second weight **346** of the second sensor **318**.

The weight module **522** can decrement the first weight **344** or the second weight **346** by decrementing previous instances of the first weight **344** or the second weight **346**, respectively. The weight module **522** can decrement previous instances of the first weight **344** or the second weight **346**, respectively, based on the sensor update frequency **340**. The weight module **522** can decrement previous instances of the first weight **344** or the second weight **346** by multiplying previous instances of the first weight **344** or the second weight **346**, respectively, by an exponential of a rate of decay multiplied by the sensor update frequency **340**.

The rate of decay can be referred to as "Rate". The weight module **522** can calculate the first weight **344** or the second weight **346** by decrementing previous instances of the first weight **344** or the second weight **346**, respectively, according to Equation 5 below.

$$\text{Weight\_}n=\text{PreviousWeight\_}n*\exp(\text{Rate}*dt) \quad \text{(Equation 5)}$$

The weight module **522** can increment the first weight **344**, the second weight **346**, or a combination thereof according to Equation 4 while also decrementing all other sensors not providing a sensor update according to Equation 5. The weight module **522** can also establish a minimum cutoff threshold for weights associated with the sensors **103**.

The weight module **522** can establish a minimum cutoff threshold associated with the first weight **344**, the second weight **346**, or a combination thereof. The minimum cutoff threshold can be a numerical value below which a sensor can be considered inactive for purposes of providing sensor updates. The weight module **522** can ignore sensors where the weights associated with the sensors **103** fall below the minimum cutoff threshold.

The weight module **522** can further calculate the first weight **344**, the second weight **346**, or a combination thereof based on environmental factors such as room lighting measurements or time of day, an orientation or body position of the user **302**, or a combination thereof.

The weight module **522** can further calculate the first weight **344**, the second weight **346**, or a combination thereof based on a user characteristic, such as age, size, preference, gender, or a combination thereof of the user **302**. The weight module **522** can further calculate the first weight **344**, the second weight **346**, or a combination thereof based on the user location **326** relative to one or more of the sensors **103**, such as a presence of the user **302** in the first range profile **328** or the second range profile **330**.

The weight module **522** can further calculate the first weight **344**, the second weight **346**, or a combination thereof using the various factors described above as inputs. The weight module **522** can include a method, a process, an equation, or a combination thereof utilizing one or more of the inputs described above to calculate the first weight **344**, the second weight **346**, or a combination thereof. For example, the weight module **522** can include one or more equations similar to Equations (4)-(5) utilizing one or more of the other inputs described above.

The weight module **522** can store the first weight **344**, the second weight **346**, or a combination thereof in the first storage unit **214**, the second storage unit **246**, or a combination thereof. The weight module **522** can update the first weight **344**, the second weight **346**, or a combination thereof after the electronic system **100** receives a sensor reading from one of the sensors **103**.

For illustrative purposes, the electronic system **100** is described with the first sensor **310** and the second sensor **318**, although it is understood that the electronic system **100** can include three or more of the sensors **103**. In the instance where the electronic system **100** includes three or more of the sensors **103**, weights can be calculated for all non-reporting sensors as soon as a sensor reading is received for one of the sensors **103**.

The blending module **520** can calculate the blended position indicator **350**. The blending module **520** can calculate the blended position indicator **350** based on the first position indicator **352**, the first weight **344**, the second position indicator **358**, the second weight **346**, the user location **326**, or a combination thereof. The blending module **520** can calculate the blended position indicator **350** for combining multiple instances of the gesture **304** captured by

the first sensor **310**, the second sensor **318**, or a combination thereof in order to estimate the direction of the gesture **304**.

For example, the blending module **520** can calculate the blended position indicator **350** for combining the gesture **304** captured by the first sensor **310** and the gesture **304** captured by the second sensor **318**. As an additional example, the blending module **520** can calculate one instance of the gesture **304**, such as the elbow position **312** and the hand position **314**, captured by one of the sensors **103** and another instance of the gesture **304**, such as the hand position **314** and the fingertip position **316**, captured by the same instance of the sensors **103**.

The blending module **520** can calculate the blended position indicator **350** by calculating a weighted sum of the first position indicator **352** and the second position indicator **358**. The blending module **520** can calculate the weighted average or mean of the first position indicator **352** and the second position indicator **358** by first applying the first weight **344** to the first position indicator **352** and applying the second weight **346** to the second position indicator **358**. The blending module **520** can then calculate the blended position indicator **350** by summing the resulting products.

For example, the blending module **520** can apply the first weight **344** to the first position indicator **352** by multiplying the first weight **344** with the coordinates of the first position indicator **352** in the uniform coordinate system **324**. Also, for example, the blending module **520** can apply the second weight **346** to the second position indicator **358** by multiplying the second weight **346** with the coordinates of the second position indicator **358**. The blending module **520** can calculate the blended position indicator **350** by summing the product of the first weight **344** and the first position indicator **352** and the product of the second weight **346** and the second position indicator **358**.

The blending module **520** can also calculate the blended position indicator **350** by calculating a weighted harmonic mean, a weighted arithmetic mean, or a combination thereof using the first position indicator **352**, the second position indicator **358**, the first weight **344**, and the second weight **346**.

The blending module **520** can calculate the blended position indicator **350** based on the user location **326** in the overlapping range profile **332**. When the overlapping range profile **332** refers to a region of intersection between the first range profile **328** associated with the first sensor **310** and the second range profile **330** associated with the second sensor **318**, the blending module **520** can calculate the blended position indicator **350** based on the first position indicator **352** calculated from the first sensor reading **306** and the second position indicator **358** calculated from appendage positions captured by the second sensor reading **308**.

When the overlapping range profile **332** refers to an overlap region between the first range profile **328** and the second range profile **330** associated with one of the first sensor **310** or the second sensor **318**, the blending module **520** can calculate the blended position indicator **350** based on the first position indicator **352** calculated from one set of appendage positions, such as the elbow position **312** and the hand position **314**, and the second position indicator **358** calculated from another set of appendage positions, such as the hand position **314** and the fingertip position **316**.

The cursor module **524** is configured to generate the cursor **348** of FIG. **3** at the blended position indicator **350**. The cursor module **524** can generate the cursor **348** at the blended position indicator **350** for communicating the blended position indicator **350** to the user **302** of the electronic system **100**. More specifically, the cursor module **524** can generate the cursor **348** at the blended position indicator **350** for the user **302** to control or manipulate a graphic or user interface depicted on a display interface such as the first display interface **230**, the second display interface **240**, or a combination thereof.

The cursor module **524** can generate the cursor **348** as a graphic icon on the first display interface **230**, the second display interface **240**, or a combination thereof. The cursor module **524** can generate the graphic icon representing the cursor **348** at a display coordinate corresponding to the blended position indicator **350**. The cursor module **524** can generate the cursor **348** on the first display interface **230** when the user **302** undertakes the gesture **304** at the first display interface **230**.

The blending module **520** can be part of the first software **226**, the second software **242**, or a combination thereof. The first control unit **212** can execute the first software **226**, the second control unit **234** can execute the second software **242**, or a combination thereof to calculate the blended position indicator **350** and generate the cursor **348** at the blended position indicator **350**. Moreover, the blending module **520** can also communicate the blended position indicator **350** and the cursor **348** between devices through the first communication unit **216**, the second communication unit **236**, or a combination thereof.

The physical transformation of displaying the cursor **348** at the blended position indicator **350** results in movement in the physical world, such as people using the electronic system **100** to control display interfaces remotely. As the movement in the physical world occurs, the movement itself generates additional instances of the cursor **348** and to continued movement in the physical world.

It has been discovered that calculating the blended position indicator **350** based on the first sensor reading **306**, the second sensor reading **308**, or a combination thereof provides a more accurate mechanism for controlling a display interface such as the first display interface **230**, the second display interface **240**, or a combination thereof. More specifically, the electronic system **100** can use the blended position indicator **350** to approximate the direction of the gesture **304** made by the user **302**. The electronic system **100** can more accurately approximate the direction of the gesture **304** based on readings from multiple instances of the sensors **103** rather than relying on readings from only one of the sensors **103**.

It has further been discovered that calculating the blended position indicator **350** based on the first sensor reading **306**, the second sensor reading **308**, or a combination thereof enhances the usability of different sensors provided by different sensor vendors or manufacturers. For example, the electronic system can blend or combine readings from the first sensor **310** and the second sensor **318** for ensuring a user gesture, such as the gesture **304**, is captured by the second sensor **318** when the user gesture is outside of the first range profile **328** of the first sensor **310**.

It has been discovered that calculating the blended position indicator **350** based on the first origin point **412**, the known terminal point **414**, the second origin point **424**, and the inferred terminal point **426** provide an improved mechanism for controlling a display interface when the user **302** is gesturing in a rapid or unpredictable manner. In this instance, the electronic system **100** can calculate the inferred terminal point **426**, representing an obscured or hard to detect appendage position, based on known appendage positions, the first appendage orientation **406**, and the second appendage orientation **416**. The electronic system **100** can calculate the blended position indicator **350** based on the

inferred terminal point **426** to prevent the cursor **348** from skipping or disappearing when an appendage position of the user **302** is not captured by any of the sensors **103**.

It has been discovered that calculating the blended position indicator **350** by applying the first weight **344** to the first position indicator **352** and applying the second weight **346** to the second position indicator **358** provides for a more accurate mechanism for controlling a display interface by taking into account the confidence score **338** and the sensor update frequency **340** of the sensors **103**. By applying more weight to the sensors **103** which provide more frequent and more confident sensor readings, the electronic system **100** can ensure the blended position indicator **350** reflects the contribution of the sensors **103** capturing the gesture **304** with the most confidence and most often.

The modules describes in this application can be ordered or partitioned differently. For example, certain modules can be combined. Each of the modules can also operate individually and independently of the other modules. Furthermore, data generated in one module can be used by another module without being directly coupled to each other.

The modules described in this application can be implemented by hardware circuitry or hardware acceleration units (not shown) in the control units. The modules described in this application can also be implemented by separate hardware units (not shown), including hardware circuitry, outside the control units but with the first device **102** or the second device **106**.

For illustrative purposes, the various modules have been described as being specific to the first device **102**, the second device **106**, or a combination thereof. However, it is understood that the modules can be distributed differently. For example, the various modules can be implemented in a different device, or the functionalities of the modules can be distributed across multiple devices.

The modules described in this application can be implemented as instructions stored on a non-transitory computer readable medium to be executed by a first control unit **412**, the second control unit **434**, or a combination thereof. The non-transitory computer medium can include the first storage unit **414**, the second storage unit **446**, or a combination thereof. The first storage unit **414**, the second storage unit **446**, or a combination thereof, or a portion therein can also be made removable from the first device **102**, the second device **106**, or a combination thereof.

The non-transitory computer readable medium can include non-volatile memory, such as a hard disk drive, non-volatile random access memory (NVRAM), solid-state storage device (SSD), compact disk (CD), digital video disk (DVD), or universal serial bus (USB) flash memory devices. The non-transitory computer readable medium can be integrated as a part of the navigation system **100** or installed as a removable portion of the navigation system **100**.

As a more specific example, one or more modules described above can be stored in the non-transitory memory medium for distribution to a different system, a different device, a different user, or a combination thereof. Also as a more specific example, the modules described above can be implemented or stored using a single hardware unit, such as a chip or a processor, or across multiple hardware units.

Referring now to FIG. **6**, therein is shown an exemplary flow chart of a method **600** of operation of the electronic system **100** of FIG. **1** in a further embodiment. In one example embodiment, the electronic system **100** can implement the control flow **500** of FIG. **5**.

The method **600** can include identifying, with the control unit **212** of FIG. **2**, the first sensor reading **306** of FIG. **3** for capturing the gesture **304** of FIG. **3** directed at the first display interface **230** of FIG. **2** using the first range profile **328** of FIG. **3** in a block **602**. The method **600** can also include identifying the second sensor reading **308** of FIG. **3** for capturing the gesture **304** directed at the first display interface **230** using the second range profile **330** of FIG. **3** in a block **604**.

The method **600** can further include calculating the blended position indicator **350** of FIG. **3** based on the first sensor reading **306**, the second sensor reading **308**, or a combination thereof in a block **606**. The method **600** can also include communicating, with the communication interface **228** of FIG. **2** coupled to the control unit **212**, the blended position indicator **350** by generating the cursor **348** of FIG. **3** at the blended position indicator **350** in a block **608**.

The method **600** can further include determining the overlapping range profile **332** of FIG. **3** involving the first range profile **328** and the second range profile **330** in a block **610**. The block **610** can also include identifying the first sensor reading **306** for capturing the gesture **304** made within the overlapping range profile **332**; identifying the second sensor reading **308** for capturing the gesture **304** made within the overlapping range profile **332**; and calculating the blended position indicator **350** based on the overlapping range profile **332**, the first sensor reading **306**, and the second sensor reading **308**.

The method **600** can further include calculating the inferred terminal point **426** of FIG. **4** based on the first origin point **412** of FIG. **4**, the known terminal point **414** of FIG. **4**, and the second origin point **424** of FIG. **4** in a block **612**. The block **612** can also include determining the first origin point **412** and the known terminal point **414** based on the first sensor frame **402** of FIG. **4** and determining the second origin point **424** of FIG. **4** based on the second sensor frame **404** of FIG. **4**. The block **612** can further include calculating the blended position indicator **350** based on the first origin point **412**, the known terminal point **414**, the second origin point **424**, and the inferred terminal point **426**.

The method **600** can further include calculating the first weight **344** of FIG. **3** associated with the first sensor reading **306** based on the first sensor characteristic **336** of FIG. **3** and calculating the second weight **346** of FIG. **3** associated with the second sensor reading **308** based on the second sensor characteristic **342** of FIG. **3** in a block **614**. The block **614** can include calculating the blended position indicator **350** by applying the first weight **344** to a first position indicator **352** and applying the second weight **346** to a second position indicator **358**.

The method **600** can further include calculating the first vector **360** of FIG. **3** for representing the gesture **304** directed at the display interface **230** and calculating the second vector **362** of FIG. **3** for representing the gesture **304** directed at the display interface **230** in a block **616**. The block **616** can also include calculating the blended position indicator **350** based on the first vector **360** and the second vector **362**.

The resulting method, process, apparatus, device, product, and/or system is straightforward, cost-effective, uncomplicated, highly versatile, accurate, sensitive, and effective, and can be implemented by adapting known components for ready, efficient, and economical manufacturing, application, and utilization. Another important aspect of the embodiment of the present invention is that it valuably supports and services the historical trend of reducing costs, simplifying systems, and increasing performance. These and other valu-

able aspects of the embodiment of the present invention consequently further the state of the technology to at least the next level.

While the invention has been described in conjunction with a specific best mode, it is to be understood that many alternatives, modifications, and variations will be apparent to those skilled in the art in light of the aforegoing description. Accordingly, it is intended to embrace all such alternatives, modifications, and variations that fall within the scope of the included claims. All matters set forth herein or shown in the accompanying drawings are to be interpreted in an illustrative and non-limiting sense.

What is claimed is:

**1**. An electronic system comprising:

a control unit configured to:

identify a first sensor reading for capturing a gesture directed at a display interface using a first range profile corresponding to a granularity or sensitivity, a physical location or orientation, or a combination thereof for the first sensor reading;

calculate a first weight associated with the first sensor reading based on a first sensor characteristic;

identify a second sensor reading for capturing the gesture directed at the display interface using a second range profile corresponding to a further granularity or sensitivity, a further physical location or orientation, or a combination thereof for the second sensor reading;

calculate a second weight associated with the second sensor reading based on a second sensor characteristic;

calculate a blended position indicator based on the first sensor reading, the second sensor reading, or a combination thereof according to the first range profile and the second range profile; by applying the first weight to a first position indicator and applying the second weight to a second position indicator; and

a communication interface, coupled to the control unit, configured to communicate the blended position indicator by generating a cursor at the blended position indicator.

**2**. The system as claimed in claim **1** wherein the control unit is further configured to:

determine an overlapping range profile involving the first range profile and the second range profile;

identify the first sensor reading for capturing the gesture made within the overlapping range profile;

identify the second sensor reading for capturing the gesture made within the overlapping range profile; and

calculate the blended position indicator based on the overlapping range profile, the first sensor reading, and the second sensor reading.

**3**. The system as claimed in claim **1** wherein the control unit is further configured to:

determine a first origin point and a known terminal point based on a first sensor frame;

determine a second origin point based on a second sensor frame;

calculate an inferred terminal point based on the first origin point, the known terminal point, and the second origin point; and

calculate the blended position indicator based on the first origin point, the known terminal point, the second origin point, and the inferred terminal point.

**4**. The system as claimed in claim **1** wherein the control unit is further configured to:

calculate the first weight by identifying a confidence score associated with the first sensor reading;

calculate the second weight by identifying the confidence score associated with the second sensor reading; and

calculate the blended position indicator by applying the first weight to the first position indicator and applying the second weight to the second position indicator.

**5**. The system as claimed in claim **1** wherein the control unit is further configured to:

calculate a first vector for representing the gesture directed at the display interface;

calculate a second vector for representing the gesture directed at the display interface; and

calculate the blended position indicator based on the first vector and the second vector.

**6**. The system as claimed in claim **1** wherein the control unit is further configured to:

calculate the first weight by identifying a confidence score associated with the first sensor reading and a sensor update frequency associated with a first sensor;

calculate the second weight by identifying a confidence score associated with the second sensor reading and a sensor update frequency associated with a second sensor; and

calculate the blended position indicator by applying the first weight to the first position indicator and applying the second weight to the second position indicator.

**7**. The system as claimed in claim **1** wherein the control unit is further configured to calculate the blended position indicator based on a user location determined to be within the first range profile, an overlapping range profile, or the second range profile.

**8**. The system as claimed in claim **1** wherein the control unit is further configured to:

identify the first sensor reading for capturing the gesture by a first sensor;

identify the second sensor reading for capturing the gesture by a second sensor different from the first sensor; and

calculate the blended position indicator for combining the gesture captured by the first sensor and the gesture captured by the second sensor.

**9**. The system as claimed in claim **1** wherein the control unit is further configured to:

determine an overlapping range profile involving the first range profile and the second range profile;

calculate a first vector based on an elbow position and a hand position for representing the gesture made in the overlapping range profile;

calculate a second vector based on the hand position and a fingertip position for representing the gesture made in the overlapping range profile; and

calculate the blended position indicator based on the overlapping range profile, the first vector, and the second vector.

**10**. The system as claimed in claim **1** wherein the control unit is further configured to:

determine a first appendage orientation based on a first sensor frame;

determine a second appendage orientation based on a second sensor frame; and

calculate the blended position indicator based on a first origin point, a known terminal point, a second origin point, the first appendage orientation, and the second appendage orientation.

**11**. A method of operation of an electronic system comprising:

identifying a first sensor reading for capturing a gesture directed at a display interface using a first range profile corresponding to a granularity or sensitivity, a physical location or orientation, or a combination thereof for the first sensor reading;

calculating a first weight associated with the first sensor reading based on a first sensor characteristic;

identifying a second sensor reading for capturing the gesture directed at the display interface using a second range profile corresponding to a further granularity or sensitivity, a further physical location or orientation, or a combination thereof for the second sensor reading;

calculating a second weight associated with the second sensor reading based on a second sensor characteristic;

calculating with a control unit a blended position indicator based on the first sensor reading, the second sensor reading, or a combination thereof according to the first range profile and the second range profile, by applying the first weight to a first position indicator and applying the second weight to a second position indicator; and

communicating, with a communication interface coupled to the control unit, the blended position indicator by generating a cursor at the blended position indicator.

**12**. The method as claimed in claim **11** further comprising:

determining an overlapping range profile involving the first range profile and the second range profile;

identifying the first sensor reading for capturing the gesture made within the overlapping range profile;

identifying the second sensor reading for capturing the gesture made within the overlapping range profile; and

calculating the blended position indicator based on the overlapping range profile, the first sensor reading, and the second sensor reading.

**13**. The method as claimed in claim **11** further comprising:

determining a first origin point and a known terminal point based on a first sensor frame;

determining a second origin point based on a second sensor frame;

calculating an inferred terminal point based on the first origin point, the known terminal point, and the second origin point; and

calculating the blended position indicator based on the first origin point, the known terminal point, the second origin point, and the inferred terminal point.

**14**. The method as claimed in claim **11** wherein:

calculating the first weight includes identifying a confidence score associated with the first sensor reading;

calculating the second weight includes identifying the confidence score associated with the second sensor reading; and

calculating the blended position indicator by applying the first weight to a first position indicator and applying the second weight to a second position indicator.

**15**. The method as claimed in claim **11** further comprising:

calculating a first vector for representing the gesture directed at the display interface;

calculating a second vector for representing the gesture directed at the display interface; and

calculating the blended position indicator based on the first vector and the second vector.

**16**. A non-transitory computer readable medium including instructions for execution, comprising:

identifying a first sensor reading for capturing a gesture directed at a display interface using a first range profile corresponding to a granularity or sensitivity, a physical location or orientation, or a combination thereof for the first sensor reading;

calculating a first weight associated with the first sensor reading based on a first sensor characteristic;

identifying a second sensor reading for capturing the gesture directed at the display interface using a second range profile corresponding to a further granularity or sensitivity, a further physical location or orientation, or a combination thereof for the second sensor reading;

calculating a second weight associated with the second sensor reading based on a second sensor characteristic;

calculating a blended position indicator based on the first sensor reading, the second sensor reading, or a combination thereof according to the first range profile and the second range profile, by applying the first weight to a first position indicator and applying the second weight to a second position indicator; and

communicating the blended position indicator by generating a cursor at the blended position indicator.

**17**. The non-transitory computer readable medium as claimed in claim **16** further comprising:

determining an overlapping range profile involving the first range profile and the second range profile;

identifying the first sensor reading for capturing the gesture made within the overlapping range profile;

identifying the second sensor reading for capturing the gesture made within the overlapping range profile; and

calculating the blended position indicator based on the overlapping range profile, the first sensor reading, and the second sensor reading.

**18**. The non-transitory computer readable medium as claimed in claim **16** further comprising:

determining a first origin point and a known terminal point based on a first sensor frame;

determining a second origin point based on a second sensor frame;

calculating an inferred terminal point based on the first origin point, the known terminal point, and the second origin point; and

calculating the blended position indicator based on the first origin point, the known terminal point, the second origin point, and the inferred terminal point.

**19**. The non-transitory computer readable medium as claimed in claim **16** wherein

calculating the first weight includes identifying a confidence score associated with the first sensor reading;

calculating the second weight includes identifying the confidence score associated with the second sensor reading; and

calculating the blended position indicator by applying the first weight to a first position indicator and applying the second weight to a second position indicator.

**20**. The non-transitory computer readable medium as claimed in claim **16** further comprising:

calculating a first vector for representing the gesture directed at the display interface;

calculating a second vector for representing the gesture directed at the display interface; and

calculating the blended position indicator based on the first vector and the second vector.

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