

What is claimed is:

1. A method comprising:

while a handheld intermediary processing device is communicatively coupled with a head-wearable device, distinct and separate from the handheld intermediary processing device, and the handheld intermediary processing device and the head-wearable device are configured to share operational data:

generating, by the handheld intermediary processing device, an artificial reality (AR) representation based on the operational data;

determining, by the handheld intermediary processing device, a location relative to the handheld intermediary processing device to present the AR representation; and

providing, by the handheld intermediary processing device, instructions to the head-wearable device that cause the head-wearable device to display the AR representation at the location relative to the handheld intermediary processing device.

2. The method of claim 1, wherein the handheld intermediary processing device does not have a screen.

3. The method of any one of claims 1-3, wherein the AR representation is further based on positional mapping data captured by the handheld intermediary processing device.

4. The method of claim 3, wherein the positional mapping data includes six degrees of freedom positional data.

5. The method of any one of claims 1-4, further comprising:

in response to a determination that the head-wearable device has moved from a first position to a second position, distinct from the first position:

updating, by the handheld intermediary processing device, the AR representation based on the second position to create an updated AR representation;

determining, by the handheld intermediary processing device, an updated location relative to the handheld intermediary processing device to present the updated AR representation; and

providing, by the handheld intermediary processing device, instructions to the head-wearable device that cause the head-wearable device to display the updated AR representation at the updated location relative to the handheld intermediary processing device.

6. The method of any one of claims 1-5, wherein the determining the location relative to the handheld intermediary processing device to present the AR representation includes selecting one of a plurality of predefined locations relative to the handheld intermediary processing device.

7. The method of claim 6, wherein the selecting the one of the plurality of predefined locations relative to the handheld intermediary processing device includes:

determining one or more foreign objects within a user's field of view; and
selecting the one of the plurality of predefined locations based on a location of the one or more foreign objects.

8. The method of any one of claims 6-7, wherein the selecting the one of the plurality of predefined locations relative to the handheld intermediary processing device includes:

receiving a user input defining the location relative to the handheld intermediary processing device; and
selecting the one of the plurality of predefined locations based on the user input.

9. The method of any one of claims 1-8, further comprising:

in response to a determination that the handheld intermediary processing device has moved from a third position to a fourth position, distinct from the third position:

updating, by the handheld intermediary processing device, the AR representation based on the fourth position to create another updated AR representation;

determining, by the handheld intermediary processing device, another updated location relative to the handheld intermediary processing device to present the other updated AR representation; and

providing, by the handheld intermediary processing device, instructions to the head-wearable device that cause the head-wearable device to display the other updated AR representation at the other updated location relative to the handheld intermediary processing device.

10. The method of any one of claims 5 and 9, further comprising:
in response to a determination that the handheld intermediary processing device is outside a field of view of the head-wearable device, providing instructions to the head-wearable device that cause the head-wearable device to cease displaying respective updated AR representations.
11. The method of any one of claims 5 and 9, further comprising:
in response to a determination that the handheld intermediary processing device is outside the user's field of view:
updating, by the handheld intermediary processing device, the AR representation based on the user's field of view to create yet another updated AR representation; and
providing, by the handheld intermediary processing device, instructions to the head-wearable device that cause the head-wearable device to display the yet other updated AR representation at a display of the head-wearable device.
12. The method of any one of claims 10 and 11, further comprising:
in response to the determination that the handheld intermediary processing device is outside the field of view of the head-wearable device, providing instructions to the head-wearable device that cause the head-wearable device to display an indicator to indicate the location relative to the handheld intermediary processing device to a user.
13. The method of any one of claims 1-12, further comprising:
prior to generating, by the handheld intermediary processing device, the AR representation based on the operational data, detecting another user input to generate the AR representation.
14. The method of any one of claims 1-13, wherein the location relative to the handheld intermediary processing device is based on the AR representation of the operational data.
15. The method of any one of claims 1-14, wherein the location relative to the handheld intermediary processing device is a portion of a surface of the handheld intermediary processing device.
16. The method of claim 15, wherein the portion of the surface of the handheld intermediary processing device is a touch input surface.

17. The method of any one of claims 1-16, wherein the location relative to the handheld intermediary processing device is a non-zero, predetermined distance above a portion of the handheld intermediary processing device.
18. The method of any one of claims 1-17, wherein the location relative to the handheld intermediary processing device is a surface of the handheld intermediary processing device.
19. The method of any one of claims 1-18, wherein the operational data includes one or more of image data, audio data, device information, application data, media content, and message data.
20. An artificial-reality system configured to perform one or more operations of any one of claims 1-19.
21. An intermediary device configured to coordinate operations of a head-wearable device and a wrist-wearable device, the intermediary device configured to convey information between the head-wearable device and the wrist-wearable device in conjunction with the method of any one of claims 1-19.
22. A system that includes one or more of an intermediary device, a wrist wearable devices, and an artificial-reality headset, and the system is configured to perform operations corresponding to any one of claims 1-19.
23. A non-transitory computer-readable storage medium including instructions that, when executed by a computing device in communication with an artificial-reality headset, cause the computer device to perform operations corresponding to any one of claims 1-19.
24. A method of operating an artificial reality headset and/or a wrist-wearable device, including operations that correspond to any one of claims 1-19. A method comprising:
while a handheld intermediary processing device and a head-wearable device are communicatively coupled and share operational data for performing one or more computational tasks:
identifying one or more back-end tasks and one or more front-end tasks associated with performing the one or more computational tasks;

causing performance of the one or more back-end tasks at the handheld intermediary processing device including updating the operational data to create updated operational data, wherein the updated operational data includes sensor data from the handheld intermediary device indicating a position of the handheld intermediary processing device; and

causing performance of the one or more front-end tasks at the head-wearable device using the updated operational data such that a representation based on the one or more computational tasks is presented to a user by the head-wearable device.

26. The method of claim 25, further comprising:

while the handheld intermediary processing device and a wrist-wearable device are communicatively coupled and share additional operational data for performing one or more additional computational tasks:

identifying one or more additional back-end tasks and one or more additional front-end tasks associated with performing the one or more additional computational tasks;

causing performance of the one or more additional back-end tasks at the handheld intermediary processing device including updating the additional operational data to create updated additional operational data; and

causing performance of the one or more additional front-end tasks at the wrist-wearable device and/or the head-wearable device based on the updated additional operational data such that a representation of the one or more additional computational tasks is presented to the user.

27. The method of claim 26, wherein:

the additional operational data includes neuromuscular signal data captured by the wrist-wearable device;

the one or more additional computational tasks include hand gesture recognition; and

the one or more additional back-end tasks include:

determining an in-air hand gesture performed by the user based on the neuromuscular signal data;

in response to a determination that the in-air hand gesture is associated with an input command, updating the additional operational data based on the input command,

such that the updated additional operational data includes a representation of the input command associated with the in-air hand gesture; and

causing performance of the one or more additional front-end tasks at the wrist-wearable device and/or head-wearable device based on the updated additional operational data such that a representation of the one or more additional computational tasks is presented to the user.

28. The method of any of claims 25-27, wherein:

the operational data includes image data captured by the head-wearable device;

the one or more computational tasks include hand gesture recognition; and

the one or more back-end tasks include:

determining an in-air hand gesture performed by the user based on the image data;

and

in response to a determination that the in-air hand gesture is associated with an input command, updating the operational data based on the input command, such that the updated operational data includes a representation of the input command associated with the in-air hand gesture.

29. The method of claim 28, wherein:

the one or more back-end tasks include:

determining an in-air hand gesture performed by the user based on the image data and the neuromuscular signal data, and

in response to a determination that the in-air hand gesture is associated with an input command, updating the operational data and/or the additional operational data based on the input command, such that the updated operational data and/or the updated additional operational data includes a representation of the input command associated with the in-air hand gesture.

30. The method of any of claims 27-29, further comprising:

in accordance with a determination that a user's hand is within a field-of view of the head-wearable device:

determining, by the one or more back-end tasks, the in-air hand gesture performed by the user based on the image data, and

in response to the determination that the in-air hand gesture is associated with the input command, updating, by the one or more back-end tasks, the operational data based on the input command, such that the updated operational data includes the representation of the input command associated with the in-air hand gesture; and

in accordance with a determination that the user's hand is not within the field-of view of the head-wearable device:

determining, by the one or more back-end tasks, the in-air hand gesture performed by the user based on the neuromuscular signal data, and

in response to the determination that the in-air hand gesture is associated with the input command, updating, by the one or more back-end tasks, the additional operational data based on the input command, such that the updated additional operational data includes the representation of the input command associated with the in-air hand gesture.

31. The method of any one of claims 25-30, further comprising:

before the handheld intermediary processing device and the head-wearable device are communicatively coupled, detecting, by the handheld intermediary processing device, the head-wearable device within a proximity to the handheld intermediary processing device and associated with the handheld intermediary processing device; and

in accordance with a determination that the head-wearable device is within the proximity to the handheld intermediary processing device and associated with the handheld intermediary processing device, communicatively coupling the head-wearable device and the handheld intermediary processing device.

32. The method of claim 31, wherein the proximity is twenty feet.

33. The method of any one of claims 31-32, wherein the detecting, by the handheld intermediary processing device, the head-wearable device is within the proximity to the handheld intermediary processing device and associated with the handheld intermediary processing device is based on:

receiving, from the handheld intermediary device, a signal to communicatively couple with the head-wearable device within the proximity of the handheld intermediary processing device.

34. The method of any one of claims 31-33, wherein the detecting, by the handheld intermediary processing device, the head-wearable device is within the proximity to the handheld intermediary processing device and associated with the handheld intermediary processing device is based on:

receiving, from the head-wearable device, a signal to communicatively couple with the handheld intermediary processing device within the proximity of the head-wearable device.

35. The method of any one of claims 25-34, wherein the identifying one or more back-end tasks and one or more front-end tasks associated with performing the one or more computational tasks comprises one or more of:

detecting respective battery levels of the head-wearable device and the handheld intermediary processing device

detecting respective thermal levels of the head-wearable device and the handheld intermediary processing device

detecting respective time-of-completions for a task of the head-wearable device and the handheld intermediary processing device

detecting respective available computational resources of the head-wearable device and the handheld intermediary processing device.

36. The method of any one of claims 25-35, wherein:

the one or more back-end tasks includes generating and/or processing one or more of image data, audio data, and haptic data based on the operational data;

the one or more front end tasks includes presenting a representation of one or more of image data, audio data, and haptic data based on the operational data.

37. The method of claim 36, wherein generating audio data, based on the operational data, includes music, alerts, alarms.

38. The method of any one of claims 36-37, wherein generating haptic data, based on the operational data, includes, alerts, notifications, urgency, semantic contextual haptics.

39. The method of any one of claims 36-38, wherein generating image data, based on the operational data, includes upsampling image data included in the operational data.

40. The method of any one of claims 36-39, wherein generating image data, based on the operational data, includes generating an artificial reality (AR) representation of the image data.
41. The method of any one of claims 25-40, further comprising:
identifying additional front-end tasks associated with performing the one or more computational tasks, and
causing performance of the additional front-end tasks at the handheld intermediary processing device using the updated operational data such that an additional representation based on the one or more computational tasks is presented to the user by the handheld intermediary processing device.
42. The method of any one of claims 25-41, wherein the sensor data from the handheld intermediary device indicating the position of the handheld intermediary processing device is simultaneous localization and mapping (SLAM) data.
43. The method of any one of claims 25-42, wherein the handheld intermediary processing device is communicatively coupled to at least one of a tablet, a smartphone, a computer, a visual display, and a gaming system.
44. An artificial-reality system configured to perform one or more operations of any one of claims 25-43.
45. An intermediary device configured to coordinate operations of a head-wearable device and a wrist-wearable device, the intermediary device configured to convey information between the head-wearable device and the wrist-wearable device in conjunction with the method of any one of claims 25-43.
46. A system that includes one or more of an intermediary device, a wrist wearable devices, and an artificial-reality headset, and the system is configured to perform operations corresponding to any one of claims 25-43.
47. A non-transitory computer-readable storage medium including instructions that, when executed by a computing device in communication with an artificial-reality headset, cause the computer device to perform operations corresponding to any one of claims 25-43.

48. A method of operating an artificial reality headset and/or a wrist-wearable device, including operations that correspond to any one of claims 25-43. A handheld intermediary processing device configured to communicatively coupled with a head-wearable device comprising:

a housing including:

a multi-touch input surface, wherein:

a first touch-input surface is defined by a surface depression of the multi-touch input surface, and

a second touch-input surface is defined by a substantially planar portion of the multi-touch input surface,

wherein (i) the first touch-input surface is disposed adjacent to the second touch-input surface and (ii) the surface depression of the multi-touch input surface is configured to guide user handling of the handheld intermediary processing device;

at least two imaging devices disposed at distinct surfaces of the housing, wherein the at least two imaging devices are configured to capture image data; and

one or more processors for determining artificial-reality (AR) data including (i) positional mapping of the handheld intermediary processing device and (ii) one or more objects in proximity to the handheld intermediary processing device,

wherein an input detected at the multi-touch input surface is based, in part, on the AR data.

50. The handheld intermediary processing device of claim 49, wherein the positional mapping of the handheld intermediary processing device includes six degrees of freedom.

51. The handheld intermediary processing device of any one of claims 49-50, wherein the handheld intermediary processing device does not have a graphic display.

52. The handheld intermediary processing device of any one of claims 49-51, wherein the surface depression of the multi-touch input surface is a substantially circular depression.

53. The handheld intermediary processing device of any one of claims 49-52, wherein the second touch-input surface includes one or more touch-input regions.

54. The handheld intermediary processing device of claim 53, wherein at least one region of the one or more touch-input regions is substantially circular.

55. The handheld intermediary processing device of claim 54, wherein the at least one region of the one or more touch-input regions is defined by at least one depression on the substantially planar portion of the multi-touch input surface.

56. The handheld intermediary processing device of claim 54, wherein the at least one region of the one or more touch-input regions is defined by at least one protrusion on the substantially planar portion of the multi-touch input surface.

57. The handheld intermediary processing device of any one of claims 49-56, wherein the surface depression of the multi-touch input surface is configured to guide user handling of the handheld intermediary processing device such that a user's palm is adjacent to the second touch-input surface.

58. The handheld intermediary processing device of any one of claims 49-57, the housing further including at least one haptic generator.

59. The handheld intermediary processing device of any one of claims 49-58, wherein the housing further includes a surface adjacent to the multi-touch input surface, the surface adjacent to the multi-touch input surface including:

at least one other imaging device distinct from the at least two imaging devices imaging devices for capturing image data; and

at least one sensor.

60. The handheld intermediary processing device of claim 59, wherein the surface adjacent to the multi-touch input surface is at a predetermined, non-perpendicular angle to the multi-touch input surface.

61. The handheld intermediary processing device of claim 60, the surface adjacent to the multi-touch input surface further including a light indicating that the at least one imaging device is capturing the image data.

62. The handheld intermediary processing device of any one of claims 49-61, wherein the housing further includes a second surface, opposite of the multi-touch input surface, wherein the second surface includes:

at least one other imaging device distinct from the at least two imaging devices imaging devices for capturing image data; and
at least one sensor.

63. The handheld intermediary processing device of any one of claims 59 and 62, wherein the at least one sensor includes a depth sensor, a time-of-flight sensor and an ambient light sensor.

64. The handheld intermediary processing device of any one of claims 62-63, wherein at least a portion of the second surface is magnetic such that the at least the portion of the second surface is configured to magnetically couple with a magnetic stand.

65. The handheld intermediary processing device of any one of claims 62-64, wherein the second surface includes at least one elastomer protrusion to support the handheld intermediary processing device in an upright position.

66. The handheld intermediary processing device of any one of claims 62-65, wherein the second surface includes a stand for the handheld intermediary processing device configured to fold out such that the stand supports the handheld intermediary processing device in an upright position when in a folded-out position, wherein the stand is planar with the second surface when in a folded-in position.

67. The handheld intermediary processing device of any one of claims 62-66, wherein the second surface further includes a button and the handheld intermediary processing device is configured to, in response to a detection of a user input at the button, perform one or more of:
turn the handheld intermediary processing device on and off;
initiate a communicatively coupling process; and
reset the handheld intermediary processing device.

68. The handheld intermediary processing device of any one of claims 49-66, wherein the housing further includes at least one USB-C type charging port.

69. The handheld intermediary processing device of claim 68, wherein the at least one USB-C type charging port is configured to support the handheld intermediary processing device in an upright position when coupled with a charging stand.

70. The handheld intermediary processing device of any one of claims 49-69, wherein the handheld intermediary processing device further comprises at least one wireless charging receiver.

71. The handheld intermediary processing device of any one of claims 49-70, wherein the housing further includes a bezel configured to receive a bezel stand for the handheld intermediary processing device.

72. The handheld intermediary processing device of any one of claims 49-71, wherein the handheld intermediary processing device further comprises one or more sensors including at least one of an inertial measurement unit, a magnetometer, an altimeter, and an ambient light sensor.

73. The handheld intermediary processing device of any one of claims 49-72, wherein the at least two imaging devices capture simultaneous localization and mapping (SLAM) data.

74. The handheld intermediary processing device of any one of claims 49-73, wherein the multi-touch input surface further includes a light indicating that the handheld intermediary processing device is on.

75. A handheld intermediary processing device in accordance with any one of claims 49-74 configured to perform the method of any one of claims 1-19 and 25-43.

76. A handheld intermediary processing device in accordance with any one of claims 49-74 configured to coordinate operations of a head-wearable device and a wrist-wearable device, the handheld intermediary processing device configured to convey information between the head-wearable device and the wrist-wearable device in conjunction with the method of any one of claims 1-19 and 25-43.

77. A non-transitory computer-readable storage medium including instructions that, when executed by a handheld intermediary processing device in accordance with any one of claims 49-74 in communication with an artificial-reality headset, cause the handheld intermediary processing device to perform operations corresponding to any one of claims 1-19 and 25-43.

78. A method of forming a handheld intermediary processing device in accordance with any one of claims 49-74. A means for performing or causing the performance of the method of any one of claims 1-19 and 25-43.