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(54) **DYNAMIC USER INTERFACES ADAPTED TO INFERRED USER CONTEXTS**

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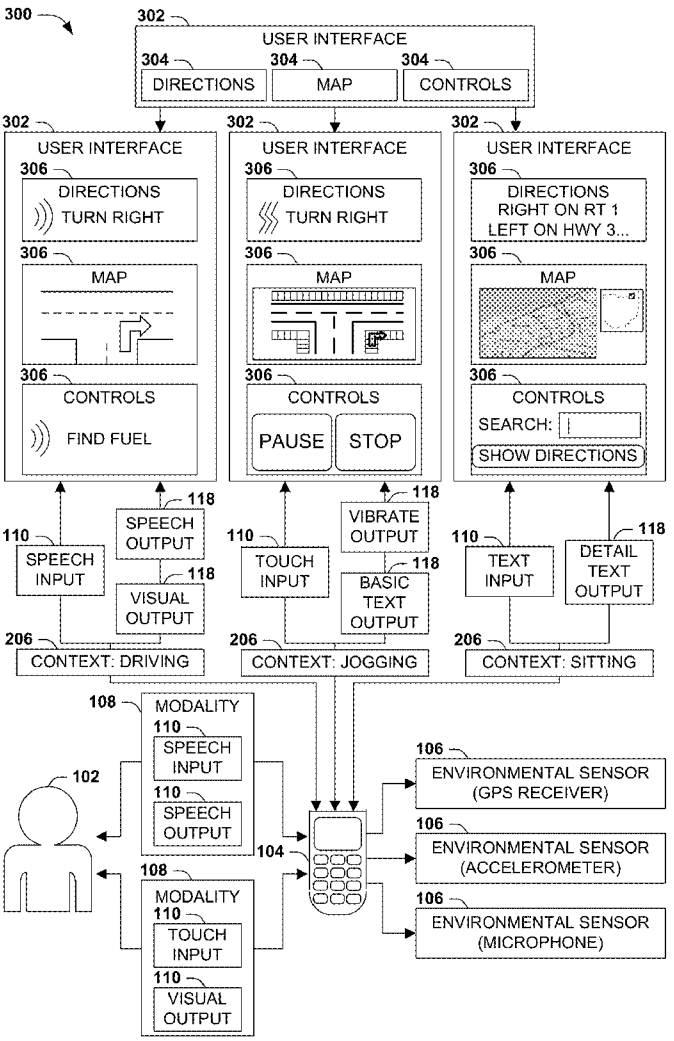
(57) **ABSTRACT**

A device comprising a set of environment detectors may detect various environmental properties (e.g., location, velocity, and vibration), and may infer from these environmental properties a current context of the user (e.g., the user's attention availability, privacy, and accessible input and output modalities). Based on the current context, the device may adjust the presentation of various user interface elements of an application. For example, the velocity and vibration level detected by the device may enable an inference of the mode of transport of the user (e.g., stationary, walking, jogging, driving a car, or riding on a bus), and each mode of transport may suggest the user's available input modality (e.g., text, touch, speech, or gaze tracking) and/or output modality (e.g., high-detail visual, simplified visual, or audible), and the application may select and present corresponding element presentations for input and output user interface elements, and/or the detail of presented content.



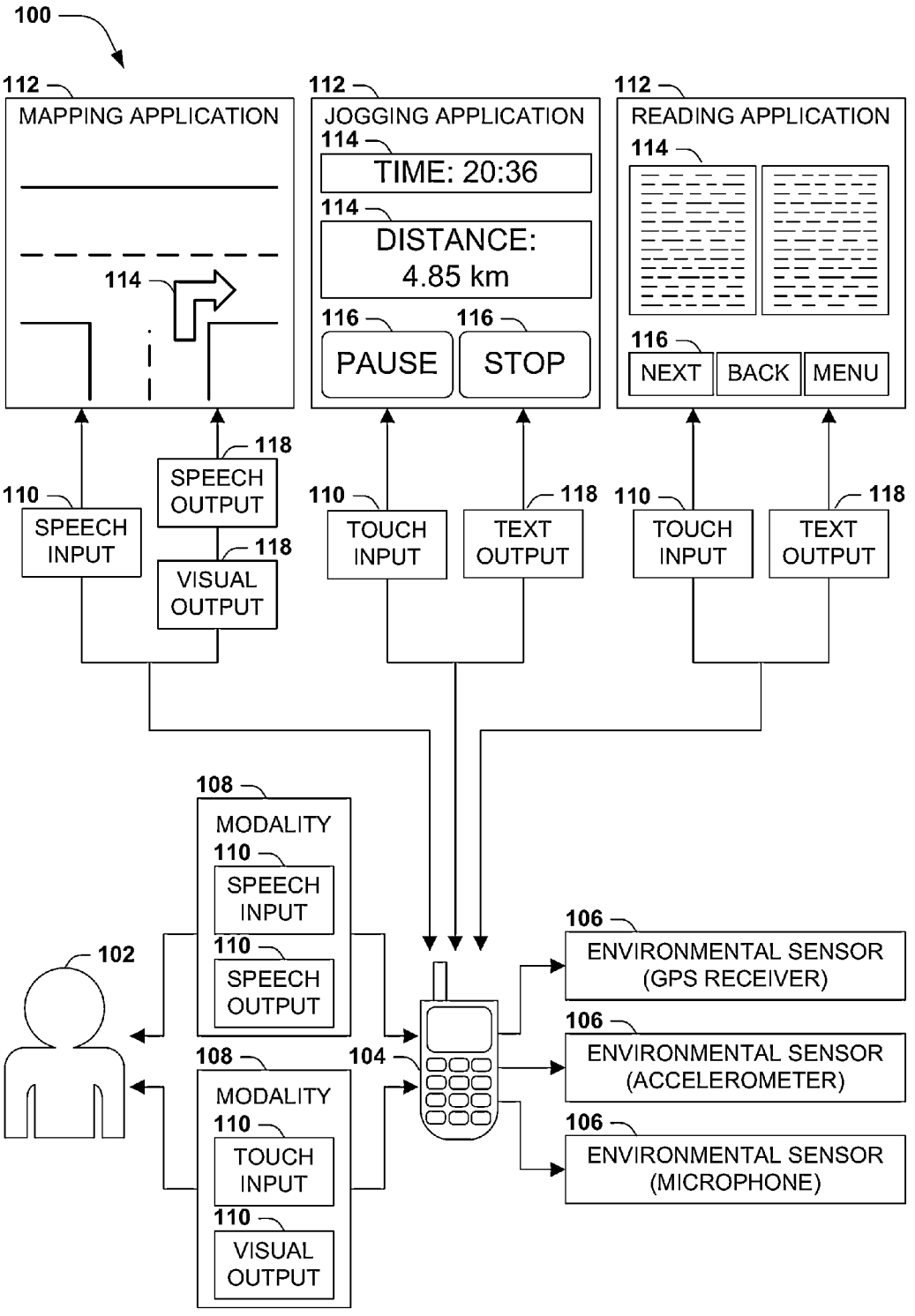

100
112
MAPPING APPLICATION
114
112
JOGGING APPLICATION
114
TIME: 20:36
114
DISTANCE:
4.85 km
116
PAUSE
116
STOP
112
READING APPLICATION
114
116
NEXT
BACK
MENU
110
SPEECH INPUT
118
SPEECH OUTPUT
118
VISUAL OUTPUT
110
TOUCH INPUT
118
TEXT OUTPUT
110
TOUCH INPUT
118
TEXT OUTPUT
108
MODALITY
110
SPEECH INPUT
110
SPEECH OUTPUT
102
108
MODALITY
110
TOUCH INPUT
110
VISUAL OUTPUT
104
106
ENVIRONMENTAL SENSOR (GPS RECEIVER)
106
ENVIRONMENTAL SENSOR (ACCELEROMETER)
106
ENVIRONMENTAL SENSOR (MICROPHONE)

FIG. 1

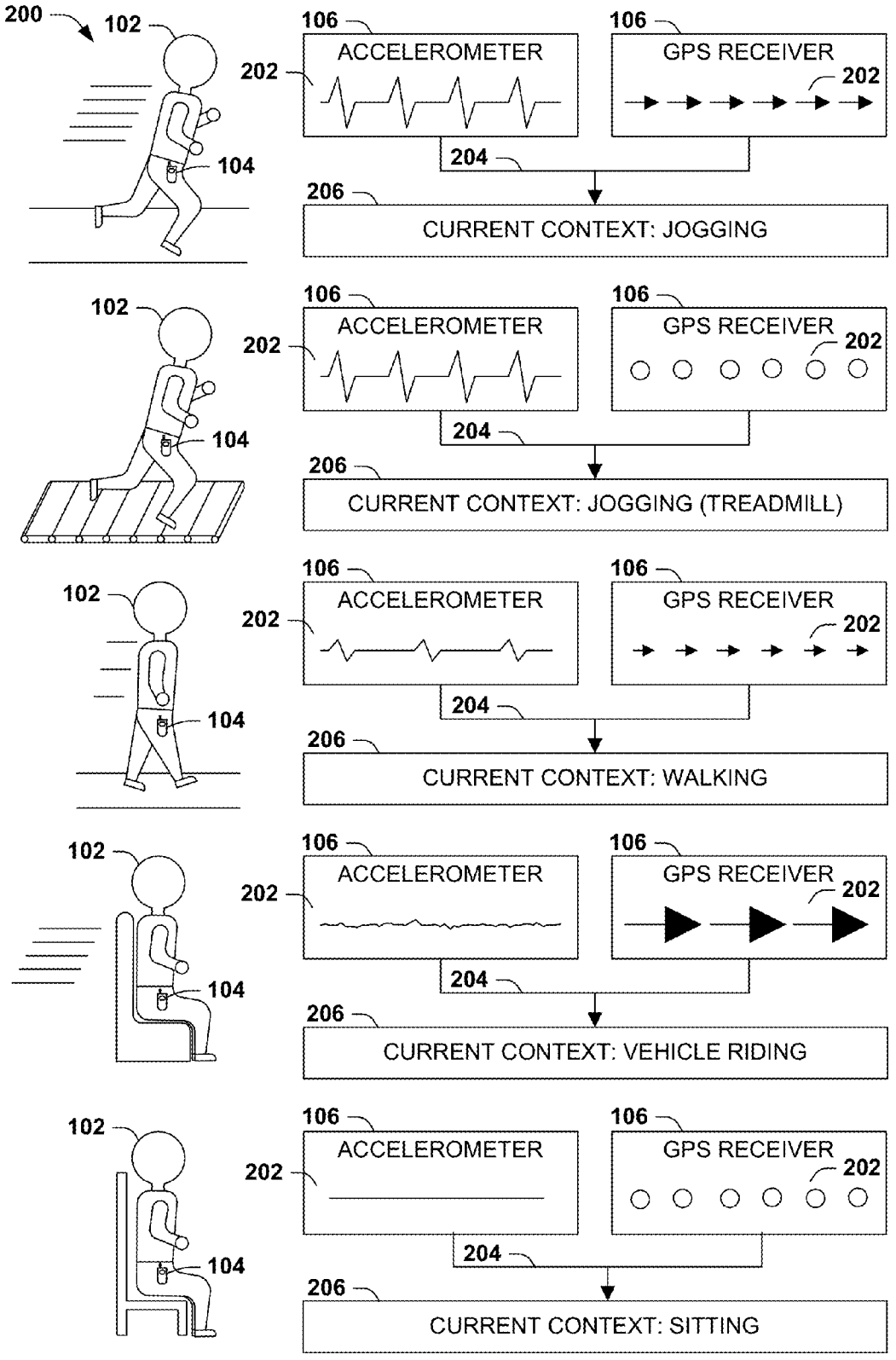

200
102
104
106
ACCELEROMETER
GPS RECEIVER
202
204
206
CURRENT CONTEXT: JOGGING
CURRENT CONTEXT: JOGGING (TREADMILL)
CURRENT CONTEXT: WALKING
CURRENT CONTEXT: VEHICLE RIDING
CURRENT CONTEXT: SITTING

FIG. 2

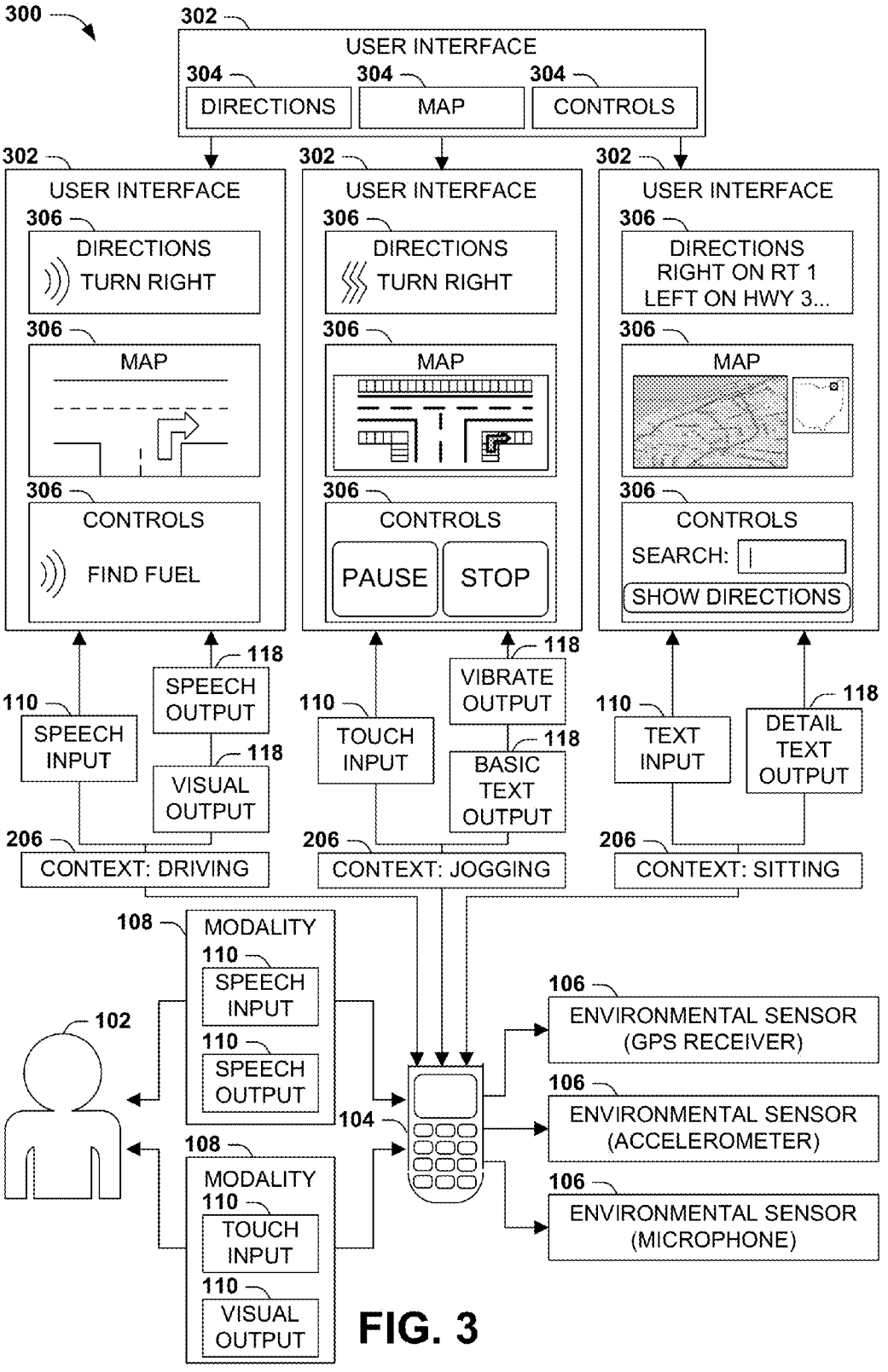

300
302
USER INTERFACE
304
DIRECTIONS
304
MAP
304
CONTROLS
302
USER INTERFACE
306
DIRECTIONS
TURN RIGHT
306
MAP
306
CONTROLS
FIND FUEL
302
USER INTERFACE
306
DIRECTIONS
TURN RIGHT
306
MAP
306
CONTROLS
PAUSE
STOP
302
USER INTERFACE
306
DIRECTIONS
RIGHT ON RT 1
LEFT ON HWY 3...
306
MAP
306
CONTROLS
SEARCH:
SHOW DIRECTIONS
110
SPEECH INPUT
118
SPEECH OUTPUT
118
VISUAL OUTPUT
110
TOUCH INPUT
118
VIBRATE OUTPUT
118
BASIC TEXT OUTPUT
110
TEXT INPUT
118
DETAIL TEXT OUTPUT
206
CONTEXT: DRIVING
206
CONTEXT: JOGGING
206
CONTEXT: SITTING
108
MODALITY
110
SPEECH INPUT
110
SPEECH OUTPUT
102
104
108
MODALITY
110
TOUCH INPUT
110
VISUAL OUTPUT
106
ENVIRONMENTAL SENSOR (GPS RECEIVER)
106
ENVIRONMENTAL SENSOR (ACCELEROMETER)
106
ENVIRONMENTAL SENSOR (MICROPHONE)

FIG. 3

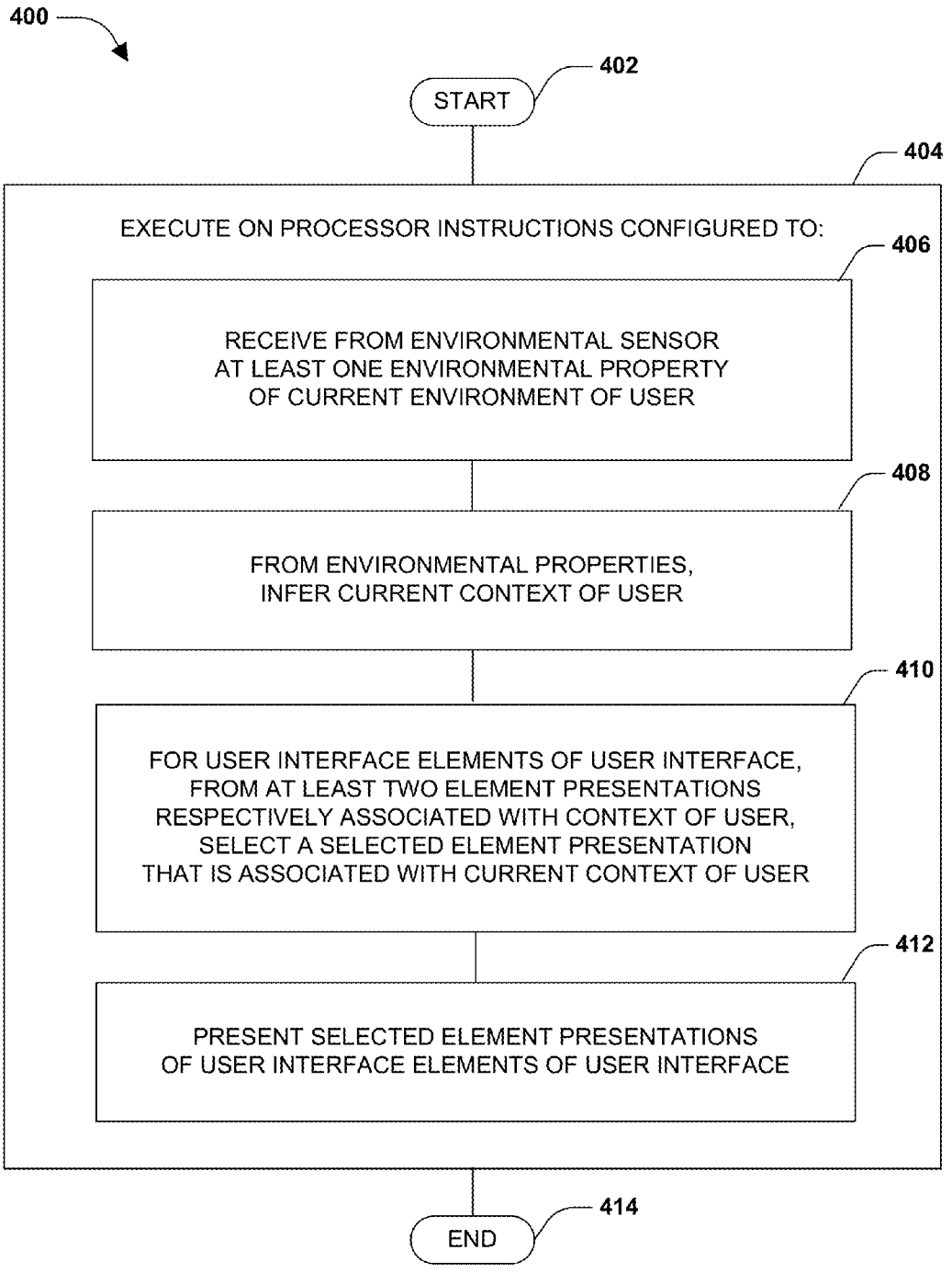

400
402
START
404
EXECUTE ON PROCESSOR INSTRUCTIONS CONFIGURED TO:
406
RECEIVE FROM ENVIRONMENTAL SENSOR AT LEAST ONE ENVIRONMENTAL PROPERTY OF CURRENT ENVIRONMENT OF USER
408
FROM ENVIRONMENTAL PROPERTIES, INFER CURRENT CONTEXT OF USER
410
FOR USER INTERFACE ELEMENTS OF USER INTERFACE, FROM AT LEAST TWO ELEMENT PRESENTATIONS RESPECTIVELY ASSOCIATED WITH CONTEXT OF USER, SELECT A SELECTED ELEMENT PRESENTATION THAT IS ASSOCIATED WITH CURRENT CONTEXT OF USER
412
PRESENT SELECTED ELEMENT PRESENTATIONS OF USER INTERFACE ELEMENTS OF USER INTERFACE
414
END

FIG. 4

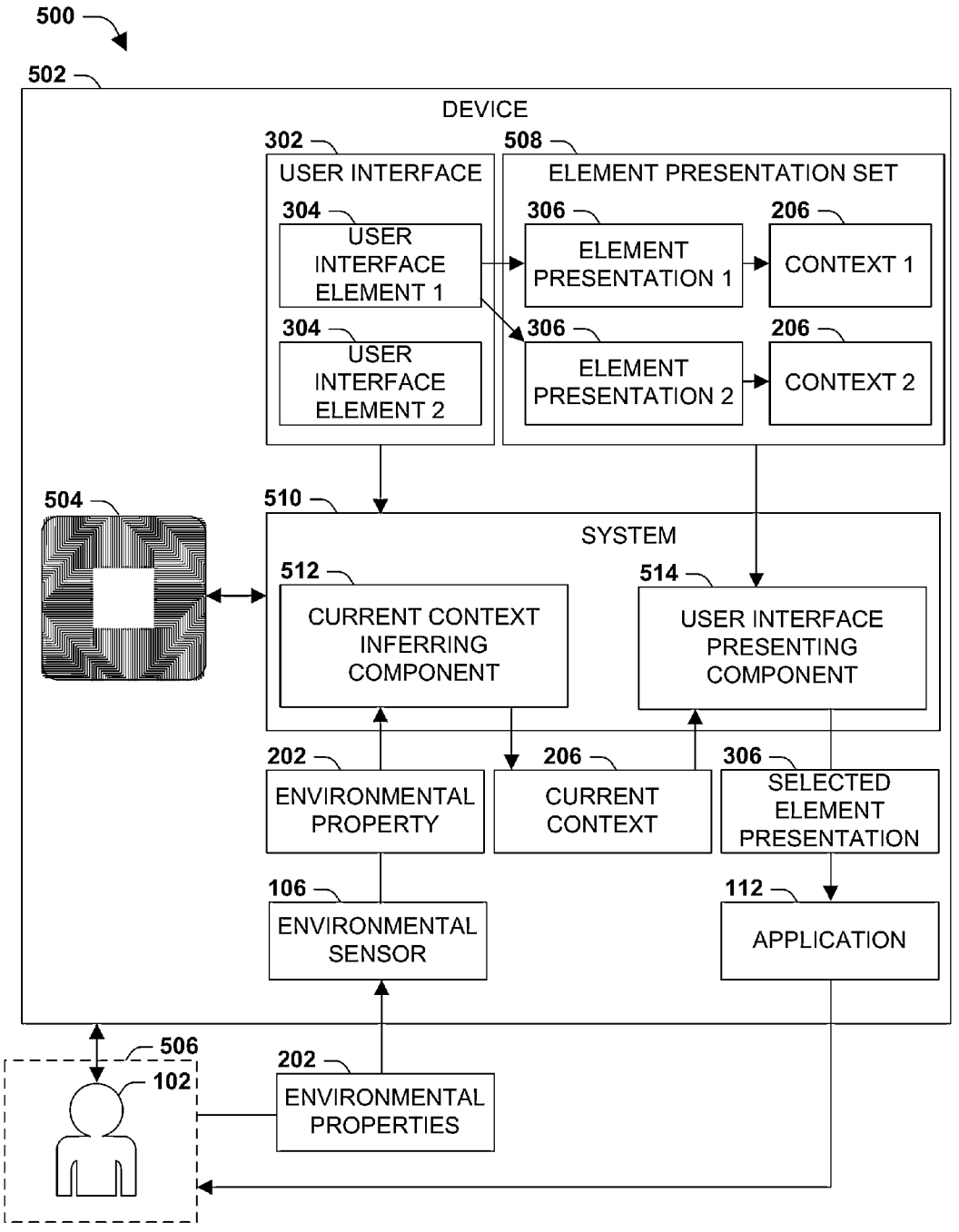

500
502
DEVICE
302
USER INTERFACE
304
USER INTERFACE ELEMENT 1
304
USER INTERFACE ELEMENT 2
508
ELEMENT PRESENTATION SET
306
ELEMENT PRESENTATION 1
306
ELEMENT PRESENTATION 2
206
CONTEXT 1
206
CONTEXT 2
504
510
SYSTEM
512
CURRENT CONTEXT INFERRING COMPONENT
514
USER INTERFACE PRESENTING COMPONENT
202
ENVIRONMENTAL PROPERTY
206
CURRENT CONTEXT
306
SELECTED ELEMENT PRESENTATION
106
ENVIRONMENTAL SENSOR
112
APPLICATION
506
102
202
ENVIRONMENTAL PROPERTIES

FIG. 5

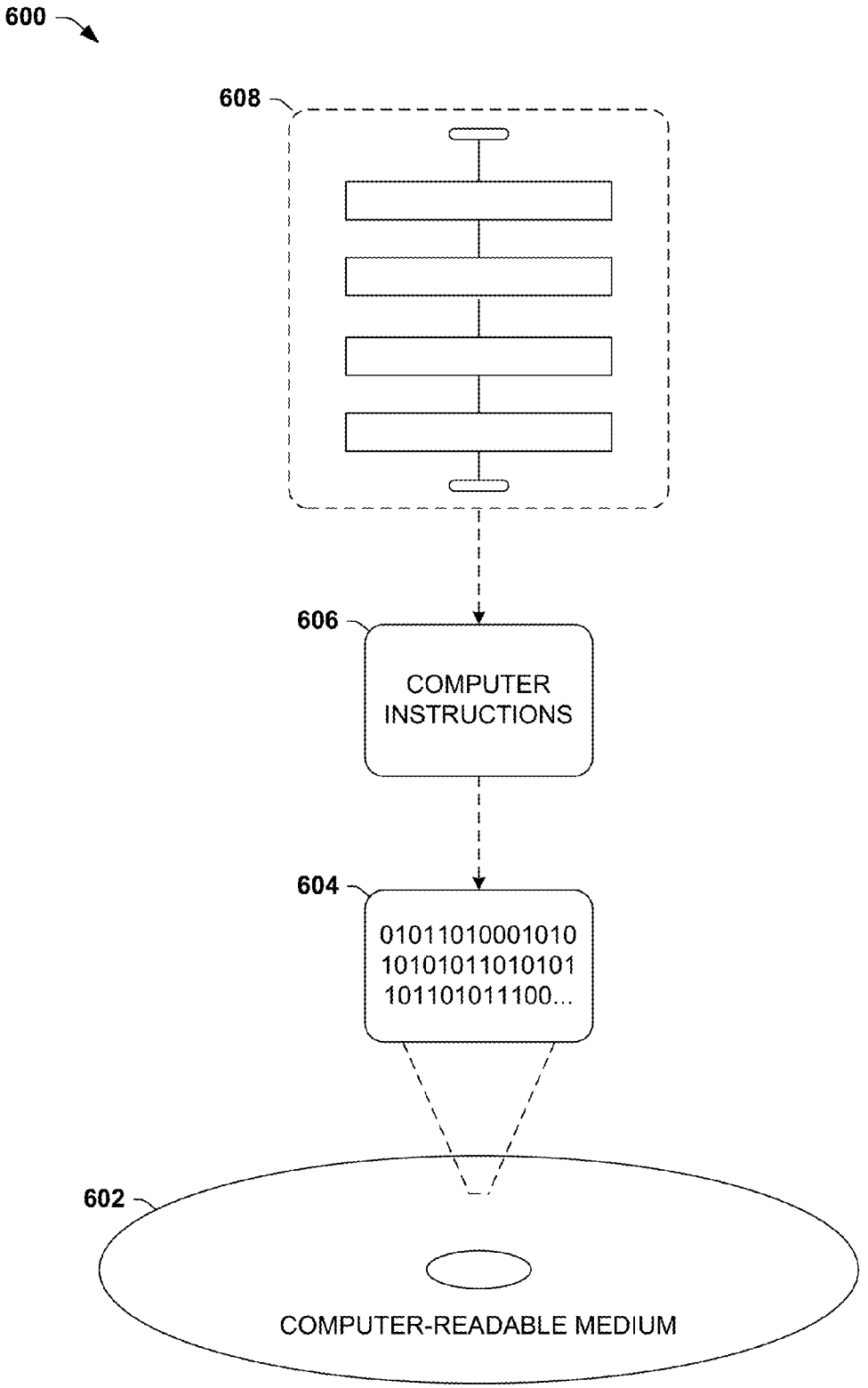

600
608
606
COMPUTER INSTRUCTIONS
604
01011010001010
10101011010101
101101011100...
602
COMPUTER-READABLE MEDIUM

FIG. 6

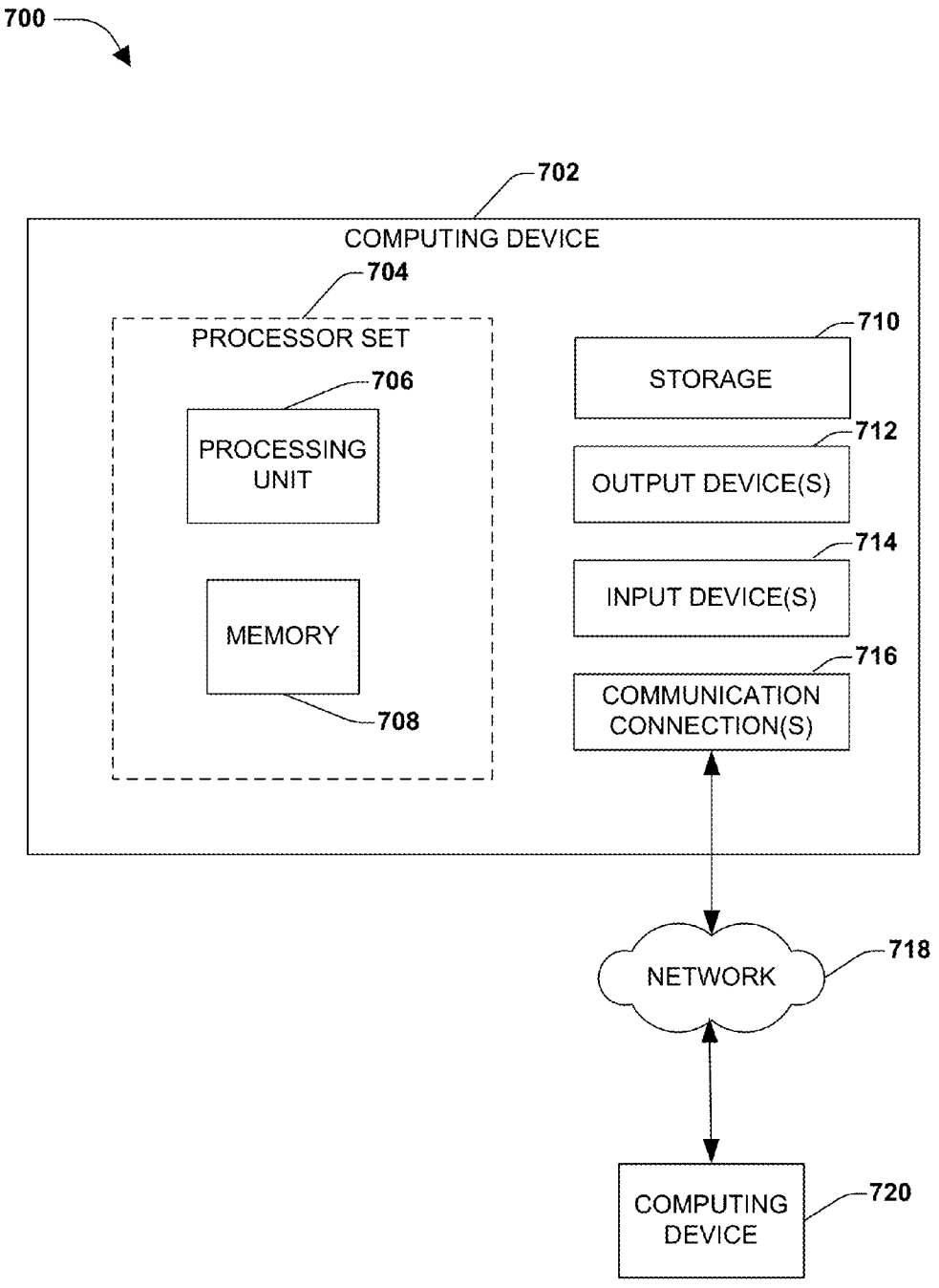

700
702
COMPUTING DEVICE
704
PROCESSOR SET
706
PROCESSING UNIT
MEMORY
708
710
STORAGE
712
OUTPUT DEVICE(S)
714
INPUT DEVICE(S)
716
COMMUNICATION CONNECTION(S)
NETWORK
718
COMPUTING DEVICE
720

FIG. 7

DYNAMIC USER INTERFACES ADAPTED TO INFERRED USER CONTEXTS

BACKGROUND

[0001] Within the field of computing, many scenarios involve devices that are used during a variety of physical activities. As a first example, a music player may play music while a user is sitting at a desk, walking on a treadmill, or jogging outdoors. The environment and physical activity of the user may not alter the functionality of the device, but it may be desirable to design the device for adequate performance for a variety of environments and activities (e.g., headphones that are both comfortable for daily use and sufficiently snug to stay in place during exercise). As a second example, a mobile device, such as a phone, may be used by a user who is stationary, walking, or riding in a vehicle. The mobile computer may store a variety of applications that a user may wish to utilize in different contexts (e.g., a jogging application that may track the user's progress during jogging, and a reading application that the user may use while seated). To this end, the mobile device may also feature a set of environmental sensors that detect various properties of the environment that are usable by the applications. For example, the mobile device may include a global positioning system (GPS) receiver configured to detect a geographical position, altitude, and velocity of the user, and a gyroscope or accelerometer configured to detect a physical orientation of the mobile device. This environmental data may be made available to respective applications, which may utilize it to facilitate the operation of the application.

[0002] Additionally, the user may manipulate the device as a form of user input. For example, the device may detect various gestures, such as touching a display of the device, shaking the device, or performing a gesture in front of a camera of the device. The device may utilize various environmental sensors to detect some environmental properties that reveal the actions communicated to the device by the user, and may extract user input from these environmental properties.

SUMMARY

[0003] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key factors or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

[0004] While respective applications of a mobile device may utilize environmental properties received from environmental sensors in various ways, it may be appreciated that this environmental information is typically used to indicate the status of the device (e.g., the geolocation and orientation of the device may be utilized to render an "augmented reality" application) and/or the status of the environment (e.g., an ambient light sensor may detect a local light level in order to adjust the brightness of the display). However, this information is not typically utilized to determine the current context of the user. For example, when the user transitions from walking to riding in a vehicle, the user may manually switch from a first application that is suitable for the context of walking (e.g., a pedestrian mapping application) to a second application that is suitable for the context of riding (e.g., a driving directions mapping application). While each application may use environmental properties in the current context of the user, the user interface of an application is typically presented statically until and unless explicitly adjusted by the user to suit the user's current context.

[0005] However, it may be appreciated that the user interface of an application may be dynamically adjusted to suit the current context inferred about the user. It may be appreciated that such adjustments may be selected not (only) in response to user input from the user and/or the detected environment properties of the environment (e.g., adapting the brightness in view of the detected ambient light level), but also in view of the context of the user.

[0006] Presented herein are techniques for configuring a device to infer a current context of the user, based on the environmental properties provided by the environmental sensors, and to adjust the user interface of an application to satisfy the user's inferred current context. For example, in contrast with adjusting the volume level of a device in view of a detected noise level of the environment, the device may infer from the detected noise level the privacy level of the user (e.g., whether the user is in a location occupied by other individuals or is alone), and may adjust the user interface according to the inferred privacy as the current context of the user (e.g., obscuring private user information while the user is in the presence of other individuals). Given the wide range of current contexts of the user (e.g., the user's location type, privacy level, available attention, and accessible input and output modalities), various user interface elements of the user interface may be selected from at least two element presentations (e.g., a user input modality may be selected from a text, touch, voice, and gaze modalities). Many types of current contexts of the user may be inferred based on many types of environmental properties may enable the selection among many types of dynamic user interface adjustments in accordance with the techniques presented herein.

[0007] To the accomplishment of the foregoing and related ends, the following description and annexed drawings set forth certain illustrative aspects and implementations. These are indicative of but a few of the various ways in which one or more aspects may be employed. Other aspects, advantages, and novel features of the disclosure will become apparent from the following detailed description when considered in conjunction with the annexed drawings.

DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is an illustration of an exemplary scenario featuring a device comprising a set of environmental sensors and configured to execute a set of applications.

[0009] FIG. **2** is an illustration of an exemplary scenario featuring an inference of a physical activity of a user through environmental properties according to the techniques presented.

[0010] FIG. **3** is an illustration of an exemplary scenario featuring a dynamic composition of a user interface using element presentations selected for the current context of the user in accordance with the techniques presented herein.

[0011] FIG. **4** is a flow chart illustrating an exemplary method of inferring physical activities of a user based on environmental properties.

[0012] FIG. **5** is a component block diagram illustrating an exemplary system for inferring physical activities of a user based on environmental properties.

[0013] FIG. **6** is an illustration of an exemplary computer-readable medium comprising processor-executable instructions configured to embody one or more of the provisions set forth herein.

[0014] FIG. **7** illustrates an exemplary computing environment wherein one or more of the provisions set forth herein may be implemented.

DETAILED DESCRIPTION

[0015] The claimed subject matter is now described with reference to the drawings, wherein like reference numerals are used to refer to like elements throughout. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the claimed subject matter. It may be evident, however, that the claimed subject matter may be practiced without these specific details. In other instances, structures and devices are shown in block diagram form in order to facilitate describing the claimed subject matter.

A. INTRODUCTION

[0016] Within the field of computing, many scenarios involve a mobile device operated by a user in a variety of contexts and environments. As a first example, a music player may be operated by a user during exercise and travel, as well as while stationary. The music player may be designed to support use in variable environments, such as providing solid-state storage that is less susceptible to damage through movement; a transflective display that is visible in both indoor and outdoor environments; and headphones that are both comfortable for daily use and that stay in place during rigorous exercise. While not altering the functionality of the device between environments, these features may promote the use of the mobile device in a variety of contexts. As a second example, a mobile device may offer a variety of applications that the user may utilize in different contexts, such as travel-oriented applications, exercise-oriented applications, and stationary-use applications. Respective applications may be customized for a particular context, e.g., by presenting user interfaces that are well-adapted to the use context.

[0017] FIG. **1** presents an illustration of an exemplary scenario **100** featuring a device **104** operated by a user **102** and usable in different contexts. In this exemplary scenario **100**, the device **104** features a mapping application **112** that is customized to assist the user **102** while traveling on a road, such as by automobile or bicycle; a jogging application **112**, which assists the user **102** in tracking the progress of a jogging exercise, such as the duration of the jog, the distance traveled, and the user's pace; and a reading application **112**, which may present documents to a user **102** that are suitable for a stationary reading experience. The device **104** may also feature a set of environmental sensors **106**, such as a global positioning system (GPS) receiver configured to identify a position, altitude, and velocity of the device **104**; an accelerometer or gyroscope configured to detect a tilt orientation of the device **104**; and a microphone configured to receive sound input. Additionally, respective applications **112** may be configured to utilize the information provided by the environmental sensors **106**. For example, the mapping application **112** may detect the current location of the device in order to display a localized map; the jogging application **112** may detect the current speed of the device **104** through space in order to track distance traveled; and the reading application **112** may use a light level sensor to detect the light level of the environment, and to set the brightness of a display component for comfortable viewing of the displayed text.

[0018] Additionally, respective applications **112** may present different types of user interfaces that are customized based on the context in which the application **112** is to be used. Such customization may include the use of the environmental sensors **106** to communicate with the user **102** through a variety of modalities **108**. For example, a speech modality **108** may include speech user input **110** received through the microphone and speech output produced through a speaker, while a visual modality **108** may comprise touch user input **110** received through a touch-sensitive display component and visual output presented on the display. In these ways, the information provided by the environmental sensors **106** may be used to receive user input **110** from the user **102**, and to output information to the user **102**. In some such devices **104**, the environmental sensors **106** may be specialized for user input **110**; e.g., the microphone may be configured for particular sensitivity to receive voice input and to distinguish such voice input from background noise.

[0019] Moreover, respective applications **112** may be adapted to present user interfaces that interact with the user **102** according to the context in which the application **112** is to be used. As a first example, the mapping application **112** may be adapted for use while traveling, such as driving a car or riding a bicycle, wherein the user's attention may be limited and touch-based user input **110** may be unavailable, but speech-based user input is suitable. The user interface may therefore present a minimal visual interface with a small set of large user interface elements **114**, such as a simplified depiction of a road and a directional indicator. More detailed information may be presented as speech output **118**, and the application **112** may communicate with the user **102** through speech-based user input **110** (e.g., voice-activated commands detected by the microphone), rather than touch-based user input **110** that may be dangerous while traveling. The application **112** may even refrain from accepting any touch-based input in order to discourage distractions. As a second example, the jogging application **112** may be adapted for the context of a user **102** with limited visual availability, limited touch input availability, and no speech input availability. Accordingly, the user interface may present a small set of large user interface elements **114** through text output **118** that may be received through a brief glance, and a small set of large user interface controls **116**, such as large buttons that may be activated with low-precision touch input. As a third example, the reading application **112** may be adapted for a reading environment based on a visual modality **108** involving high visual output **118** and precise touch-based user input **110**, but reducing audial interactions that may be distracting in reading environments such as a classroom or library. Accordingly, the user interface for the reading application **112** may interact only through touch-based user input **110** and textual user interface elements **114**, such as highly detailed renderings of text. In this manner, respective applications **112** may utilize the environmental sensors **106** for environment-based context and for user input **110** received from the user **102**, and may present user interfaces that are well-adapted to the context in which the application **112** is to be used.

B. PRESENTED TECHNIQUES

[0020] The exemplary scenario **100** of FIG. **1** presents several advantageous uses of the environmental sensors **106** to

facilitate the applications **112**, and several adaptations of the user interface elements **114** and user interface controls **116** of respective applications **112** to suit the context in which the application **112** is likely to be used. In particular, as used in the exemplary scenario **100** of FIG. **1**, the environmental properties detected by the environmental sensors **106** may be interpreted as the status of the device **104** (e.g., its position or orientation), the status of the environment (e.g., the local sound level), or explicit communication with the user **102** (e.g., touch-based or speech-based user input **110**). However, the environmental properties may also be used as a source of information about the context of the user **102** while using the device **104**. For example, while the device **104** is attached to the user **102**, the movements of the user **102** and environmental changes caused thereby may enable an inference about various properties of the location of the user, including the type of location; the presence and number of other individuals in the proximity of the user **102**, which may enable an inference of the privacy level of the user **102**; the attention availability of the user **102** (e.g., whether the attention of the user **102** is readily available for interaction, or whether the user **102** may be only periodically interrupted); and the input modalities that may be accessible to the user **102** (e.g., whether the user **102** is available to receive visual output, audial output, or tactile output such as vibration, and whether the user **102** is available to provide input through text, manual touch, device orientation, voice, or eye gaze). An application **112** comprising a set of user interface elements may therefore be presented by selecting, for respective user interface elements, an element presentation that Is suitable for the current context of the user **102**. Moreover, this dynamic composition of the user interface may be performed automatically (e.g., not in response to user input directed by the user **102** to the device **104** and specifying the user's current context), and in a more sophisticated manner than directly using the environmental properties, which may be of limited value in selecting element presentations for the user **102**.

[0021] FIG. **2** presents an illustration of an exemplary scenario **200** featuring an inference of a current context **206** of a user **102** of a device **104** based on environmental properties **202** reported by respective environmental sensors **106**, including an accelerometer and a global positioning system (GPS) receiver. As a first example, the user **102** may engage in a jogging context **206** while attached to the device **104**. Even when the user **102** is not directly interacting with the device **104** (in the form of user input), the environmental sensors **106** may detect various properties of the environment that enable an inference **204** of the current context **206** of the user **102**. For example, the accelerometer may detect environmental properties **202** indicating a modest repeating impulse caused by the user's footsteps while jogging, while the GPS receiver also detects a speed that is within the typical speed of jogging context **206**. Based on these environmental properties **202**, the device **104** may therefore perform an inference **204** of the jogging context **206** of the user **102**. As a second example, the user **102** may perform a jogging exercise on a treadmill. While the accelerometer may detect and report the same pattern of modest repeating impulses, the GPS receiver may indicate that the user **102** is stationary. The device **104** may therefore perform an evaluation resulting in an inference **204** of a treadmill jogging context **206**. As a third example, a walking context **206** may be inferred from a first environmental property **202** of a regular set of impulses having a lower magnitude than for the jogging context **206** and a steady but lower-speed direction of travel indicated by the GPS receiver. As a fourth example, when the user **102** is seated on a moving vehicle such as a bus, the accelerometer may detect a latent vibration (e.g., based on road unevenness) and the GPS receiver may detect high-velocity directional movement, leading to an inference **204** of a vehicle riding context **206**. As a fifth example, when the user **102** is seated and stationary, the accelerometer and GPS receiver may both indicate very-low-magnitude environmental properties **202**, and the device **104** may reach an inference **204** of a stationary context **206**. In this manner, a device **104** may infer the current context **206** of the user **102** based on the environmental properties **202** detected by the environmental sensors **106**.

[0022] FIG. **3** presents an illustration of an exemplary scenario **300** featuring the use of an inferred current context **206** of the user **102** to achieve a dynamic, context-aware composition of a user interface **302** of an application **112**. In this exemplary scenario **300**, a user **102** may operate a device **104** having a set of environmental sensors **106** configured to detect various environmental properties **202**, from which a current context **206** of the user **102** may be inferred. Moreover, various contexts **206** may be associated with various types of modalities **108**; e.g., each context **206** may involve a selection of one or more forms of input **110** selected from a set of input modalities **108**, and/or a selection of one or more forms of output **118** selected from a set of output modalities **108**.

[0023] In view of this information, the device **104** may present an application **112** comprising a user interface **302** comprising a set of user interface elements **304**, such as a mapping application **112** involving a directions user interface element **304**; a map user interface element **304**; and a controls user interface element **304**. In view of the inferred current context **206** of the user **102**, the device **104** may select, for each user interface element **304**, an element presentation **306** that is suitable for the context **206**. As a first example, the mapping application **112** may be operated in a driving context **206**, in which the user input **110** of the user **102** is limited to speech, and the output **118** of the user interface **302** involves speech and simplified, driving-oriented visual output. The directions user interface element **304** may be presented as voice directions; the mapping user interface element **304** may present a simplified map with driving directions; and the controls user interface element **306** may involve a non-visual, speech analysis technique. As a second example, the mapping application **112** may be operated in a jogging context **206**, in which the user input **110** of the user **102** is limited to comparatively inaccurate touch, and the output **118** of the user interface **302** involves vibration and simplified, pedestrian-oriented visual output. The directions user interface element **304** may be presented as vibrational directions (e.g., buzzing once for a left turn and twice for a right turn); the mapping user interface element **304** may present a simplified map with pedestrian directions; and the controls user interface element **306** may involve large buttons and large text that are easy to view and activate while jogging. As a third example, the mapping application **112** may be operated in a stationary context **206**, such as while sitting at a workstation and planning a trip, in which the user input **110** of the user **102** is robustly available as text input and highly accurate pointing controls, and the output **118** of the user interface **302** involves detailed text and high-quality visual output. The directions user interface element **304** may be presented as a detailed, textual description of directions; the mapping user interface

element **304** may present a highly detailed and interactive map; and the controls user interface element **306** may involve a sophisticated set of user interface controls providing extensive map interaction. In this manner, the user interface **302** of the application **112** may be dynamically composed based on the current context **206** of the user **102**, which in turn may be automatically inferred from the environmental properties **202** detected by the environmental sensors **106**, in accordance with the techniques presented herein.

C. EXEMPLARY EMBODIMENTS

[0024] FIG. **4** presents a first exemplary embodiment of the techniques presented herein, illustrated as an exemplary method **400** of presenting a user interface **302** to a user **102** of a device **104** having a processor and an environmental sensor **106**. The exemplary method **400** may be implemented, e.g., as a set of processor-executable instructions stored in a memory component of the device **104** (e.g., a memory circuit, a solid-state storage device, a platter of a hard disk drive, or a magnetic or optical device) that, when executed on a processor of the device, cause the device to operate according to the techniques presented herein. The exemplary method **400** begins at **402** and involves executing **404** the instructions on the processor. Specifically, the instructions may be configured to receive **406** from the environmental sensor **106** at least one environmental property **202** of a current environment of the user **102**. The instructions are also configured to, from the at least one environmental property **202**, infer **408** a current context **206** of the user **102**. The instructions are also configured to, for respective user interface elements **304** of the user interface **302**, from at least two element presentations **306** respectively associated with a context **206** of the user **102**, select **410** a selected element presentation **306** that is associated with the current context **206** of the user **102**. The instructions are also configured to present **412** the selected element presentations **306** of the user interface elements **304** of the user interface **302**. By compositing the user interface **302** based on the inference of the context **206** of the user **102** from the environmental properties **202** provided by the environmental sensors **106**, the exemplary method **400** operates according to the techniques presented herein, and so ends at **414**.

[0025] FIG. **5** presents a second embodiment of the techniques presented herein, illustrated as an exemplary scenario **500** featuring an exemplary system **510** configured to present a user interface **302** that is dynamically adjusted based on an inference of a current context **206** of a current environment **506** of a user **102** of the device **502**. The exemplary system **510** may be implemented, e.g., as a set of interoperating components, each respectively comprising a set of instructions stored in a memory component (e.g., a memory circuit, a solid-state storage device, a platter of a hard disk drive, or a magnetic or optical device) of a device **502** having an environmental sensor **106**, such that, when the instructions are executed on a processor **504** of the device **502**, cause the device **502** to apply the techniques presented herein. The exemplary system **510** comprises a current context inferring component **512** configured to infer a current context **206** of the user **102** by receiving, from the environmental sensor **106**, at least one environmental property **202** of a current environment **506** of the user **102**, and to, from the at least one environmental property **202**, infer a current context **206** of the user **102** (e.g., according to the techniques presented in the exemplary scenario **200** of FIG. **2**). The exemplary system **510** further comprises a user interface presenting component **514** that is configured to, for respective user interface elements **304** of the user interface **302**, from an element presentation set **508** comprising at least two element presentations **306** that are respectively associated with a context **206** of the user **102**, select a selected element presentation **306** that is associated with the current context **206** of the user **102** as inferred by the current context inferring component **512**; and to present the selected element presentations **306** of the user interface elements **304** of the user interface **302** to the user **102**. In this manner, the interoperating components of the exemplary system **510** enable the presentation of the user interface **302** in a manner that is dynamically adjusted based on the inference of the current context **206** of the user **102** in accordance with the techniques presented herein.

[0026] Still another embodiment involves a computer-readable medium comprising processor-executable instructions configured to apply the techniques presented herein. Such computer-readable media may include, e.g., computer-readable storage media involving a tangible device, such as a memory semiconductor (e.g., a semiconductor utilizing static random access memory (SRAM), dynamic random access memory (DRAM), and/or synchronous dynamic random access memory (SDRAM) technologies), a platter of a hard disk drive, a flash memory device, or a magnetic or optical disc (such as a CD-R, DVD-R, or floppy disc), encoding a set of computer-readable instructions that, when executed by a processor of a device, cause the device to implement the techniques presented herein. Such computer-readable media may also include (as a class of technologies that are distinct from computer-readable storage media) various types of communications media, such as a signal that may be propagated through various physical phenomena (e.g., an electromagnetic signal, a sound wave signal, or an optical signal) and in various wired scenarios (e.g., via an Ethernet or fiber optic cable) and/or wireless scenarios (e.g., a wireless local area network (WLAN) such as WiFi, a personal area network (PAN) such as Bluetooth, or a cellular or radio network), and which encodes a set of computer-readable instructions that, when executed by a processor of a device, cause the device to implement the techniques presented herein.

[0027] An exemplary computer-readable medium that may be devised in these ways is illustrated in FIG. **6**, wherein the implementation **600** comprises a computer-readable medium **602** (e.g., a CD-R, DVD-R, or a platter of a hard disk drive), on which is encoded computer-readable data **604**. This computer-readable data **604** in turn comprises a set of computer instructions **606** configured to operate according to the principles set forth herein. In one such embodiment, the processor-executable instructions **606** may be configured to perform a method of adjusting a user interface **302** inferring user context of a user **102** based on environmental properties, such as the exemplary method **510** of FIG. **5**. In another such embodiment, the processor-executable instructions **506** may be configured to implement a system for inferring physical activities of a user based on environmental properties, such as the exemplary system of FIG. **5**. Some embodiments of this computer-readable medium may comprise a nontransitory computer-readable storage medium (e.g., a hard disk drive, an optical disc, or a flash memory device) that is configured to store processor-executable instructions configured in this manner. Many such computer-readable media may be

devised by those of ordinary skill in the art that are configured to operate in accordance with the techniques presented herein.

D. VARIATIONS

[0028] The techniques discussed herein may be devised with variations in many aspects, and some variations may present additional advantages and/or reduce disadvantages with respect to other variations of these and other techniques. Moreover, some variations may be implemented in combination, and some combinations may feature additional advantages and/or reduced disadvantages through synergistic cooperation. The variations may be incorporated in various embodiments (e.g., the exemplary method **400** of FIG. **4** and the exemplary system **510** of FIG. **5**) to confer individual and/or synergistic advantages upon such embodiments.

[0029] D1. Scenarios

[0030] A first aspect that may vary among embodiments of these techniques relates to the scenarios wherein such techniques may be applied.

[0031] As a first variation of this first aspect, the techniques presented herein may be used with many types of devices **104**, including mobile phones, tablets, personal information manager (PIM) devices, portable media players, portable game consoles, and palmtop or wrist-top devices. Additionally, these techniques may be implemented by a first device that is in communication with a second device that is attached to the user **102** and comprises the environmental sensors **106**. The first device may comprise, e.g., a physical activity identifying server, which may evaluate the environmental properties **202** provided by the first device, arrive at an inference **204** of a current context **206**, and inform the first device of the inferred current context **206**.

[0032] As a second variation of this first aspect, the techniques presented herein may be used with many types of environmental sensors **106** providing many types of environmental properties **202** about the environment of the user **102**. For example, the environmental properties **202** may be generated by one or more environmental sensors **106** selected from an environmental sensor set comprising a global positioning system (GPS) receiver configured to detect a geolocation, a linear velocity, and/or an acceleration; a gyroscope configured to detect an angular velocity; a touch sensor configured to detect touch input that does not comprise user input (e.g., an accidental touching of a touch-sensitive display, such as the palm of a device who is holding the device); a wireless communication signal sensor configure to detect a wireless communication signal (e.g., a cellular signal strength, which may be indicative of the distance of the device **104** from a wireless communication signal source at a known location); a gyroscope or accelerometer configured to detect a device orientation (e.g., a tilt impulse, or vibration level); an optical sensor, such as a camera, configured to detect a visibility level (e.g., an ambient light level); a microphone configured to detect a noise level of the environment; a magnetometer configured to detect a magnetic field; and a climate sensor configured to detect a climate condition of the location of the device **104**, such as temperature or humidity. A combination of such environmental sensors **106** may enable a set of overlapping and/or discrete environmental properties **202** that provide a more robust indication of the current context **206** of the user **102**. These and other types of contexts **206** may be inferred in accordance with the techniques presented herein.

[0033] D2. Context Inference Properties

[0034] A second aspect that may vary among embodiments of these techniques relates to the types of information utilized to reach an inference **204** of a current context **206** from one or more environmental properties **202**.

[0035] As a first variation of this second aspect, the inference **204** of the current context **206** of the user **102** may include many types of current contexts **206**. For example, the inferred current context **206** may include the location type of the location of the device **104** (e.g., whether the location of the user **102** and/or device **104** is identified as the home of the user **102**, the workplace of the user **102**, a street, a park, or a particular type of store). As a second example, the inferred current context **206** may include a mode of transport of a user **102** who is in motion (e.g., whether the user **102** is walking, jogging, riding a bicycle, driving or riding a car, riding on a bus or train, or riding in an airplane). As a third example, the inferred current context **206** may include an attention availability of the user **102** (e.g., whether the user **102** is idle and may be readily notified by the device **104**; whether the user **102** is active, such that interruptions by the device **104** are to be reserved for significant events; and whether the user **102** is engaged in an uninterruptible activity, such that element presentations **306** that interrupt the user **102** are to be avoided). As a fourth example, the inferred current context **206** may include a privacy condition of the user **102** (e.g., if the user **102** is alone, the device **104** may present sensitive information and may utilize voice input and output; but if the user **102** is in a crowded location, the device **104** may avoid presenting sensitive information and may utilize input and output modalities other than voice). As a fifth example, the device **104** may infer a physical activity of the user **102** that does not comprise user input directed by the user **102** to the device **104**, such as a distinctive pattern of vibrations indicating that the user **102** is jogging.

[0036] As a second variation of this second aspect, the techniques presented herein may enable the inference **204** of many types of contexts **206** of the user **102**. As a first example, a walking context **206** may be inferred from a regular set of impulses of a medium magnitude and/or a speed of approximately four kilometers per hour. As a second example, a jogging context **206** may be inferred from a faster and higher-magnitude set of impulses and/or a speed of approximately six kilometers per hour. As a third example, a standing context **206** may be inferred from a zero velocity, neutral impulse readings from an accelerometer, a vertical tilt orientation of the device **104**, and optionally a dark reading from a light sensor indicating the presence of the device in a hip pocket, while a sitting context **206** may provide similar environmental properties **202** but may be distinguished by a horizontal tilt orientation of the device **104**. As a fourth example, a swimming physical activity may be inferred from an impedance metric indicating the immersion of the device **104** in water. As a fifth example, a bicycling context **206** may be inferred from a regular circular tilt motion indicating a stroke of an appendage to which the device **104** is attached and a speed exceeding typical jogging speeds. As a sixth example, a vehicle riding context **206** may be inferred from a background vibration (e.g., created by uneven road surfaces) and a high speed. Moreover, in some such examples, the device **104** may further infer, along with a vehicle riding physical activity, at least one vehicle type that, when the vehicle riding physical activity is performed by the user **102** while attached to the device and while the user **102** is riding in a vehicle of the vehicle type, results in the environmental property **202**. For example, the

velocity, rate of acceleration, and magnitude of vibration may distinguish when the user **102** is riding on a bus, in a car, or on a motorcycle.

[0037] As a third variation of this second aspect, many types of additional information may be evaluated together with the environmental properties **202** to infer the current context **206** of the user **102**. As a first example, the device **104** may have access to a user profile of the user **102**, and may use the user profile to facilitate the inference of the current context **206** of the user **102**. For example, if the user **102** is detected to be riding in a vehicle, the device **104** may refer to a user profile of the user **102** to determine whether the user is controlling the vehicle or is only riding in the vehicle. As a second example, if the device **104** is configured to detect a geolocation, the device **104** may distinguish between a transient presence at a particular location (e.g., within a range of coordinates) from a presence of the device **104** at the location for a duration exceeding a duration threshold. For instance, different types of inferences may be derived based on whether the user **102** passes through a location such as a store or remains at the store for more than a few minutes. As a third example, the device **104** may be configured to receive a second current context **206** indicating the activity of a second user **102** (e.g., a companion of the first user **102**), and may infer the current context **206** of the first user **102** in view of the current context **206** of the second user **102** as well as the environmental properties of the first user **102**. As a fourth example, the device **104** that utilizes a geolocation of the user **102** may further identify the type of location, e.g., by querying a mapping service with a request to provide at least one location descriptor describing the location of the user **102** (e.g., a residence, an office, a store, a public street, a sidewalk, or a park), and upon receiving such location descriptors, may infer the current context **206** of the user **102** in view of the location descriptors describing the user's location. These and other types of information may be utilized in implementations of the techniques presented herein.

[0038] D3. Context Inference Architectures

[0039] A third aspect that may vary among embodiments of these techniques involves the architectures that may be utilized to achieve the inference of the current context **206** of the user **102**.

[0040] As a first variation of this third aspect, the user interface **302** that is dynamically composited through the techniques presented herein may be attached to many types of processes, such as the operating system, a natively executing application, and an application executing within a virtual machine or serviced by a runtime, such as a web application executing within a web browser. The user interface **302** may also be configured to present an interactive application, such as a utility or game, or a non-interactive application, such as a comparatively static web page with content adjusted according to the current context **206** of the user **102**.

[0041] As a second variation of this third aspect, the device **104** may achieve the inference **204** of the current context **206** of the user **102** through many types of notification mechanisms. As a first example, the device may provide an environmental property querying interface, and an application may (e.g., at application launch and/or periodically thereafter) query the environmental property querying interface to receive the latest environmental properties **202** detected by the device **104**. As a second example, the device **104** may utilize an environmental property notification system that may be invoked to request with an environmental property notification service to receive detected environmental properties **202**. An application may therefore register with the environmental property notification service, and when an environmental sensor **106** detects an environmental property **202**, the environmental property notification service may send a notification thereof to the application. As a third example, the device **104** may utilize a delegation architecture, wherein an application specifies different types of user interfaces that are available for different contexts **206** (e.g., an application manifest indicating the set of element presentations **306** to be used in different contexts **206**), and an operating system or runtime of the device **104** may dynamically select and adjust the element presentations **306** of the user interface **302** of the application as the inference of the current context **206** of the user **102** is achieved and changes.

[0042] As a third variation of this third aspect, the device **104** may utilize an external services to facilitate the inference **204**. As a first interact with the user **102** to determine the context **206** represented by a set of environmental properties **202**. For example, if the environmental properties **202** are difficult to correlate with any currently identified context **206**, or if the user **102** performs a currently identified context **206** in a peculiar or user-specific manner that leads to difficult-to-infer environmental properties **202**, the device **104** may ask the user **102**, or a third user (e.g., as part of a "mechanical Turk" solution), to identify the current context **206** resulting in the reported environmental properties **202**. Upon receiving a user identification of the current context **206**, the device **104** may adjust the classifier logic in order to achieve a more accurate identification of the context **206** of the user **102** upon next encountering similar environmental properties **202**.

[0043] As a fourth variation of this third aspect, the inference of the current context **206** may be automatically achieved through many techniques. As a first such example, a system may comprise a context inference map that correlates respective set of environmental properties **202** with a context **206** of the user **102**. The context inference map may be provided by an external service, specified by a user, or automatically inferred, and the device **104** may store the context inference map and refer to it to infer the current context **206** of the user **104** from the current set of environmental properties **202**. This variation may be advantageous, e.g., for enabling a computationally efficient detection that reduces the ad hoc computation and expedites the inference for use in realtime environments. As a first such example, the device **104** may utilize one or more physical activity profiles that are configured to correlate environmental properties **202** with a current context **206**, and that may be invoked to select a physical activity profile matching the environmental properties **202** in order to infer the current context **206** of the user **102**. As a second such example, the device **104** may comprise a set of one or more physical activity profiles that respectively indicate a value or range of an environmental property **202** that may enable an inference **204** of the current context **206** (e.g., a specified range of accelerometer impulses and speed indicating a jogging context **206**). The physical activity profiles may be generated by a user **102**, automatically generated by one or more statistical correlation techniques, and/or a combination thereof, such as user manual tuning of automatically generated physical activity profiles. The device **104** may then infer the current context **206** by comparing a set of collected environmental properties **202** with those of the physical activity profiles in order to identify a selected physical activity profile. As a third such example, the device **104** may comprise

an ad hoc classification technique, e.g., an artificial neural network or a Bayesian statistical classifier. For instance, the device **104** may comprise a training data set that identifies sets of environmental properties **202** as well as the context **206** resulting in such environmental properties **202**. The classifier logic may be trained using the training data set until it is capable of recognizing such contexts **206** with an acceptable accuracy. As a fourth such example, the device **104** may delegate the inference to an external service; e.g., the device **104** may send the environmental properties **202** to an external service, which may return the context **206** inferred for such environmental properties **202**.

[0044] As a fifth variation of this third aspect, the accuracy of the inference **204** of the current context **206** may be refined during use by feedback mechanisms. As a first such example, respective contexts **206** may be associated with respective environmental properties **202** according to an environmental property significance, indicating the significance of the environmental property to the inference **204** of the current context **206**. For example, a device **104** may comprise an accelerometer and a GPS receiver. A vehicle riding context **206** may place higher significance on the speed detected by the GPS receiver than the accelerometer (e.g., if the user device **104** is moving faster than speeds achievable by an unassisted human, the vehicle riding context **206** may be automatically selected). As a second such example, a specific set of highly distinctive impulses may be indicative of a jogging context **206** at a variety of speeds, and thus may place high significance on the environmental properties **202** generated by the accelerometer than those generated by the GPS receiver. The inference **204** performed by the classifier logic may accordingly weigh the environmental properties **202** according to the environmental property significances for respective contexts **206**. These and other variations in the inference architectures may be selected according to the techniques presented herein.

[0045] D4. Element Presentation

[0046] A fourth aspect that may vary among embodiments of these techniques relates to the selection and use of the element presentations of respective user interface elements **304** of a user interface **302**.

[0047] As a first variation of this fourth aspect, at least one user interface element **304** may utilize a range of element presentations **306** reflecting different element input modalities and/or output modalities. As a first such example, in order to suit a particular current context **206** of the user **104**, a user interface element **304** may present a text input modality (e.g., a software keyboard); a manual pointing input modality (e.g., a point-and-click); a device orientation input modality (e.g., a tilt or shake interface); a manual gesture input modality (e.g., a touch or air gesture interface); a voice input modality (e.g., a keyword-based or natural-language speech interpreter); and a gaze tracking input modality (e.g., an eye-tracking interpreter). As a second such example, in order to suit a particular current context **206** of the user **104**, a user interface element **304** may present a textual visual output modality (e.g., a body of text); a graphical visual output modality (e.g., a set of icons, pictures, or graphical symbols); a voice output modality (e.g., a text-to-speech interface); an audible output modality (e.g., a set of audible cues); and a tactile output modality (e.g., a vibration or heat indicator).

[0048] As a second variation of this fourth aspect, at least one user interface element **304** comprising a visual element presentation that is presented on a display of the device **104** may be visually adapted based on the current context **206** of the user **102**. As a first example of this second variation, the visual size of elements may be adjusted for presentation on the display (e.g., adjusting a text size, or adjusting the sizes of visual controls, such as using small controls that may be precisely selected in a stationary environment and large controls that may be selected in mobile, inaccurate input environments). As a second example of this second variation, the device **104** may adjust a visual element count of the user interface **302** in view of the current context **206** of the user **102**, e.g., by showing more user interface elements **304** in contexts where the user **102** has plentiful available attention, and a reduced set of user interface elements **304** in contexts where the attention of the user **102** is to be conserved.

[0049] As a third variation of this fourth aspect, the content presented by the device **104** may be adapted to the current context **206** of the user **102**. As a first such example, upon inferring a current context **206** of the user **102**, the device **104** may select for presentation an application that is suitable for the current context **206** (e.g., either by initiating an application matching that context **206**; by bringing an application associated with that context **206** to the foreground; or simply by notifying an application **206** associated with the context **206** that the context **206** has been inferred). As a second such example, the content presented by the user interface **302** may be adapted to suit the inferred current context **206** of the user **102**. For example, the content presentation of one or more element presentations **306** may be adapted, e.g., by presenting more extensive information when the attention of the user **102** is readily available, and by presenting a reduced and/or relevance-filtered set of information when the attention of the user **102** is to be conserved (e.g., by summarizing the information or presenting only the information that is relevant to the current context **206** of the user **102**).

[0050] As a fourth variation of this fourth aspect, as the inference of the context **206** changes from a first current context **206** to a second current context **206**, the device **102** may dynamically recompose the user interface **302** of an application to suit the different current contexts **206** of the user **104**. For example, for a particular user interface element **304**, the user interface may switch from a first element presentation **306** (suitable for the first current context **206**) to a second element presentation **306** (suitable for the second current context **206**). Moreover, the device **104** may present a visual transition therebetween; e.g., upon a switching from a stationary context **206** to a mobile context **206**, a mapping application may fade out a text entry user interface (e.g., a text keyboard) and fade in a visual control for a voice interface (e.g., a list of recognized speech keywords). These and other types of element presentations **306** may be selected for the user interface elements **304** of the user interface **302** in accordance with the techniques presented herein.

E. COMPUTING ENVIRONMENT

[0051] FIG. **7** and the following discussion provide a brief, general description of a suitable computing environment to implement embodiments of one or more of the provisions set forth herein. The operating environment of FIG. **7** is only one example of a suitable operating environment and is not intended to suggest any limitation as to the scope of use or functionality of the operating environment. Example computing devices include, but are not limited to, personal computers, server computers, hand-held or laptop devices, mobile devices (such as mobile phones, Personal Digital Assistants

(PDAs), media players, and the like), multiprocessor systems, consumer electronics, mini computers, mainframe computers, distributed computing environments that include any of the above systems or devices, and the like.

[0052] Although not required, embodiments are described in the general context of "computer readable instructions" being executed by one or more computing devices. Computer readable instructions may be distributed via computer readable media (discussed below). Computer readable instructions may be implemented as program modules, such as functions, objects, Application Programming Interfaces (APIs), data structures, and the like, that perform particular tasks or implement particular abstract data types. Typically, the functionality of the computer readable instructions may be combined or distributed as desired in various environments.

[0053] FIG. **7** illustrates an example of a system **700** comprising a computing device **702** configured to implement one or more embodiments provided herein. In one configuration, computing device **702** includes at least one processing unit **706** and memory **708**. Depending on the exact configuration and type of computing device, memory **708** may be volatile (such as RAM, for example), non-volatile (such as ROM, flash memory, etc., for example) or some combination of the two, such as the processor set **704** illustrated in FIG. **7**.

[0054] In other embodiments, device **702** may include additional features and/or functionality. For example, device **702** may also include additional storage (e.g., removable and/or non-removable) including, but not limited to, magnetic storage, optical storage, and the like. Such additional storage is illustrated in FIG. **7** by storage **710**. In one embodiment, computer readable instructions to implement one or more embodiments provided herein may be in storage **710**. Storage **710** may also store other computer readable instructions to implement an operating system, an application program, and the like. Computer readable instructions may be loaded in memory **708** for execution by processing unit **706**, for example.

[0055] The term "computer readable media" as used herein includes computer storage media. Computer storage media includes volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information such as computer readable instructions or other data. Memory **708** and storage **710** are examples of computer storage media. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, Digital Versatile Disks (DVDs) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by device **702**. Any such computer storage media may be part of device **702**.

[0056] Device **702** may also include communication connection(s) **716** that allows device **702** to communicate with other devices. Communication connection(s) **716** may include, but is not limited to, a modem, a Network Interface Card (NIC), an integrated network interface, a radio frequency transmitter/receiver, an infrared port, a USB connection, or other interfaces for connecting computing device **702** to other computing devices. Communication connection(s) **716** may include a wired connection or a wireless connection. Communication connection(s) **716** may transmit and/or receive communication media.

[0057] The term "computer readable media" may include communication media. Communication media typically embodies computer readable instructions or other data in a "modulated data signal" such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" may include a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal.

[0058] Device **702** may include input device(s) **714** such as keyboard, mouse, pen, voice input device, touch input device, infrared cameras, video input devices, and/or any other input device. Output device(s) **712** such as one or more displays, speakers, printers, and/or any other output device may also be included in device **702**. Input device(s) **714** and output device (s) **712** may be connected to device **702** via a wired connection, wireless connection, or any combination thereof. In one embodiment, an input device or an output device from another computing device may be used as input device(s) **714** or output device(s) **712** for computing device **702**.

[0059] Components of computing device **702** may be connected by various interconnects, such as a bus. Such interconnects may include a Peripheral Component Interconnect (PCI), such as PCI Express, a Universal Serial Bus (USB), firewire (IEEE 1394), an optical bus structure, and the like. In another embodiment, components of computing device **702** may be interconnected by a network. For example, memory **708** may be comprised of multiple physical memory units located in different physical locations interconnected by a network.

[0060] Those skilled in the art will realize that storage devices utilized to store computer readable instructions may be distributed across a network. For example, a computing device **720** accessible via network **718** may store computer readable instructions to implement one or more embodiments provided herein. Computing device **702** may access computing device **720** and download a part or all of the computer readable instructions for execution. Alternatively, computing device **702** may download pieces of the computer readable instructions, as needed, or some instructions may be executed at computing device **702** and some at computing device **720**.

F. USAGE OF TERMS

[0061] Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.

[0062] As used in this application, the terms "component," "module," "system", "interface", and the like are generally intended to refer to a computer-related entity, either hardware, a combination of hardware and software, software, or software in execution. For example, a component may be, but is not limited to being, a process running on a processor, a processor, an object, an executable, a thread of execution, a program, and/or a computer. By way of illustration, both an application running on a controller and the controller can be a component. One or more components may reside within a process and/or thread of execution and a component may be localized on one computer and/or distributed between two or more computers.

[0063] Furthermore, the claimed subject matter may be implemented as a method, apparatus, or article of manufac-

ture using standard programming and/or engineering techniques to produce software, firmware, hardware, or any combination thereof to control a computer to implement the disclosed subject matter. The term "article of manufacture" as used herein is intended to encompass a computer program accessible from any computer-readable device, carrier, or media. Of course, those skilled in the art will recognize many modifications may be made to this configuration without departing from the scope or spirit of the claimed subject matter.

[0064] Various operations of embodiments are provided herein. In one embodiment, one or more of the operations described may constitute computer readable instructions stored on one or more computer readable media, which if executed by a computing device, will cause the computing device to perform the operations described. The order in which some or all of the operations are described should not be construed as to imply that these operations are necessarily order dependent. Alternative ordering will be appreciated by one skilled in the art having the benefit of this description. Further, it will be understood that not all operations are necessarily present in each embodiment provided herein.

[0065] Moreover, the word "exemplary" is used herein to mean serving as an example, instance, or illustration. Any aspect or design described herein as "exemplary" is not necessarily to be construed as advantageous over other aspects or designs. Rather, use of the word exemplary is intended to present concepts in a concrete fashion. As used in this application, the term "or" is intended to mean an inclusive "or" rather than an exclusive "or". That is, unless specified otherwise, or clear from context, "X employs A or B" is intended to mean any of the natural inclusive permutations. That is, if X employs A; X employs B; or X employs both A and B, then "X employs A or B" is satisfied under any of the foregoing instances. In addition, the articles "a" and "an" as used in this application and the appended claims may generally be construed to mean "one or more" unless specified otherwise or clear from context to be directed to a singular form.

[0066] Also, although the disclosure has been shown and described with respect to one or more implementations, equivalent alterations and modifications will occur to others skilled in the art based upon a reading and understanding of this specification and the annexed drawings. The disclosure includes all such modifications and alterations and is limited only by the scope of the following claims. In particular regard to the various functions performed by the above described components (e.g., elements, resources, etc.), the terms used to describe such components are intended to correspond, unless otherwise indicated, to any component which performs the specified function of the described component (e.g., that is functionally equivalent), even though not structurally equivalent to the disclosed structure which performs the function in the herein illustrated exemplary implementations of the disclosure. In addition, while a particular feature of the disclosure may have been disclosed with respect to only one of several implementations, such feature may be combined with one or more other features of the other implementations as may be desired and advantageous for any given or particular application. Furthermore, to the extent that the terms "includes", "having", "has", "with", or variants thereof are used in either the detailed description or the claims, such terms are intended to be inclusive in a manner similar to the term "comprising."

What is claimed is:

1. A computer-readable storage device comprising instructions that, when executed on a processor of a device having an environmental sensor, cause the device to present a user interface to a user of the device by:

receiving from the environmental sensor at least one environmental property of a current environment of the user;

from the at least one environmental property, inferring a current context of the user;

for respective user interface elements of the user interface, from at least two element presentations respectively associated with a context of the user, selecting a selected element presentation that is associated with the current context of the user; and

presenting the selected element presentations of the user interface elements of the user interface.

2. The computer-readable storage device of claim **1**, at least one of the environmental properties selected from an environmental property set comprising:

a geolocation of the device;

an orientation of the device;

a velocity of the device;

a vibration level of the device;

a noise level of a location of the device; and

a visibility level of a location of the device.

3. The computer-readable storage device of claim **1**, the current context of the user selected from a current context set comprising:

a location type of the device;

a mode of transport of the user;

an attention availability of the user;

a privacy condition of the user; and

a physical activity of the user not comprising user input directed by the user to the device.

4. The computer-readable storage device of claim **1**, at least one of the element presentations selected from an element input modality set comprising:

a text input modality;

a manual pointing input modality;

a device orientation input modality;

a manual gesture input modality;

a voice input modality; and

a gaze tracking input modality.

5. The computer-readable storage device of claim **1**, at least one of the element presentations selected from an element output modality set comprising:

a textual visual output modality;

a graphical visual output modality;

a voice output modality;

an audible output modality; and

a tactile output modality.

6. A method of presenting a user interface to a user of a device having a processor and an environmental sensor, the method comprising:

executing on the processor instructions configured to:

receive from the environmental sensor at least one environmental property of a current environment of the user;

from the at least one environmental property, infer a current context of the user;

for respective user interface elements of the user interface, from at least two element presentations respectively associated with a context of the user, select a

selected element presentation that is associated with the current context of the user; and

present the selected element presentations of the user interface elements of the user interface.

7. The method of claim **6**:

at least one environmental property comprising a location of the user; and

inferring the current context of the user comprising: inferring the current context after detecting a presence of the device at the location for a duration exceeding a duration threshold.

8. The method of claim **6**:

the instructions further configured to receive a second current context of a second user; and

inferring the current context of the user comprising: inferring the current context of the user from the at least one environmental property and the second current context of the second user.

9. The method of claim **6**:

at least one environmental property comprising a location of the user; and

inferring the current context of the user comprising:

querying a service for at least one location descriptor describing the location of the user; and

inferring the current context of the user comprising: inferring the current context of the user from the at least one environmental property and the at least one location descriptor describing the location of the user.

10. The method of claim **6**:

at least one element presentation comprising a visual element presentation to be presented on a display of the device; and

selecting the element presentation comprising: for at least one visual element presentation, selecting a visual size of the visual element presentation to be presented on the display of the device.

11. The method of claim **6**:

at least one element presentation comprising a visual element presentation to be presented on a display of the device; and

selecting the element presentation comprising: for at least one visual element presentation, selecting an element count of the user interface elements comprising the visual element presentation to be presented on the display of the device.

12. The method of claim **6**:

at least one element presentation comprising a content presentation of content; and

selecting the element presentation comprising: for at least one element presentation, adjusting the content presentation of the content presented by the element presentation.

13. The method of claim **6**, the instructions further configured to, upon inferring a second current context that is different from a first current context of the user:

for respective user interface elements of the user interface, from at least two element presentations respectively associated with a context of the user, select a selected second element presentation that is associated with the current context of the user, the selected second element presentation comprising a different element presentation than a selected first element presentation selected for the first current context; and

for respective visual elements, present a transition from the selected first element presentation for the first current context to the selected second element presentation for the second current context.

14. A system for presenting a user interface to a user of a device having a processor, a memory, and an environmental sensor, the system comprising:

a current context inferring component comprising instructions stored in the memory that, when executed on the processor, cause the device to infer a current context of the user by:

receiving from the environmental sensor at least one environmental property of a current environment of the user; and

from the at least one environmental property, infer a current context of the user; and

a user interface presenting component comprising instructions stored in the memory that, when executed on the processor, cause the device to present the user interface to the user by:

for respective user interface elements of the user interface, from at least two element presentations respectively associated with a context of the user, select a selected element presentation that is associated with the current context of the user; and

present the selected element presentations of the user interface elements of the user interface.

15. The system of claim **14**:

the environmental sensor comprising an environmental property querying interface; and

the current context inferring component configured to receive the at least one environmental property by querying the environmental property querying interface.

16. The system of claim **14**:

the environmental sensor comprising an environmental property notification service; and

the current context inferring component configured to receive the at least one environmental property by:

requesting the environmental property notification service to send a notification to the current context inferring component upon receiving an environmental property; and

receiving a notification of the environmental property from the environmental property notification service.

17. The system of claim **14**:

the system further comprising a user profile of the user; and

the current context inferring component configured to infer the current context of the user from the at least one environmental property and the user profile of the user.

18. The system of claim **14**:

the system further comprising a context inference map identifying, for respective at least one environmental properties, the current context of the user; and

the current context inferring component configured to infer the current context of the user from the at least one environmental property and the context inference map.

19. The system of claim **14**, further comprising: an application selecting component configured to, upon detecting a current context of the user, select for presentation an application that is associated with the current context of the user.

20. The system of claim **14**, the user interface presenting component configured to select the selected element presentation by:

sending the current context of the user to an element presentation selecting service; and

receiving from the element presentation selecting service the selected element presentation for the current context of the user.

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