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(54) **DIGITAL CONTENT SEARCH AND ENVIRONMENTAL CONTEXT**

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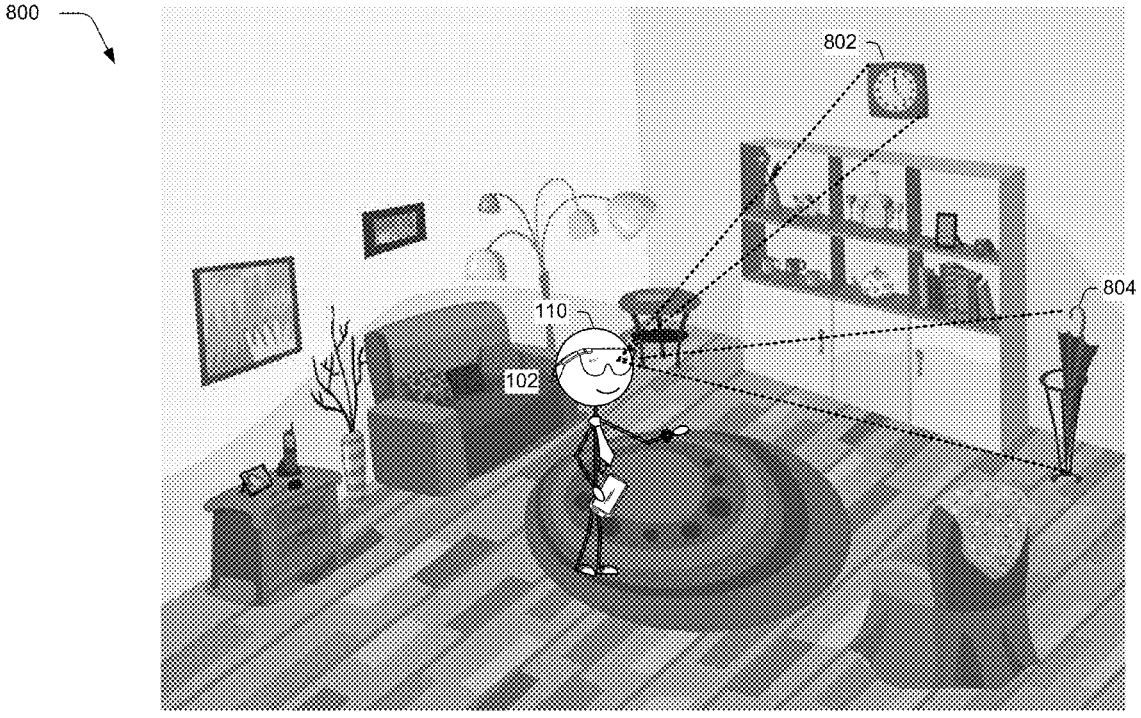
(57) **ABSTRACT**

Digital content search and environmental context techniques and systems are described. The environmental context is leveraged to provide additional information and insight into a likely goal of a textual search query input by a user. In one example, environmental conditions are leveraged to provide a search query context. In another example, environmental conditions are detected to determine a type of object that is disposed in the physical environment of a user. From this, the computing device identifies and launches an application that corresponds to the detected type of object from an image captured of the physical environment. In a further example, the environmental context is used to refine a search in response to user selection of physical objects in a physical environment of the user.



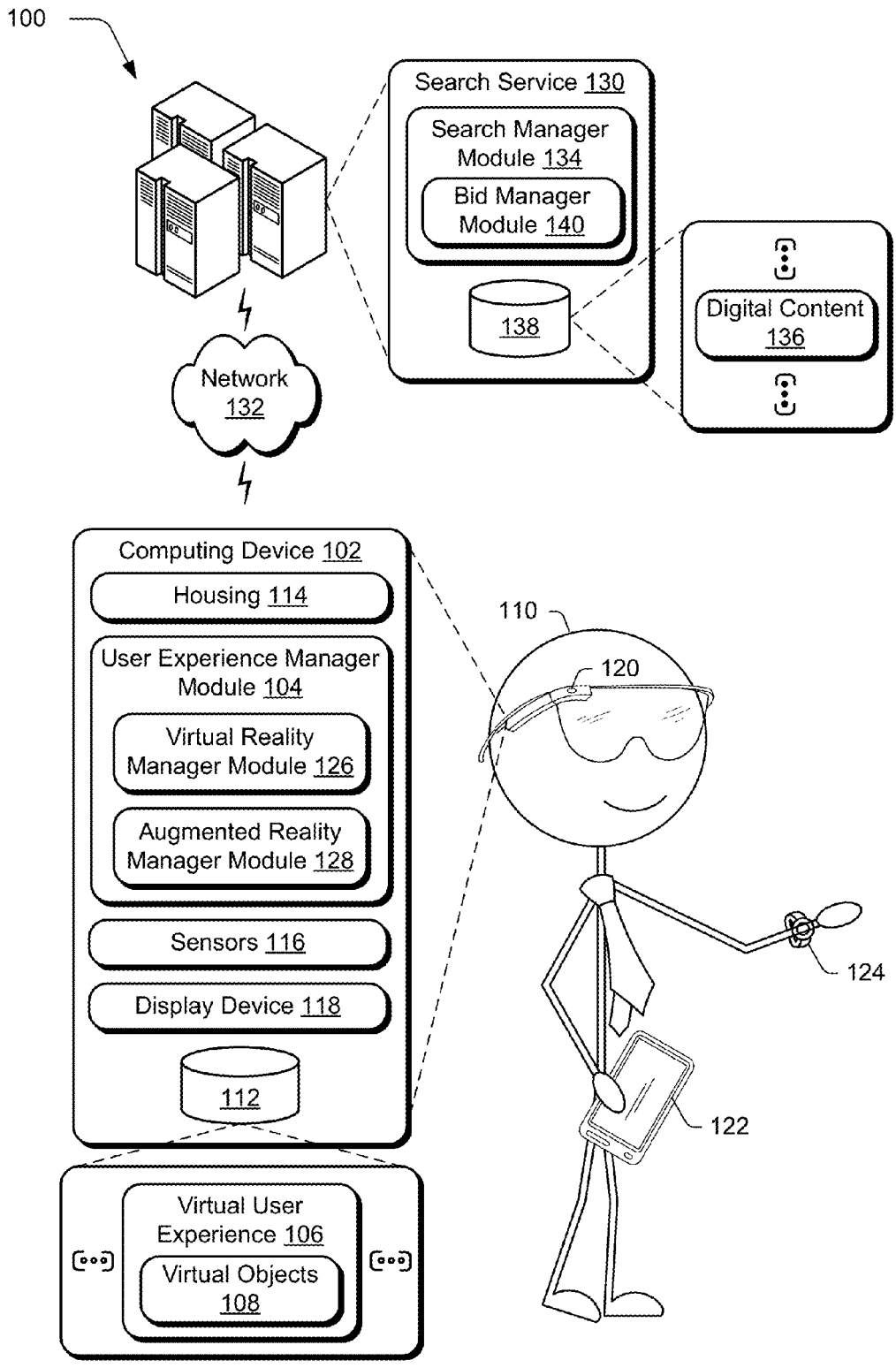

100
Search Service 130
Search Manager Module 134
Bid Manager Module 140
138
Digital Content 136
Network 132
Computing Device 102
Housing 114
User Experience Manager Module 104
Virtual Reality Manager Module 126
Augmented Reality Manager Module 128
Sensors 116
Display Device 118
112
Virtual User Experience 106
Virtual Objects 108
110
120
124
122

Fig. 1

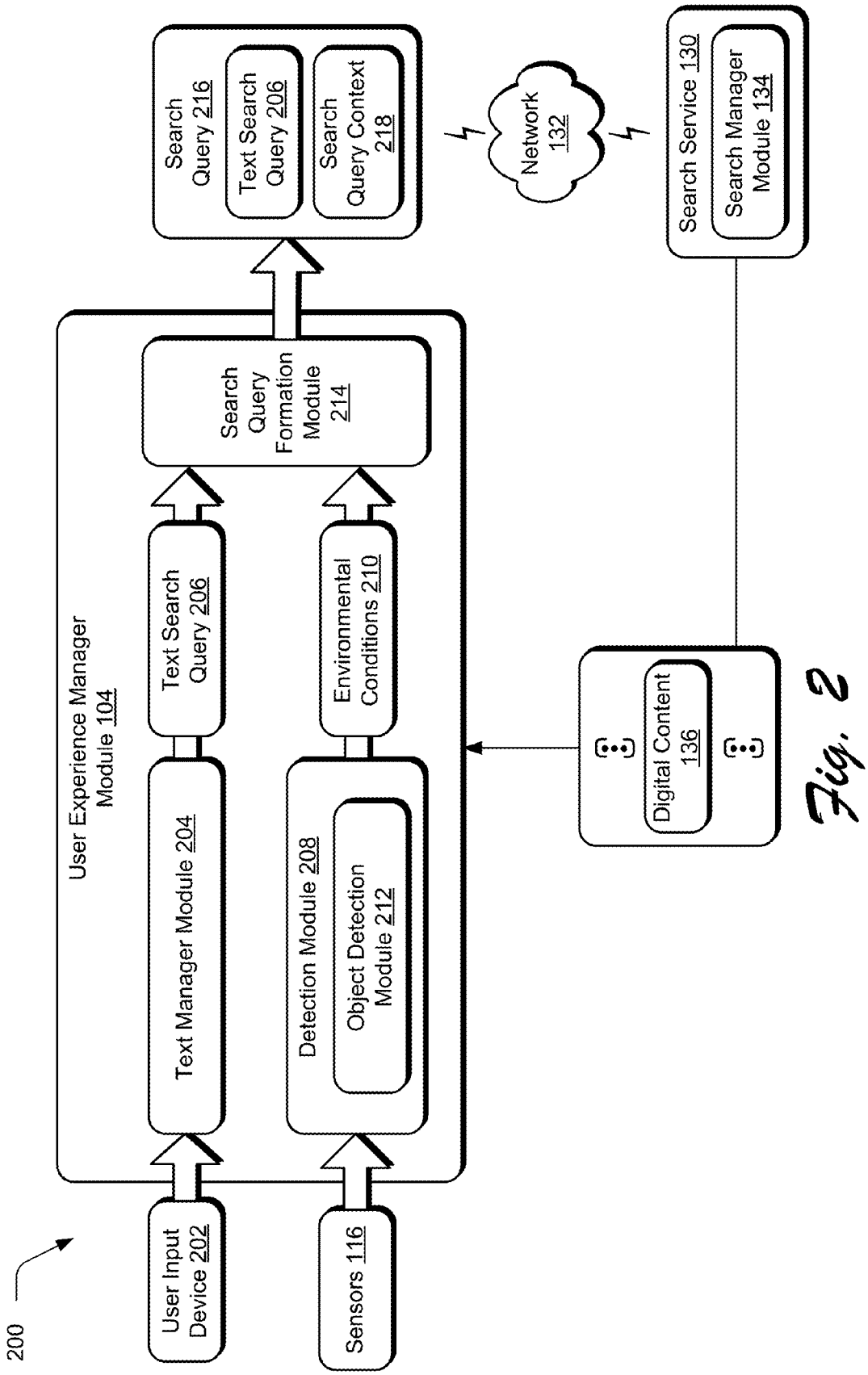

200
User Input Device 202
Sensors 116
User Experience Manager Module 104
Text Manager Module 204
Detection Module 208
Object Detection Module 212
Text Search Query 206
Environmental Conditions 210
Search Query Formation Module 214
Search Query 216
Text Search Query 206
Search Query Context 218
Network 132
Search Service 130
Search Manager Module 134
Digital Content 136

Fig. 2

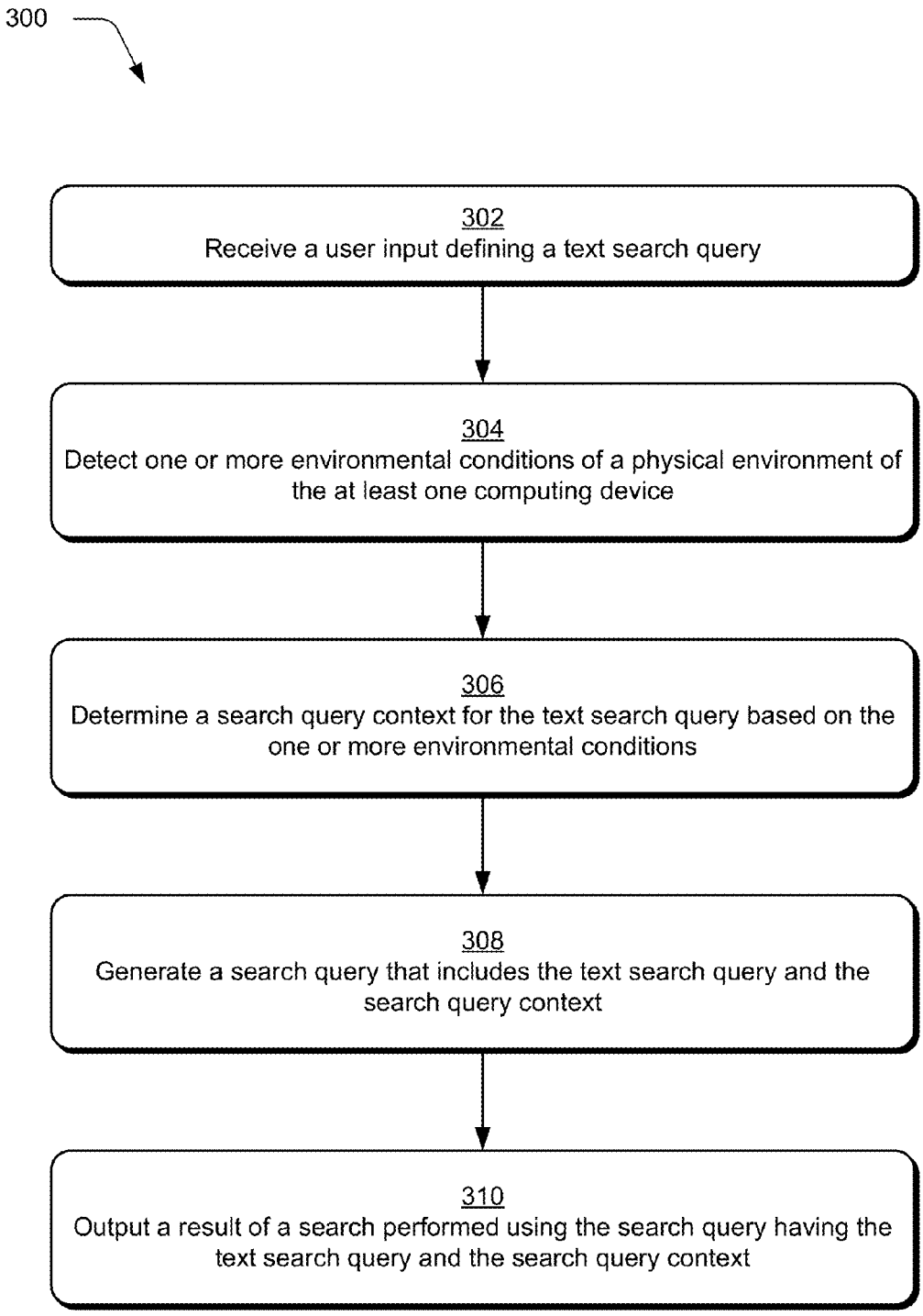

300
302
Receive a user input defining a text search query
304
Detect one or more environmental conditions of a physical environment of the at least one computing device
306
Determine a search query context for the text search query based on the one or more environmental conditions
308
Generate a search query that includes the text search query and the search query context
310
Output a result of a search performed using the search query having the text search query and the search query context

Fig. 3

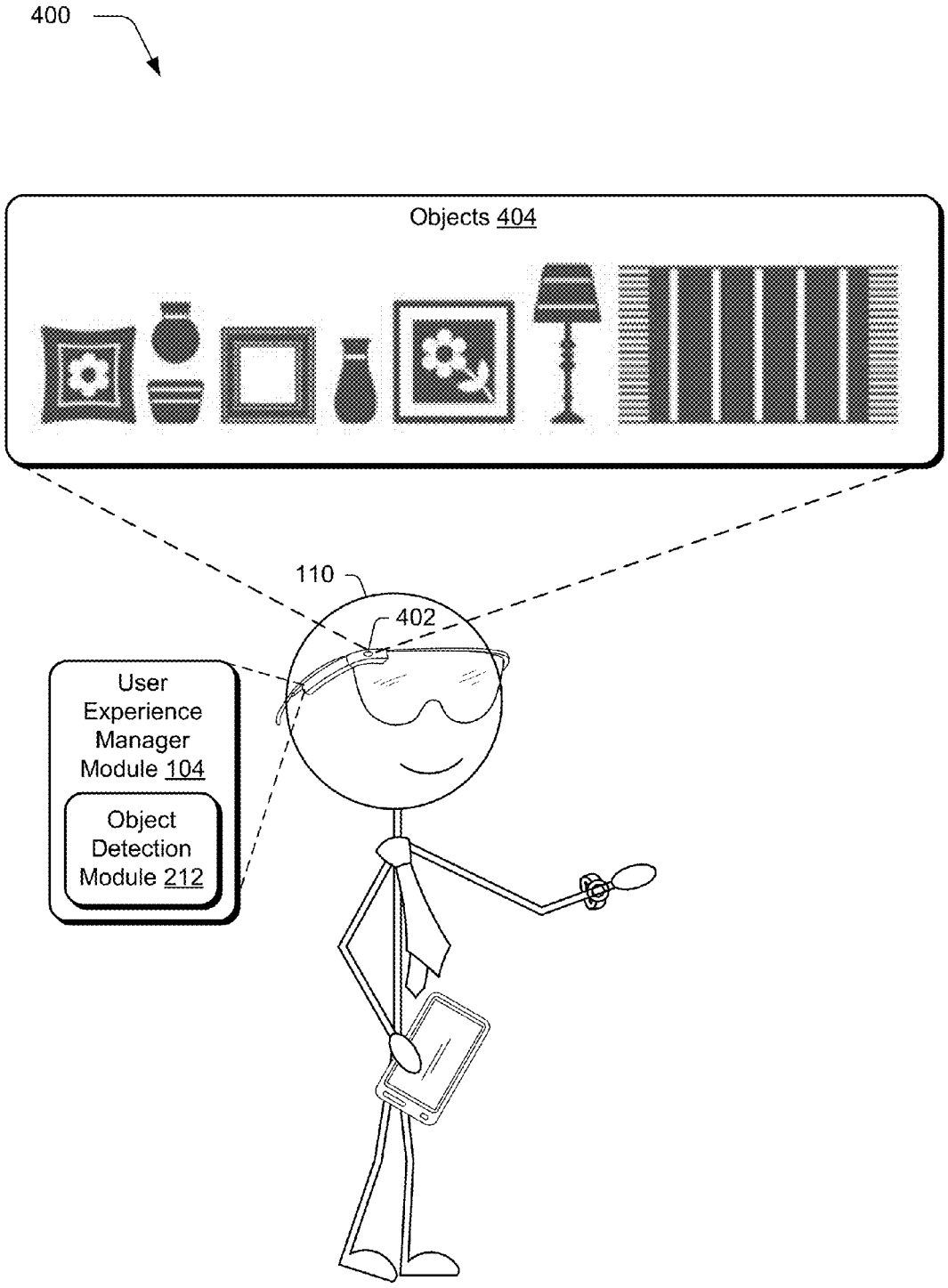

400
Objects 404
110
402
User Experience Manager Module 104
Object Detection Module 212

Fig. 4

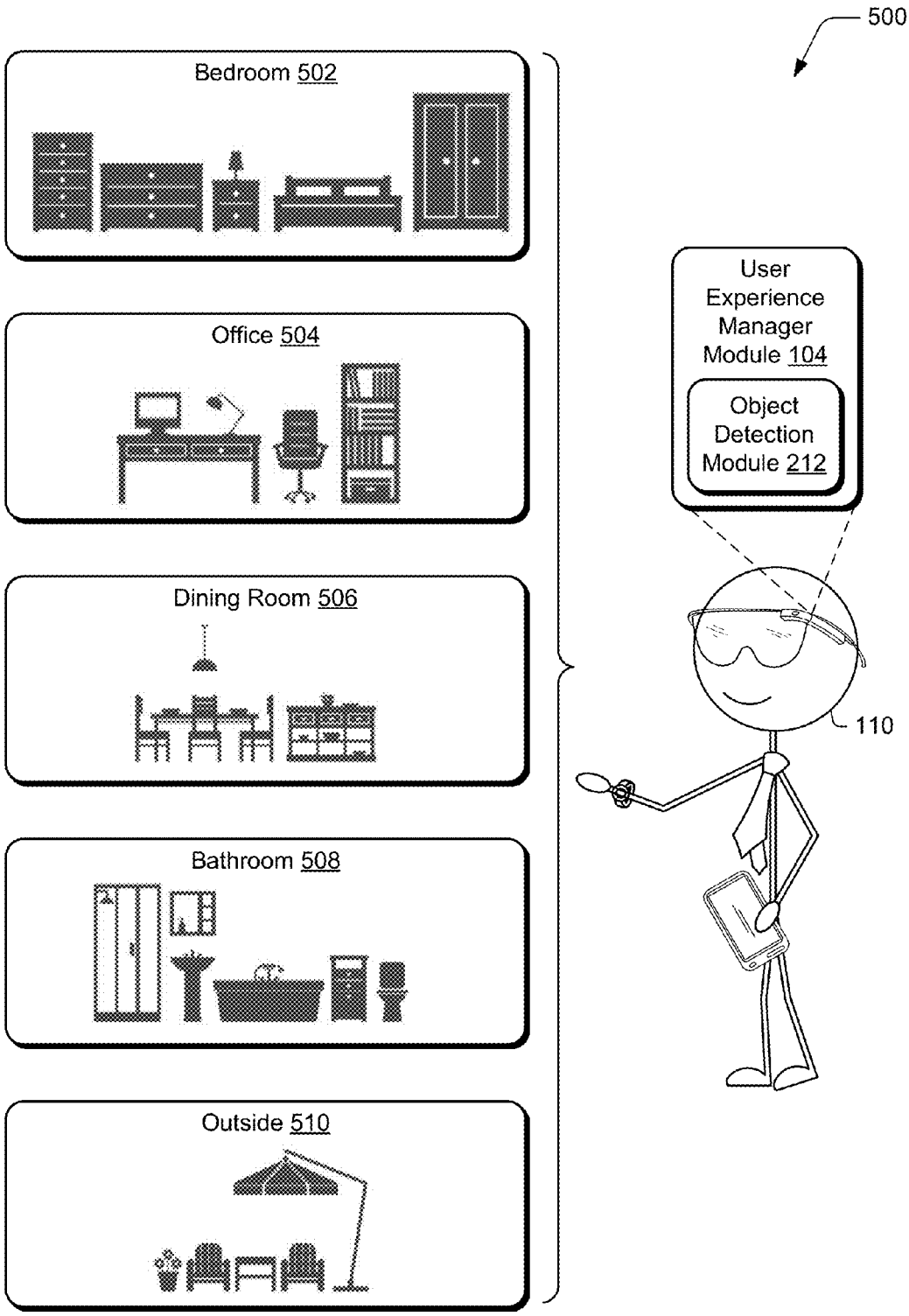

500
Bedroom 502
Office 504
Dining Room 506
Bathroom 508
Outside 510
User Experience Manager Module 104
Object Detection Module 212
110

Fig. 5

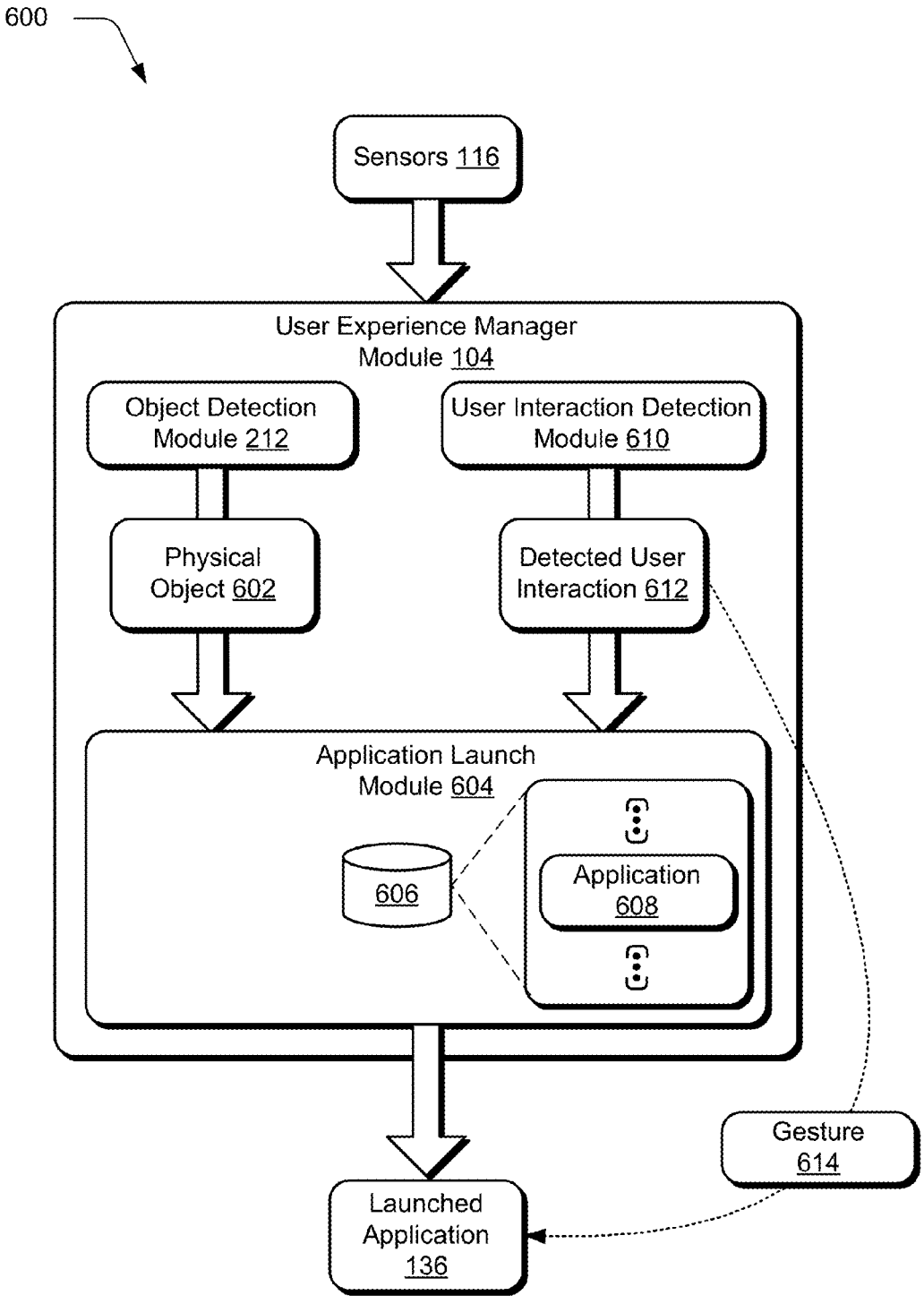

600
Sensors 116
User Experience Manager Module 104
Object Detection Module 212
User Interaction Detection Module 610
Physical Object 602
Detected User Interaction 612
Application Launch Module 604
606
Application 608
Gesture 614
Launched Application 136

Fig. 6

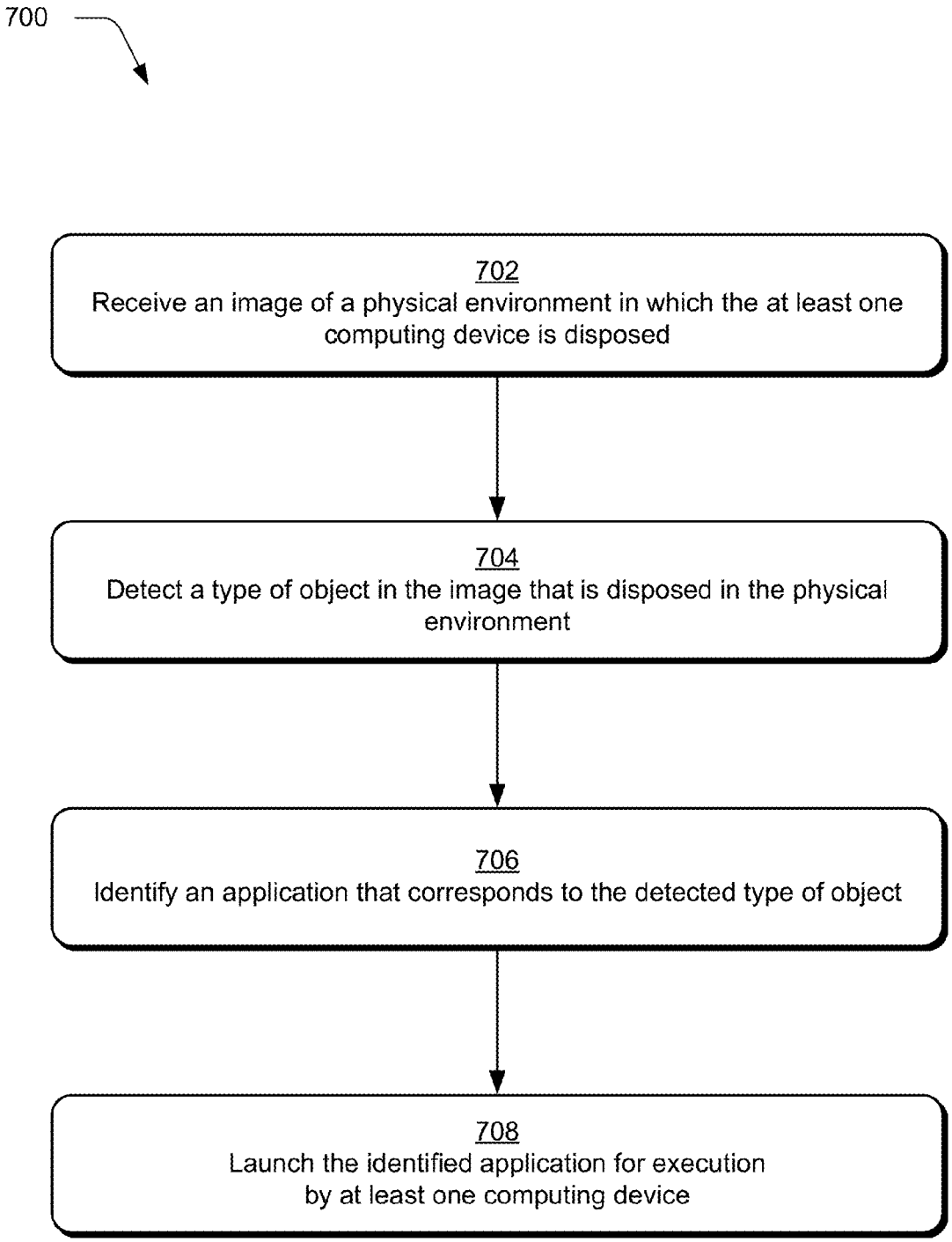

700
702
Receive an image of a physical environment in which the at least one computing device is disposed
704
Detect a type of object in the image that is disposed in the physical environment
706
Identify an application that corresponds to the detected type of object
708
Launch the identified application for execution by at least one computing device

Fig. 7

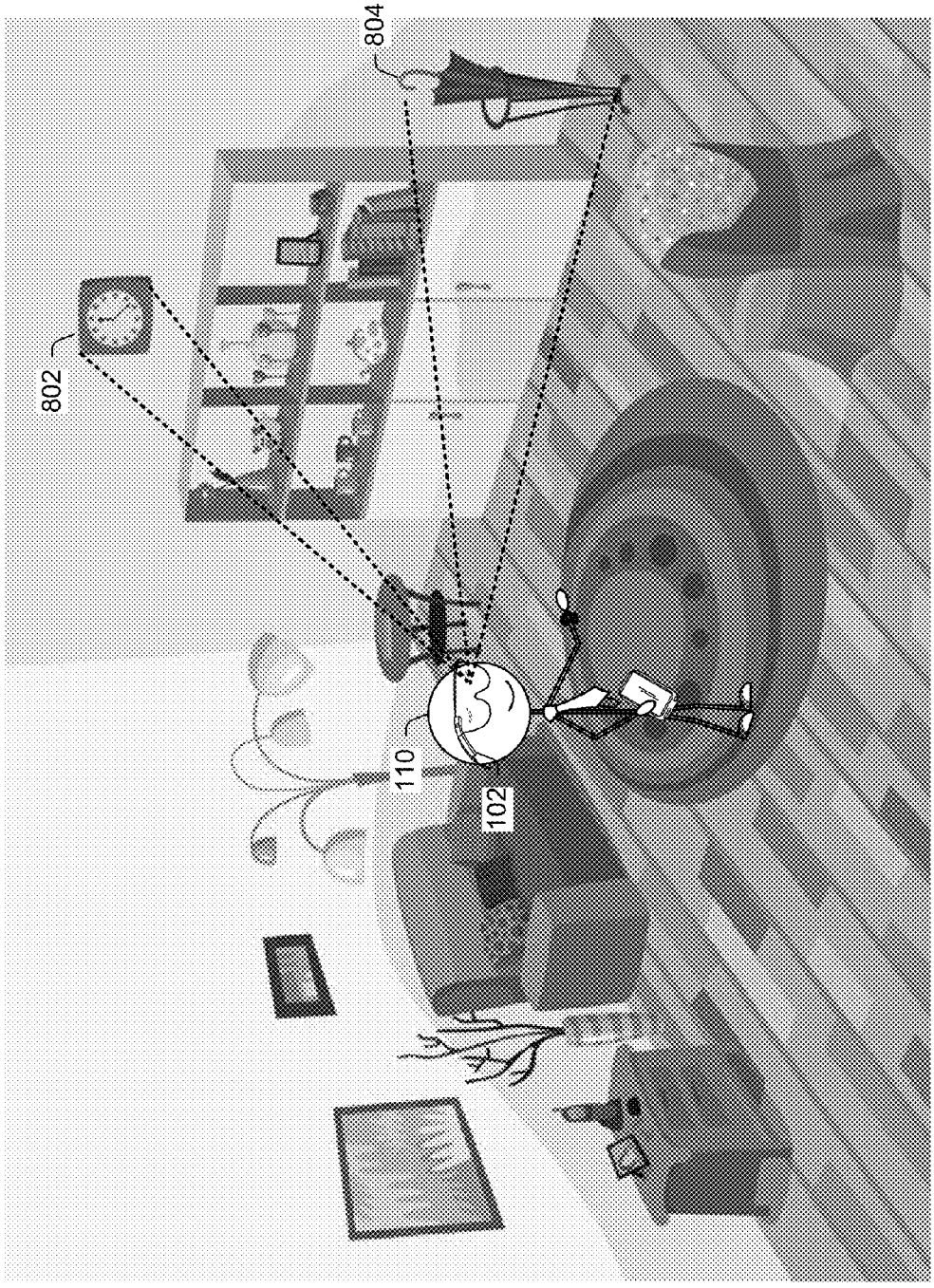


Fig. 8

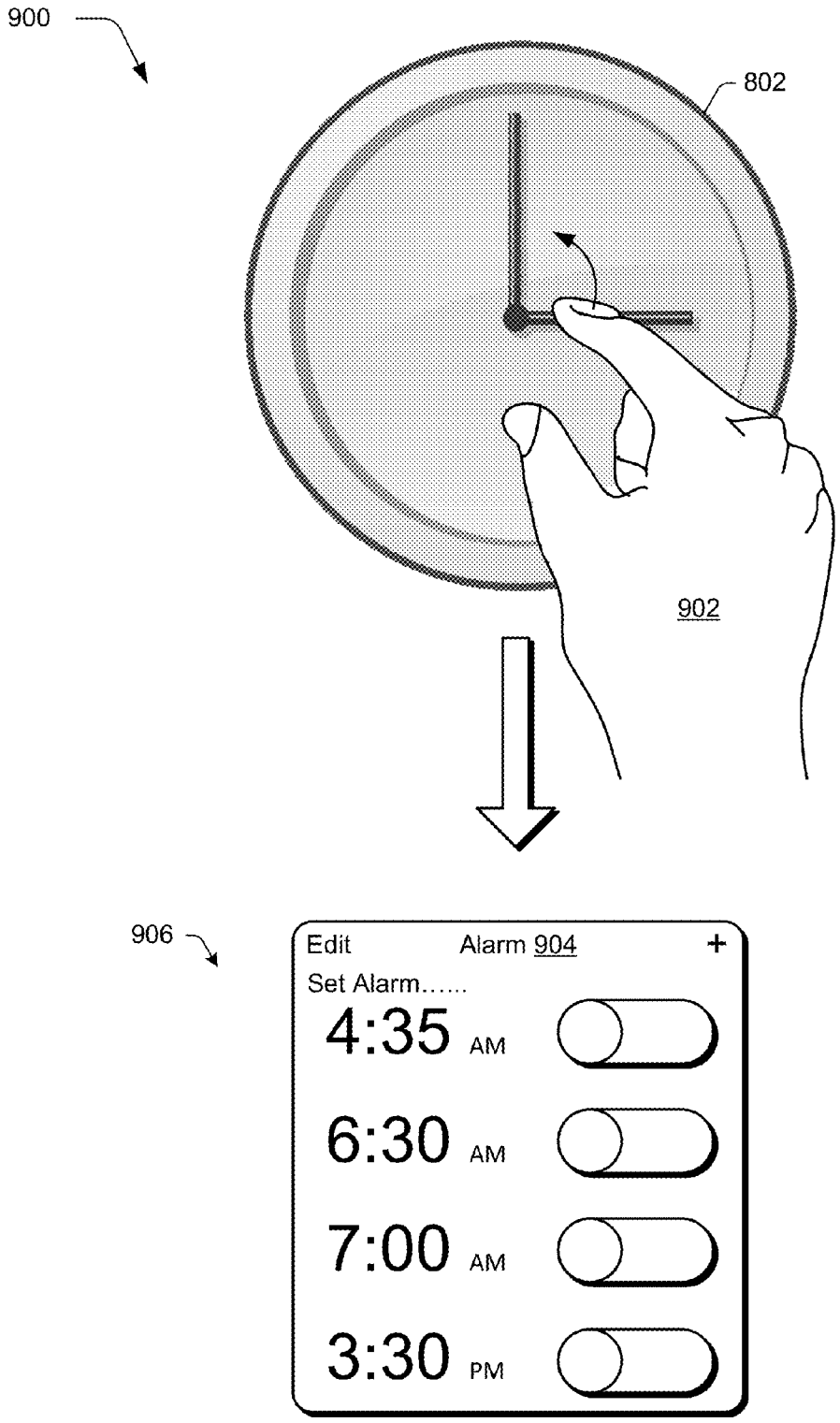

900
802
902
906
Edit
Alarm 904
+
Set Alarm.....
4:35 AM
6:30 AM
7:00 AM
3:30 PM

Fig. 9

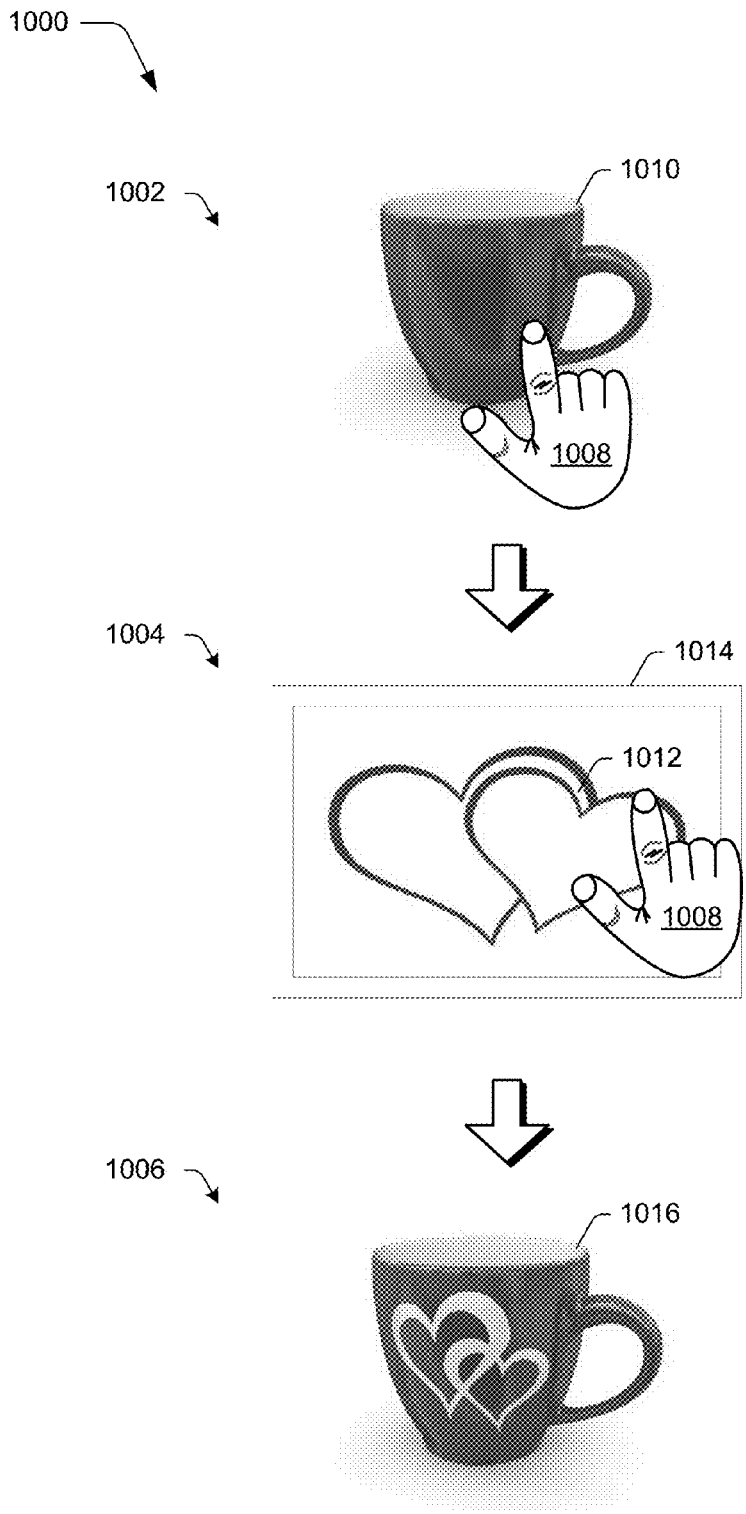


Fig. 10

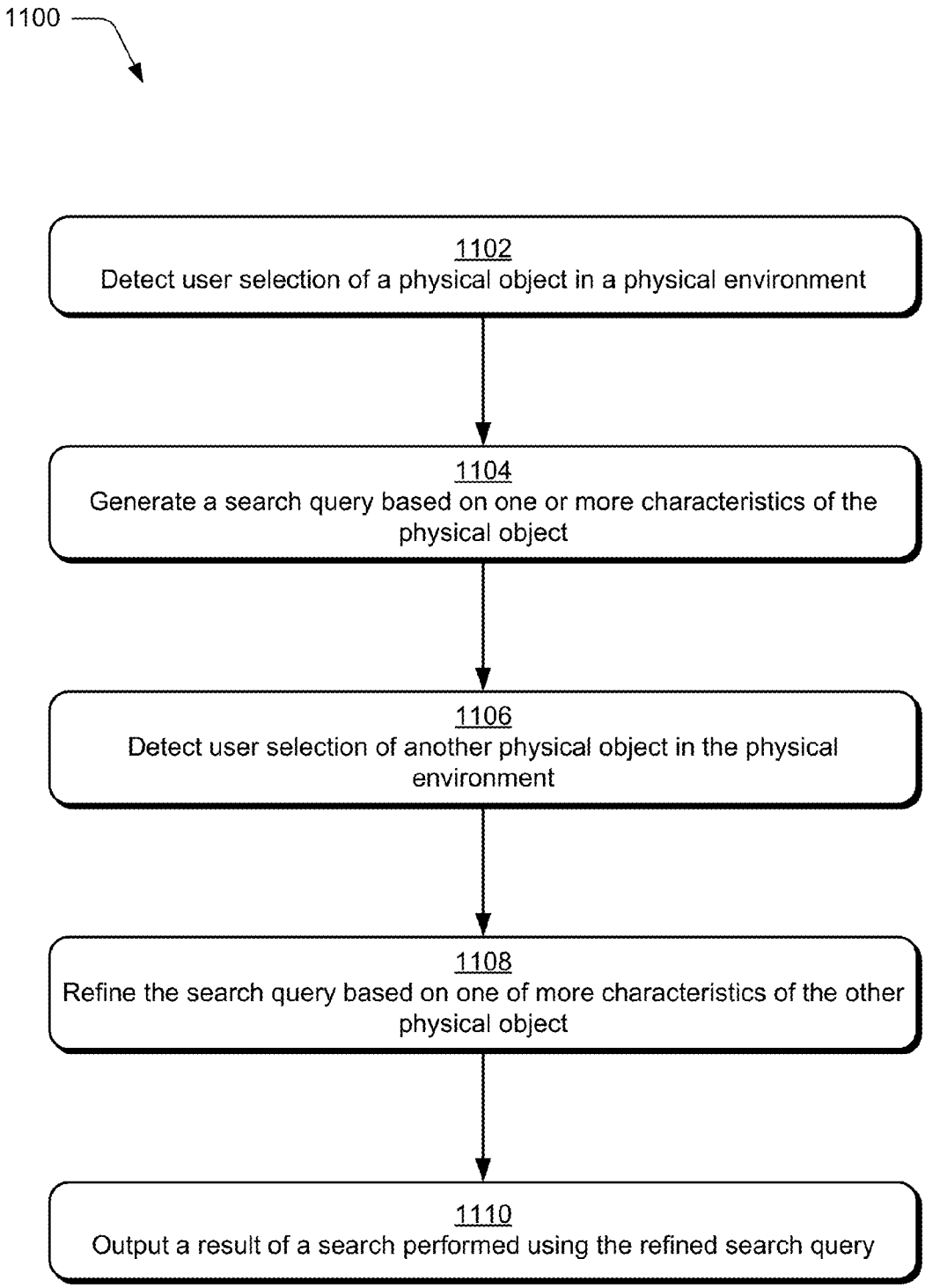

1100
1102
Detect user selection of a physical object in a physical environment
1104
Generate a search query based on one or more characteristics of the physical object
1106
Detect user selection of another physical object in the physical environment
1108
Refine the search query based on one of more characteristics of the other physical object
1110
Output a result of a search performed using the refined search query

Fig. 11

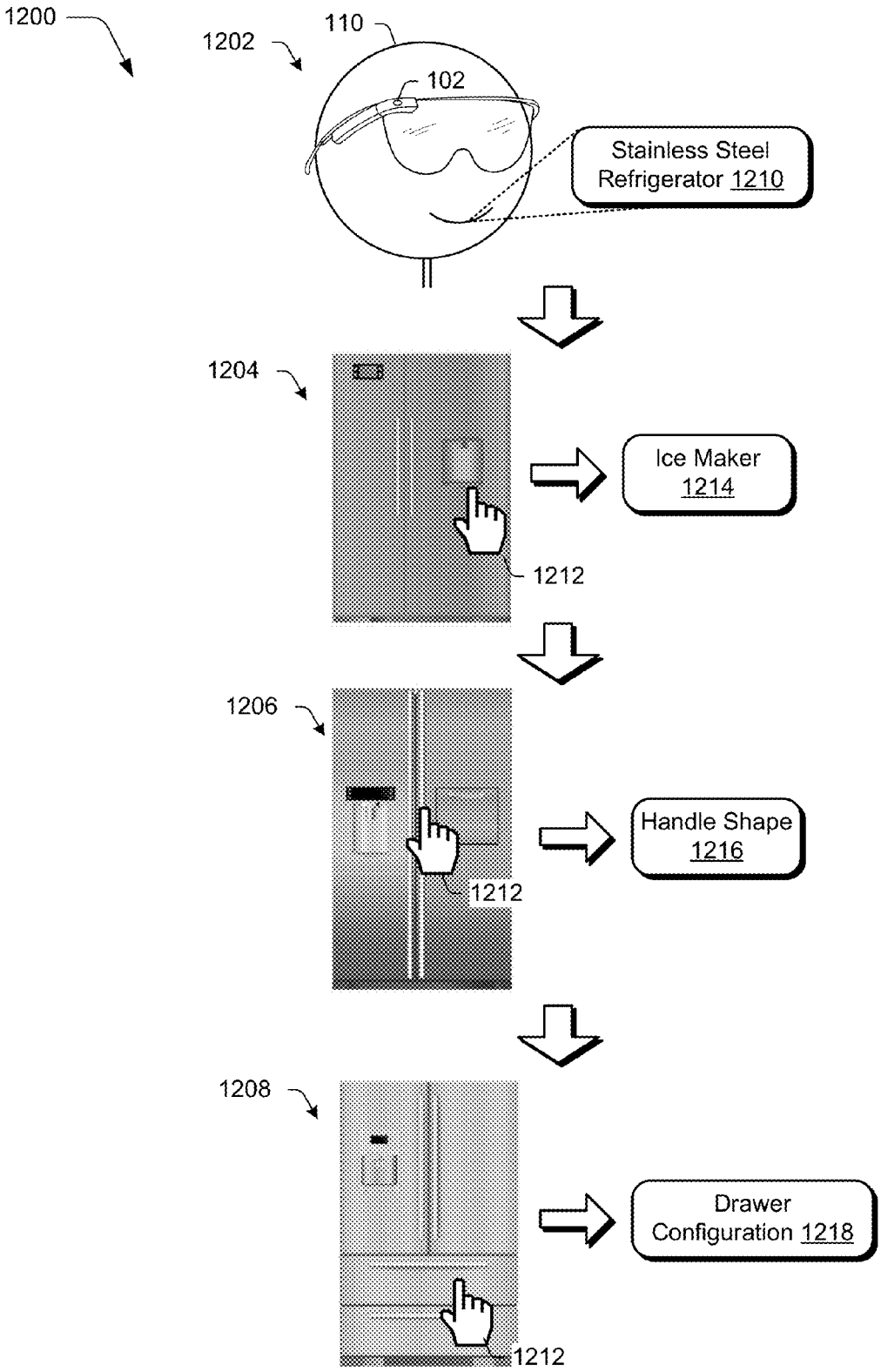

1200
1202
110
102
Stainless Steel Refrigerator 1210
1204
Ice Maker 1214
1212
1206
Handle Shape 1216
1212
1208
Drawer Configuration 1218
1212

Fig. 12

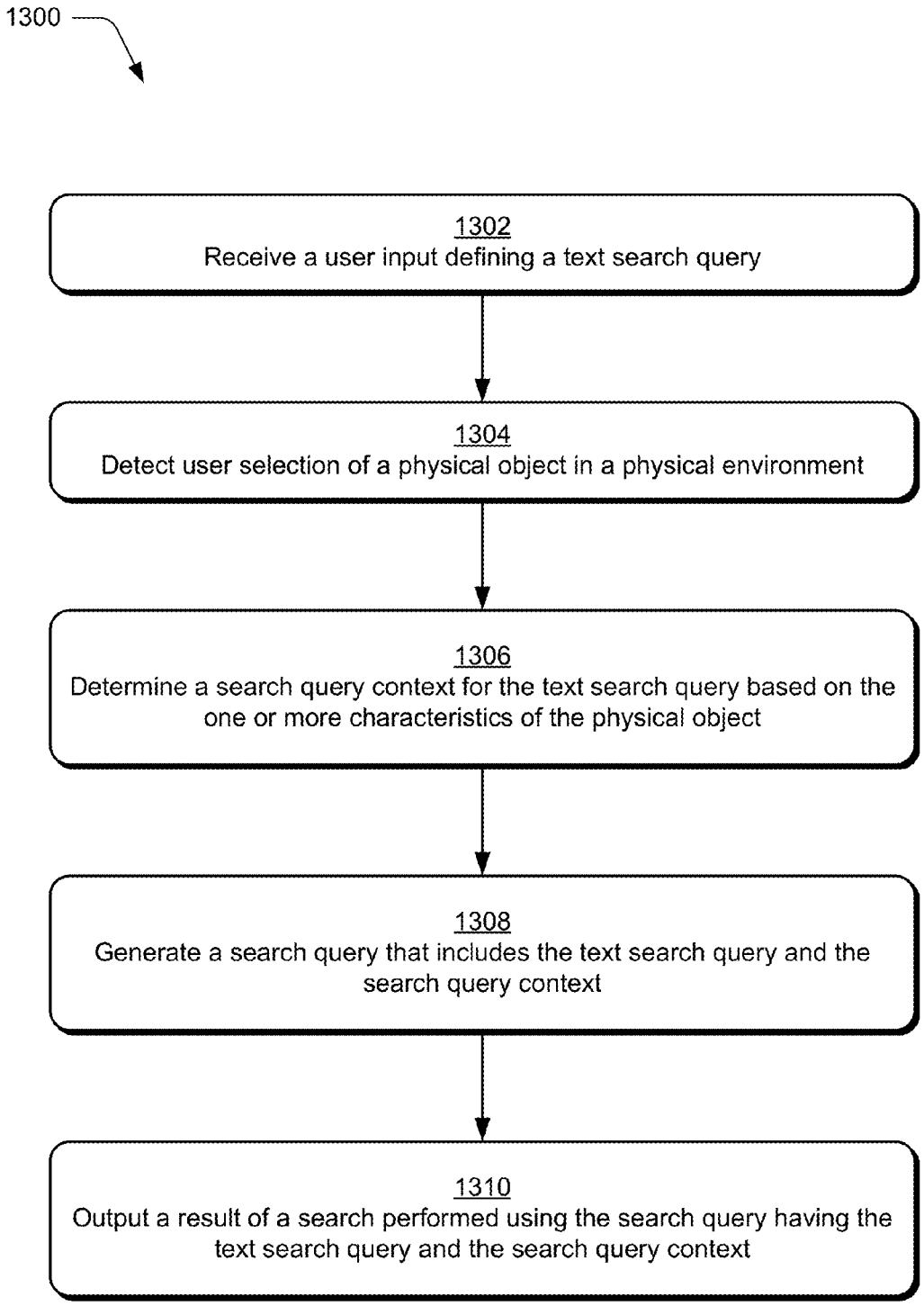

1300
1302
Receive a user input defining a text search query
1304
Detect user selection of a physical object in a physical environment
1306
Determine a search query context for the text search query based on the one or more characteristics of the physical object
1308
Generate a search query that includes the text search query and the search query context
1310
Output a result of a search performed using the search query having the text search query and the search query context

Fig. 13

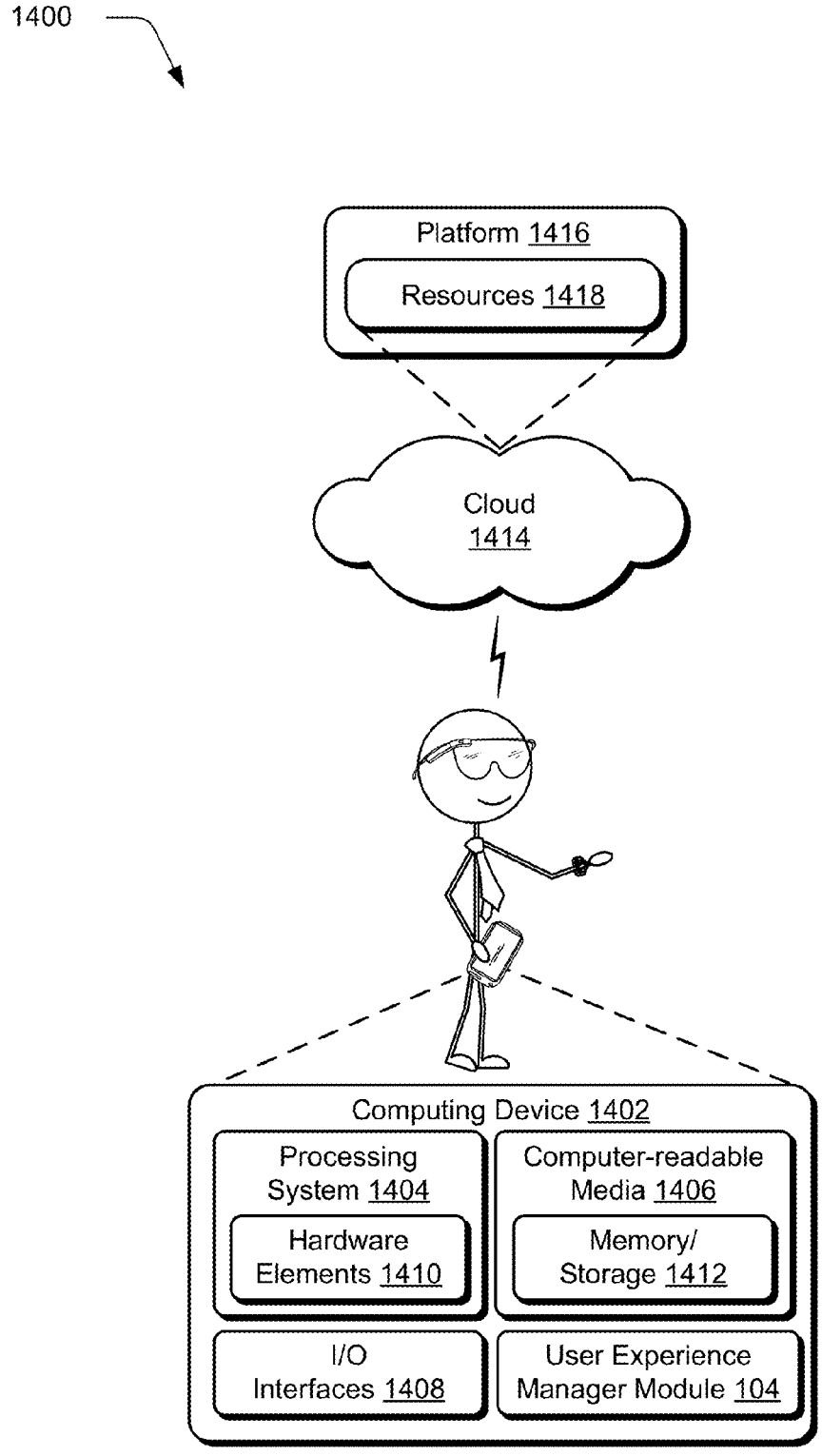

1400
Platform 1416
Resources 1418
Cloud
1414
Computing Device 1402
Processing System 1404
Hardware Elements 1410
Computer-readable Media 1406
Memory/ Storage 1412
I/O Interfaces 1408
User Experience Manager Module 104

Fig. 14

DIGITAL CONTENT SEARCH AND ENVIRONMENTAL CONTEXT

BACKGROUND

[0001] Search is one of the primary techniques used to locate digital content of interest. A user, for instance, may interact with a search engine over the internet to locate webpages, online videos, and so forth. Likewise, a user may initiate a search locally on a computing device to locate digital content of interest, such as songs and images.

[0002] Conventional search techniques, however, rely solely on entry of text by a user. This text is then matched with descriptions (e.g., metadata) associated with the digital content as part of the search. Consequently, these conventional search techniques are dependent on an ability of the user to express a desired result of the search using text. These conventional techniques also are dependent on reaching consensus between how a user describes a desired result of the search using text with the descriptions provided by originators of the digital content. As such, conventional search techniques may be limited in an ability to achieve an accurate search result and typically rely on refinement of a search query over multiple iterations, which is both inefficient and frustrating.

[0003] In addition, the world of augmented and virtual reality provides interesting new opportunities for immersive entertainment. Users are either interacting with the real world with digital enhancements (augmented reality) or are interacting with a wholly digital world (virtual reality). Current implementations of these experiences rely on typical text or voice web search behavior as discussed above to access digital content.

SUMMARY

[0004] Digital content search and environmental context techniques and systems are described. The environmental context is leveraged to provide additional information and insight into a likely goal of a textual search query input by a user. In this way, accuracy of a search result is improved in an efficient manner without additional manual user input, which otherwise may be difficult to express using text in certain instances.

[0005] In one example, a user's interaction with physical objects is used to generate a search query. A user, for instance, may select a physical coffee cup "in real life." Characteristics of the coffee cup are then used to define a search query, e.g., shape of a handle, object type (cup), material type, color, and so forth. The user may then continue to select other physical objects in order to refine this search, such as to select another physical object and have characteristics that are detected for that object supplement the search, e.g., a color of a wall. An output of the search may be performed in a variety of ways, such as virtual objects as part of an augmented or virtual reality scenario. In this way, the search query may be formed by leveraging knowledge of interaction of a user as part of a physical environment in order to launch the search.

[0006] In another example, a computing device of a user receives an input defining a text search query to locate digital content. The computing device also detects one or more environmental conditions of a physical environment in which the computing device is disposed. The environmental conditions are usable to detect potential likes and dislikes of a user in a current context of the user, such as a particular brand of object in the environment, preferred colors, and so forth.

[0007] In a further example, environmental conditions are also detected to determine a type of object that is disposed in the physical environment of a user. An image, for instance, may be captured of a physical environment, in which, the device is disposed. From this, the computing device identifies an application that corresponds to the detected type of object from an image captured of the physical environment. The computing device then launches the application, such as to enable a user to set an alarm or schedule an appointment by looking at a wall clock, check the weather by looking at an umbrella, and so forth.

[0008] In a further example, and specifically valuable in an augmented or virtual reality environment, the environmental context is used to refine a search in response to user selection of physical objects. The user, for instance, may provide a text search query via speech, manual entry, and so forth. The user may then select a physical object. Characteristics of the physical object that are relevant to the text search query are then used to provide a search query context, e.g., a shape, color, texture, and so forth. In this way, a user may leverage interaction with physical objects to further refine a search in a manner that may be difficult to perform using text alone.

[0009] This Summary introduces a selection of concepts in a simplified form that are further described below in the Detailed Description. As such, this Summary is not intended to identify essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The detailed description is described with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The use of the same reference numbers in different instances in the description and the figures may indicate similar or identical items. Entities represented in the figures may be indicative of one or more entities and thus reference may be made interchangeably to single or plural forms of the entities in the discussion.

[0011] FIG. **1** is an illustration of an environment in an example implementation that is operable to employ techniques described herein.

[0012] FIG. **2** depicts a system in an example implementation showing operation of a user experience manager module of FIG. **1** as generating a search query context for use with a text search query.

[0013] FIG. **3** is a flow diagram depicting a procedure in an example implementation of generation of the search query context.

[0014] FIGS. **4** and **5** depict example implementations of detection of environmental conditions as giving context to a search.

[0015] FIG. **6** depicts a system in an example implementation showing operation of a user experience manager module of FIG. **1** as launching an application based on an environmental context

[0016] FIG. **7** is a flow diagram depicting a procedure in an example implementation in which an application is launched.

[0017] FIGS. **8** and **9** depict example implementations of detection of an object in a physical environment of a user and user interaction with the object to launch an application.

[0018] FIG. **10** depicts a system and FIG. **11** depicts a procedure in an example implementation showing operation of the user experience manager module of FIG. **1** as generating and refining a search query based on interaction with physical objects.

[0019] FIG. **12** depicts a system in an example implementation in which a search is refined based on detection of objects in a physical environment of a user.

[0020] FIG. **13** is a flow diagram depicting a procedure in an example implementation in which a search is refined based on detection of objects in a physical environment of a user.

[0021] FIG. **14** illustrates an example system including various components of an example device that can be implemented as any type of computing device as described and/or utilize with reference to FIGS. **1-13** to implement embodiments of the techniques described herein.

DETAILED DESCRIPTION

[0022] Overview

[0023] Techniques and systems are described to support searches and provide an environmental context to a digital content search. The searches and environmental context are leveraged to provide additional information and insight into a likely goal of a search by a user and thus increase a likely accuracy of a search result in an efficient manner without additional manual user input.

[0024] In one example, a user's interaction with physical objects is used to generate and even launch a search query. The user, for instance, may touch a coffee cup. From this, the user's computing device may form a search query for coffee, cup, coffee cup, or any other logical search request based on the physical cup is launched. If there is a brand logo on the cup, the search query may include the brand. This support a search technique that is more intuitive and accurate than in current text web search environment of today. In a further embodiment, the keywords, characteristics, and so forth generated from the user interaction (e.g., touching) of the physical object can be used to drive a keyword advertising bidding process, allowing advertisers to bid to place ads if certain physical objects are touched. This provides advertisers a precise mechanism to target their ads. In this way, the search query may be formed by leveraging knowledge of interaction of a user as part of a physical environment, further discussion of which may be found in relation to FIGS. **10-11** in the following.

[0025] In another example, a computing device of a user receives an input defining a text search query to locate digital content, such as a search of "people talking together" for a digital image. The computing device also detects one or more environmental conditions of a physical environment in which the computing device is disposed. The environmental conditions, for instance, may describe objects surrounding the device, colors of the objects, types of objects, and so forth. These environmental conditions are usable to detect potential likes and dislikes of a user in a current context of the user, such as a particular brand of object in the environment, preferred colors, and so forth.

[0026] Further, these environmental conditions may be used to infer other environmental conditions, such as a room type (e.g., living room, bedroom), whether in a home or work environment, and so forth. Accordingly, the detected environmental conditions provide a search query context to the text search query that may give additional insight into a likely goal of a user in initiating the search.

[0027] Continuing with the previous example, the search query context may be used determine that the computing device is likely disposed within a work environment, e.g., through detection of chairs, a desk, and a company logo on a wall. The search query context, along with the text search query for "people talking together" is then used in a search to locate digital images of people talking together that is suitable for a work environment, e.g., talking around a conference table. In this way, the search result has a greater likelihood of being accurate than a search performed without such a context. Further, the search results may also change dynamically as the search query context changes, even for a matching text search query, such as to return digital images in an informal setting when the user is disposed at a home environment in the previous example. Further discussion of use of a search query context involving environmental conditions along with a text search query is described in the following in relation to FIGS. **2-5**.

[0028] In a further example, environmental conditions are also detected to determine a type of object that is disposed in the physical environment of a user. A user, for instance, may wear a headset (e.g., supporting virtual reality or augmented reality), view a mobile device such as a phone or tablet, wear a wearable computing device, or other computing device configuration. Regardless of configuration, the computing device is configured to capture a digital image of the physical environment, in which, the device is disposed. From this digital image, the device detects an object that is included in the physical environment, along with user interaction involving this object.

[0029] A user, for instance, may view a physical clock mounted on a wall in a physical environment of the user. The user may gaze at the wall clock for over a threshold amount of time, make a verbal utterance (e.g., schedule an appointment), make a gesture detectable in a natural user interface (e.g., appear to grab one of the hands of the clock), physically touch the clock, and so forth. From this, the computing device identifies an application that corresponds to the detected type of object from an image captured of the physical environment.

[0030] The computing device then launches the application, such as to enable a user to set an alarm, schedule an appointment, and so forth in this example. Further, in an instance of a gesture, the gesture may continue to initiate an operation of the launched application, e.g., to change a time of an appointment. In this way, objects in a physical environment of a user may act as cues to guide and predict future user interaction with the computing device. Further discussion of these and other examples of application launch is described in the following in relation to FIGS. **6-9**.

[0031] In a further example, the environmental context is used to refine a search in response to user selection of physical objects in a physical environment of the user. The user, for instance, may provide a text search query "stainless steel refrigerator" via a spoken utterance, typed on a keyboard, and so forth. The user may then select a physical object, such as a door handle of a refrigerator at an appliance store. Characteristics of the door handle that are relevant to the text search query are then used to provide a search query context, e.g., a shape of the handle, color, and so forth. In

this way, a user may leverage interaction with physical objects to further refine a search in a manner that may be difficult to perform using text alone, e.g., to describe the shape of the handle. Further discussion of these and other examples of application launch is described in the following in relation to FIGS. **12-13**.

[0032] In the following discussion, an example environment is first described that may employ the techniques described herein. Example procedures are then described which may be performed in the example environment as well as other environments. Consequently, performance of the example procedures is not limited to the example environment and the example environment is not limited to performance of the example procedures.

[0033] Example Environment

[0034] FIG. **1** is an illustration of an environment **100** in an example implementation that is operable to employ techniques described herein. The illustrated environment **100** includes a computing device **102** configured for use in augmented reality and/or virtual reality scenarios, which may be configured in a variety of ways.

[0035] The computing device **102** is illustrated as including a user experience manager module **104** that is implemented at least partially in hardware of the computing device **102**, e.g., a processing system and memory of the computing device as further described in relation to FIG. **14**. The user experience manager module **104** is configured to manage output of and user interaction with a virtual user experience **106** having one or more virtual objects **108** that are made visible to a user **110**. The virtual user experience **106** and one or more virtual objects **108** are illustrated as maintained in storage **112** of the computing device **102**.

[0036] The computing device **102** includes a housing **114**, one or more sensors **116**, and a display device **118**. The housing **114** is configurable in a variety of ways to support interaction with the virtual user experience **106**. In one example, the housing **114** is configured to be worn on the head of a user **110** (i.e., is "head mounted" **120**), such as through configuration as goggles, glasses, contact lens, and so forth. In another example, the housing **114** assumes a hand-held **122** form factor, such as a mobile phone, tablet, portable gaming device, and so on. In yet another example, the housing **114** assumes a wearable **124** form factor that is configured to be worn by the user **110**, such as a watch, broach, pendant, or ring. Other configurations are also contemplated, such as configurations in which the computing device **102** is disposed in a physical environment apart from the user **110**, e.g., as a "smart mirror," wall-mounted projector, television (e.g., a series of curved screens arranged in a semicircular fashion), and so on.

[0037] The sensors **116** may also be configured in a variety of ways to detect a variety of different conditions. In one example, the sensors **116** are configured to detect an orientation of the computing device **102** in three dimensional space, such as through use of accelerometers, magnetometers, inertial devices, radar devices, and so forth. In another example, the sensors **116** are configured to detect environmental conditions of a physical environment in which the computing device **102** is disposed, such as objects, distances to the objects, motion, colors, and so forth. Examples of which include cameras, radar devices, light detection sensors (e.g., IR and UV sensors), time of flight cameras, structured light grid arrays, barometric pressure, altimeters, temperature gauges, compasses, geographic positioning systems (e.g., GPS), and so forth. In a further example, the sensors **116** are configured to detect environmental conditions involving the user **110**, e.g., heart rate, temperature, movement, and other biometrics.

[0038] The display device **118** is also configurable in a variety of ways to support the virtual user experience **106**. Example of which include a typical display device found on a mobile device such as a camera or tablet computer, a light field display for use on a head mounted display in which a user may see through portions of the display, stereoscopic displays, projectors, and so forth. Other hardware components may also be included as part of the computing device **102**, including devices configured to provide user feedback such as haptic responses, sounds, and so forth.

[0039] The housing **114**, sensors **116**, and display device **118** are also configurable to support different types of virtual user experiences **106** by the user experience manager module **104**. In one example, a virtual reality manager module **126** is employed to support virtual reality. In virtual reality, a user is exposed to an immersive environment, the viewable portions of which are entirely generated by the computing device **102**. In other words, everything that is seen by the user **110** is rendered and displayed by the display device **118** through use of the virtual reality manager module **126**.

[0040] The user, for instance, may be exposed to virtual objects **108** that are not "really there" (e.g., virtual bricks) and are displayed for viewing by the user in an environment that also is completely computer generated. The computer-generated environment may also include representations of physical objects included in a physical environment of the user **110**, e.g., a virtual table that is rendered for viewing by the user **110** to mimic an actual physical table in the environment detected using the sensors **116**. On this virtual table, the virtual reality manager module **126** may also dispose virtual objects **108** that are not physically located in the physical environment of the user **110**, e.g., the virtual bricks as part of a virtual playset. In this way, although an entirely of the display being presented to the user **110** is computer generated, the virtual reality manager module **126** may represent physical objects as well virtual objects **108** within the display.

[0041] The user experience manager module **104** is also illustrated as supporting an augmented reality manager module **128**. In augmented reality, the virtual objects **108** are used to augment a direct view of a physical environment of the user **110**. The augmented reality manger module **128**, for instance, may detect landmarks of the physical table disposed in the physical environment of the computing device **102** through use of the sensors **116**, e.g., object recognition. Based on these landmarks, the augmented reality manager module **128** configures a virtual object **108** of the virtual bricks to appear as is placed on the physical table.

[0042] The user **110**, for instance, may view the actual physical environment through head-mounted **120** goggles. The head-mounted **120** goggles do not recreate portions of the physical environment as virtual representations as in the VR scenario above, but rather permit the user **110** to directly view the physical environment without recreating the environment. The virtual objects **108** are then displayed by the display device **118** to appear as disposed within this physical environment. Thus, in augmented reality the virtual objects **108** augment what is "actually seen" by the user **110** in the physical environment. In the following discussion, the virtual user experience **106** and virtual objects **108** of the user

experience manager module **104** may be used in both a virtual reality scenario and an augmented reality scenario.

[0043] The environment **100** is further illustrated as including a search service **130** that is accessible to the computing device **102** via a network **132**, e.g., the Internet. The search service **130** includes a search manager module **134** that is implemented at least partially in hardware of a computing device (e.g., one or more servers) to search digital content **136**, which is illustrated as stored in storage **136**. Other examples are also contemplated, such as to search digital content **136** located elsewhere other than the search service **130** (e.g., webpages), implemented locally at the computing device **102** (e.g., to locate digital content **136** such as songs, videos, digital images), and so forth.

[0044] As previously described, digital content search is one of the primary techniques by which a user **110** locates digital content of interest. For instance, rather than manually navigate through a hierarchy of folders or webpages to locate a particular song of interest, a user may input a text search query (e.g., a name of the song) to locate the song. While this technique may achieve accurate and efficient results when searching for objects having names that are known to the user (e.g., the song "Happy Birthday"), these techniques are challenged in other situations in which the proper name is not known to the user or if more abstract concepts are wished to be conveyed.

[0045] Accordingly, in such situations, interaction of the user **110** with physical objects may be used to generate, launch, and refine a search query. in order to locate the digital content of interest as described in relation to FIGS. **10-14**. The user experience manager module **104** is also configured to determine a search query context, which may be used to supplement the search query in order to improve accuracy of the search as further described in relation to FIGS. **2-5**. Additionally, the user experience manager module **104** may also leverage knowledge of environmental conditions involving user interaction with a physical environment to launch applications, further discussion of which may be found in relation to a discussion of FIGS. **6-9**.

[0046] A bid process may also be incorporated as part of the search service **130** such that entities (e.g., advertisers) may bid on opportunities to include respective virtual user experiences **106** and/or virtual objects **108** as part of a digital content **136** of a search result. Functionality of the bid process is represented as implemented at least partially in hardware by a bid manager module **140**. Advertisers, for instance, may bid on opportunities to include items of digital content **136**, virtual objects **108**, and virtual user experiences **106** as part of a search result. This may include bidding on textual words, characteristics of physical object with which the user has interacted, environmental contexts used to refine the search, and so forth as further described in relation to FIGS. **10-11**. In this way, the search service **130** may collect revenue by exposing a user interface, via which, bids may be collected and used to control dissemination of digital content.

[0047] The search service **130** may then control generation of search results based at least in part on these bids. Thus, bid techniques of the bid manager module **140** may be incorporated as part of any of the search techniques and supporting context of these search techniques that are described in the following. This includes physical interactions used to launch a search, used to refine a search, environmental conditions associated alone with a search query, characteristics of physical objects used as a basis of the search, and so forth.

[0048] In general, functionality, features, and concepts described in relation to the examples above and below may be employed in the context of the example procedures described in this section. Further, functionality, features, and concepts described in relation to different figures and examples in this document may be interchanged among one another and are not limited to implementation in the context of a particular figure or procedure. Moreover, blocks associated with different representative procedures and corresponding figures herein may be applied together and/or combined in different ways. Thus, individual functionality, features, and concepts described in relation to different example environments, devices, components, figures, and procedures herein may be used in any suitable combinations and are not limited to the particular combinations represented by the enumerated examples in this description.

[0049] Environmental Context to Supplement a Search of Digital Content

[0050] FIG. **2** depicts a system **200** in an example implementation showing operation of the user experience manager module **104** of FIG. **1** as generating a search query context for use with a search query. FIG. **3** depicts a procedure **300** in an example implementation of generation of the search query context. FIGS. **4** and **5** depict example implementations **400**, **500** of determinations of search query contexts from a physical environment in which a computing device is disposed.

[0051] The following discussion describes techniques that may be implemented utilizing the described systems and devices. Aspects of each of the procedures may be implemented in hardware, firmware, or software, or a combination thereof. The procedures are shown as a set of blocks that specify operations performed by one or more devices and are not necessarily limited to the orders shown for performing the operations by the respective blocks. In portions of the following discussion, reference is made interchangeably to FIGS. **2-5**.

[0052] In this example, a user input is received that defines a text search query (block **302**). The user **110**, for instance, may interact with a user input device **202** to provide inputs that are received by a text manager module **204** to form a text search query **206**. The text may be received directly or determined indirectly by the text manager module **204**. In a direct example, the user **110** inputs the text through use of a user input device **202** configured as a keyboard. In an indirect example, an utterance **110** of the user **110** is converted to text by the text manager module **204**, e.g., using speech-to-text functionality. Other examples are also contemplated, such as to define and launch the search query based solely on user interaction with physical objects, an example of which is further described in relation to FIGS. **10-11**.

[0053] One or more environmental conditions are also detected of a physical environment of the at least one computing device (block **304**). Sensors **116** of the computing device **102**, for instance, may provide signals to a detection module **208** to detect environmental conditions **210** that are to give a context to the text search query **206**. The detection module **208**, for instance, may detect the environmental conditions **210** in response to receipt of the user input specifying the text search query **206**. The envi-

ronmental conditions **210** may describe a variety of aspects of a physical environment, in which, the computing device **102** is disposed. Examples of such conditions include what objects are located in the physical environment through use of an object detection module **212**, a type of environment, actions performed by the user **110**, and so forth.

[0054] As shown in an example implementation **400** of FIG. **4**, for instance, a camera **402** of the computing device **102** is forward facing and used to capture images of objects **404** in a physical environment of a user **110**. An object detection module **212** is then used to detect objects from the images, such as through use of a classifier trained using machine learning. Illustrated examples include detection of household items in an environment of a user, such as pillows, vases, art, lamps, rugs, and so forth. The object detection module **212** may also be used to detect characteristics of these objects, such as colors, textures, brands, features, and so on.

[0055] Detection of these objects **404** is also usable to infer other characteristics of a physical environment of the user **110**. As shown in an example implementation **500** of FIG. **5**, for instance, objects are used to detect a type of room in which the user **110** is disposed. A bedroom **502**, for instance, may be inferred from objects including a bed, dresser, wardrobe, and so forth. An office **504**, on the other hand, is inferred from objects such as a desk and chair, computer, lamp, and bookcase. Similar techniques are usable to infer a dining room **506** from a dinner table, bathroom **508** from a sink, and whether the user is outside **510**. Other examples of inferences include whether the user **110** is at a home or work environment. Accordingly, the detected objects and inferences that may be learned from these objects may be used to give context to a text search query.

[0056] Returning again to FIGS. **2** and **3**, a search query context is determined for the text search query based on the one or more environmental conditions (block **306**). A search query is then generated that includes the text search query and the search query context (block **308**). For example, these environmental conditions **210** are then used by a search query formation module **214** to form a search query **216** having the text search query **206** and a search query context **218** for the text.

[0057] In one example, the search query formation module **214** is configured to determine relevancy of the environmental conditions **210** to the text search query **206**. In a text search for home goods, for instance, objects that are relevant to that text include home goods in the user's physical environment as well as characteristics of those goods, e.g., colors, patterns, textures, and so forth. In a search for music to be played, relevancy may include whether the user **110** is at home or at work. Thus, in this example, the relevancy of the environmental conditions **210** may be based on the text search query **206** and also a type of digital content being searched.

[0058] In the illustrated example of FIG. **2**, the search query formation module **214** forms the search query **216** to include the text search query **206** as well as the determined search query context **218**. This is communicated over a network **132** to a search service **130** and used to perform a search. Digital content **136** resulting from the search (e.g., ordered search results, songs, images, and so forth) is communicated back to the user experience manager module **104** via the network **132**. A result is then output of a search performed using the search query having the text search query and the search query context (block **310**), e.g., displayed in user interface of the computing device **102**. This includes output as one or more virtual objects **108** as part of a virtual reality scenario or an augmented reality scenario.

[0059] A variety of implementation scenarios may be supported by leveraging knowledge of environmental conditions to give context to a text search query. The user experience module **104**, for instance, may detect a number of objects of a particular type over a threshold amount. For example, the user **110** may walk around a store and look at a display of different types of kitchen appliances. The user experience manager module **104** may thus infer that the user is located in a store and has exhibited interest in these objects. Accordingly, a text search input received at that time has a likelihood of being related to those objects. The search query context **218** may then be leveraged to address this likelihood, such as to promote search results that pertain to reviews or comparisons of the objects. Similar techniques may be used to promote search results for brands that are found in the user's **110** house or workplace environment.

[0060] Environmental Context and Application Launch

[0061] FIG. **6** depicts a system **600** and FIG. **7** depicts a procedure **700** in an example implementation showing operation of the user experience manager module **104** of FIG. **1** as launching an application based on an environmental context. FIGS. **8** and **9** depict example implementations of detection of an object in a physical environment of a user and user interaction with the object to launch an application.

[0062] The following discussion describes techniques that may be implemented utilizing the described systems and devices. Aspects of each of the procedures may be implemented in hardware, firmware, or software, or a combination thereof. The procedures are shown as a set of blocks that specify operations performed by one or more devices and are not necessarily limited to the orders shown for performing the operations by the respective blocks. In portions of the following discussion, reference is made interchangeably to FIGS. **6-9**.

[0063] To begin, an image is received of a physical environment in which the at least one computing device is disposed (block **702**). A user **110**, for instance, may gaze at a physical object in the physical environment for at least a predetermined amount of time. In response, sensors **116** (e.g., a camera) of the computing device **102** are used to capture an image of the physical environment. As shown in FIG. **8**, for instance, a user **110** may gaze at a physical clock **802** for a predetermined amount of time, which causes the computing device **102** to capture an image of the clock **802**. Likewise, a user may gaze at an umbrella **804**, which causes capture of an image of the umbrella **804**. The images may also be captured in response to a user input, e.g., a button press, gesture, and so forth.

[0064] A type of object is detected in the image that is disposed in the physical environment (block **704**). As previously described, an object detection module **212** employs one or more classifiers that are trained using machine learning to recognize objects included in the image. Through use of these classifiers, the object detection module **212** identifies a type of the physical object **602** from the image. Accordingly, identification of the type of physical object may be used for an arbitrary object of that type. For example, recognition of the type of physical object (e.g., clock or umbrella) may be used for any arbitrary object

having that type, and thus is not limited to particular instances of those objects, e.g., a particular brand of object.

[0065] An application is identified that corresponds to the detected type of object (block **706**). The user experience manager module **104**, for instance, may maintain an index of applications as corresponding to particular physical objects **602**, e.g., a timer application for the clock **802**, a weather application for the umbrella **804**, and so forth. The identified application is launched for execution by the at least one computing device (block **708**). Thus, in this example, the user experience manager module **104** is configured to launch applications based on physical objects **602** that are disposed in the user's physical environment. This may also be combined with detected user interactions.

[0066] The user experience module **104**, for instance, may include a user interaction detection module **610** that is implemented at least partially in hardware to detect user interaction **612** involving the physical objects **602**. A variety of different user interactions may be detected. In the previous example, for instance, a detected user's gaze over a threshold amount of time is used to initiate detection of the physical object **602** by the object detection module **212**.

[0067] In another example, the detected user interaction **612** may involve a gesture **614** to initiate an operation of the launched application **136**. As shown in FIG. **9**, for instance, a finger of a user's hand **902** is recognized as performing a gesture that mimics movement of a hand of the physical clock **802**. In response, the user experience manager module **104** launches an application corresponding to the clock, e.g., an alarm application **904** in this instance. Thus, in this example a combination of the gesture and detection of the physical object is used to launch the application.

[0068] The user experience manager module **104** is also configured to initiate an operation of the launched application that corresponds to the gesture. In this example, the operation involves setting **906** an alarm as recognized by the mimicked motion relative to the hands of the clock **802**. This gesture is recognized without involving actual contact with the clock **802**, e.g., in a natural user interface. Other examples are also contemplated, such as the "grab the umbrella" **804** to launch output of the weather application to obtain a weather forecast at a current location of the user.

[0069] Search Query Generation and Launch

[0070] FIG. **10** depicts a system **1000** and FIG. **11** depicts a procedure **1100** in an example implementation showing operation of the user experience manager module **104** of FIG. **1** as generating and refining a search query based on interaction with physical objects. The procedure **1100** may be implemented by a variety of different systems, such as the system **200** of FIG. **2**. The system **1000** is illustrated using first, second, and third stages **1002**, **1004**, **1006**.

[0071] The following discussion describes techniques that may be implemented utilizing the described systems and devices. Aspects of each of the procedures may be implemented in hardware, firmware, or software, or a combination thereof. The procedures are shown as a set of blocks that specify operations performed by one or more devices and are not necessarily limited to the orders shown for performing the operations by the respective blocks. In portions of the following discussion, reference is made interchangeably to FIGS. **2**, **10-11**.

[0072] To begin, user selection is detected of a physical object in a physical environment (block **1102**). The computing device **102**, for instance, may use sensors **116** such as a camera, radar techniques, and so forth to detect that a user has interacted with a physical object. This may include specific gestures made by the user **110** in order to initiate the selection, use of a threshold amount of time over which selection of the object is deemed to have been made by the computing device **102** (e.g., an amount of time looking at the physical object), and so forth.

[0073] In response, a search query is generated based on one or more characteristics of the physical object (block **1104**). The search query may be text based, employ an image captured of the object (e.g., as part of an image similarity determination performed using machine learning), and so forth. As shown at the first stage **1002** of FIG. **10**, for instance, a hand **1008** of the user **110** is used to tap a coffee mug **1010**. This tap is detected using sensors **116** of the computing device **102**. In response, the computing device **102** collects data describing characteristics of the physical object, i.e., the coffee mug **1010**. These characteristics may include a type of object (e.g., using object recognition of a digital image captured of the mug), color of the object, shape of the object, textures, positioning of the object, an environment in which the object is disposed, and so forth. From this, the search query is generated to include these characteristics.

[0074] Continued user selection of physical objects may then be used to refine the search query. For example, user selection is detected of another physical object in the physical environment (block **1106**). The search query is then refined based on one or more characteristics of the other physical object (block **1108**). As shown at the second stage **1004**, the hand **1008** of the user is detected as selecting a design **1012** of two hearts included as part of an artwork **1014**. Characteristics of the design **1012** are used to further refine the search query, such as to include text of "two hearts," used as part of a digital image similarity determination without the use of text, and so forth. Thus, these characteristics of the design **1012** and the characteristics of the coffee mug **1010** are used to form the refined search query. This process may continue over additional interactions, such as to select a style of handle, material for the mug (e.g., by selecting a stainless steel surface of a refrigerator), and so forth.

[0075] The refined search query is then used as a basis for a search, which may be performed locally by the computing device **102** and/or remotely through use of the search service **130**. A result is output of a search performed using the refined search query (block **1110**). The result, for instance, may be configured as a conventional search result as displayed on a display device of a mobile phone, desktop computer, and so on. In another instance, the result is formed for display as one or more virtual objects **108** as part of a virtual user experience in an augmented or virtual reality environment as described in relation to FIG. **1**.

[0076] An example of this is shown at the third stage **1006** in which a search result **1016** is configured as a virtual object **108** of a coffee mug of the first stage **1002** having a design that approximates the selected design **1012** from the second stage **1004**. In this way, the user **110** is able to generate and launch a search query **110** without manually inputting text, which may thus overcome conventional difficulties of the user in articulating a desired result.

[0077] As previously described in relation to FIG. **1**, a bidding process may be incorporated as part of a search performed by the search service **130**. For example, the bid

manager module **140** may expose functionality via a user interface in which advertisers and other entities may bid on opportunities for inclusion in a search result based on interaction of the user **110** with physical objects. This may include opportunities to bid on types of objects, characteristics of the objects (e.g., red, stainless steel), types of user interactions with the objects (e.g., held versus looked upon over a threshold amount of time), and so forth. This may also include opportunities for how the search results are output, e.g., on a conventional display device versus part of a virtual user experience **106**.

[0078] Search Refinement Using Object Detection

[0079] FIG. **12** depicts a system **1200** and FIG. **13** depicts a procedure **1300** in an example implementation showing operation of the user experience manager module **104** of FIG. **1** as refining a search based on an environmental context. The procedure **1300** may be implemented by a variety of different systems, such as the system **200** of FIG. **2**. The system **1200** is illustrated using first, second, third, and fourth stages **1202**, **1204**, **1206**, **1208**.

[0080] The following discussion describes techniques that may be implemented utilizing the described systems and devices. Aspects of each of the procedures may be implemented in hardware, firmware, or software, or a combination thereof. The procedures are shown as a set of blocks that specify operations performed by one or more devices and are not necessarily limited to the orders shown for performing the operations by the respective blocks. In portions of the following discussion, reference is made interchangeably to FIGS. **2**, **12-13**.

[0081] As before, a user input is received that defines a text search query (block **1302**). The user **110**, for instance, may interact with a user input device **202** to provide inputs that are received by a text manager module **204** to form a text search query **206**. The text may be received directly or determined indirectly by the text manager module **204**. In a direct example, the user **110** inputs the text through use of a user input device **202** configured as a keyboard. In an indirect example, an utterance **110** of the user **110** is converted to text by the text manager module **204**, e.g., using speech-to-text functionality.

[0082] In this example, user selection is detected of a physical object in a physical environment (block **1304**). A search query context for the text search query is then determined based on the one or more characteristics of the physical object (block **1306**), which is then used to generate a search query that includes the text search query and the search query context. In this way, user selection of the physical objects may be used to further refine the text search query.

[0083] As shown in an example system **1200** of FIG. **12**, for instance, a user **110** provides a text input search query, in this case via a spoken utterance of stainless steel refrigerator **1210** at the first stage **1202**. In response, the user experience manager module **104** initiates a search for stainless steel refrigerators.

[0084] The user **110**, in this example, may be disposed in an appliance warehouse and select physical objects in succession, which are then used to further refine the search results. At the second stage **1204**, for instance, a user selection is received of an ice maker **1214** by tapping object with a hand **1212** of the user. The user selection of the ice maker **1214** is used as a search query context **218** along with the text search query **206** to perform a search to retrieve refrigerators that include ice makers.

[0085] At the third stage **1206**, a user selection is received of a handle. The user experience manager module then determines which characteristics of the handle are relevant to the text search query, which in this case is a handle shape **1216**. This process may continue through selection of additional physical objects, such as to select a lower drawer as shown at the fourth stage **1208**. From this selection of the lower drawer, the user experience manager module **104** infers that the user is interested in refrigerators having that drawer configuration **1218**.

[0086] In the illustrated example of FIG. **2**, the search query formation module **214** forms the search query **216** to include the text search query **206** as well as the determined search query context **218**. This is communicated over a network **132** to a search service **130** and used to perform a search. Digital content **136** resulting from the search (e.g., ordered search results, songs, images, and so forth) is communicated back to the user experience manager module **104** via the network **132**. A result is then output of a search performed using the search query having the text search query and the search query context (block **1310**). The result of the search may be configured in a variety of ways.

[0087] In the previous example, a user interface is output having digital content **136** that depicts refrigerators that are available that satisfy the combination of text search query **206** and search query context **218**. In the example of the store, the digital content **136** may also include directions to refrigerators that are available at that store, i.e., directions on where in the store these refrigerators are located, other stores, or online Thus, in this example the characteristics of the physical objects are used to further refine the text search query **206**.

[0088] Example System and Device

[0089] FIG. **12** illustrates an example system generally at **1200** that includes an example computing device **1202** that is representative of one or more computing systems and/or devices that may implement the various techniques described herein. This is illustrated through inclusion of the user experience manager module **104**. The computing device **1202** may be, for example, a server of a service provider, a device associated with a client (e.g., a client device), an on-chip system, and/or any other suitable computing device or computing system.

[0090] The example computing device **1202** as illustrated includes a processing system **1204**, one or more computer-readable media **1206**, and one or more I/O interface **1208** that are communicatively coupled, one to another. Although not shown, the computing device **1202** may further include a system bus or other data and command transfer system that couples the various components, one to another. A system bus can include any one or combination of different bus structures, such as a memory bus or memory controller, a peripheral bus, a universal serial bus, and/or a processor or local bus that utilizes any of a variety of bus architectures. A variety of other examples are also contemplated, such as control and data lines.

[0091] The processing system **1204** is representative of functionality to perform one or more operations using hardware. Accordingly, the processing system **1204** is illustrated as including hardware element **1210** that may be configured as processors, functional blocks, and so forth. This may include implementation in hardware as an application spe-

cific integrated circuit or other logic device formed using one or more semiconductors. The hardware elements **1210** are not limited by the materials from which they are formed or the processing mechanisms employed therein. For example, processors may be comprised of semiconductor(s) and/or transistors (e.g., electronic integrated circuits (ICs)). In such a context, processor-executable instructions may be electronically-executable instructions.

[0092] The computer-readable storage media **1206** is illustrated as including memory/storage **1212**. The memory/storage **1212** represents memory/storage capacity associated with one or more computer-readable media. The memory/storage component **1212** may include volatile media (such as random access memory (RAM)) and/or nonvolatile media (such as read only memory (ROM), Flash memory, optical disks, magnetic disks, and so forth). The memory/storage component **1212** may include fixed media (e.g., RAM, ROM, a fixed hard drive, and so on) as well as removable media (e.g., Flash memory, a removable hard drive, an optical disc, and so forth). The computer-readable media **1206** may be configured in a variety of other ways as further described below.

[0093] Input/output interface(s) **1208** are representative of functionality to allow a user to enter commands and information to computing device **1202**, and also allow information to be presented to the user and/or other components or devices using various input/output devices. Examples of input devices include a keyboard, a cursor control device (e.g., a mouse), a microphone, a scanner, touch functionality (e.g., capacitive or other sensors that are configured to detect physical touch), a camera (e.g., which may employ visible or non-visible wavelengths such as infrared frequencies to recognize movement as gestures that do not involve touch), and so forth. Examples of output devices include a display device (e.g., a monitor or projector), speakers, a printer, a network card, tactile-response device, and so forth. Thus, the computing device **1202** may be configured in a variety of ways as further described below to support user interaction.

[0094] Various techniques may be described herein in the general context of software, hardware elements, or program modules. Generally, such modules include routines, programs, objects, elements, components, data structures, and so forth that perform particular tasks or implement particular abstract data types. The terms "module," "functionality," and "component" as used herein generally represent software, firmware, hardware, or a combination thereof. The features of the techniques described herein are platform-independent, meaning that the techniques may be implemented on a variety of commercial computing platforms having a variety of processors.

[0095] An implementation of the described modules and techniques may be stored on or transmitted across some form of computer-readable media. The computer-readable media may include a variety of media that may be accessed by the computing device **1202**. By way of example, and not limitation, computer-readable media may include "computer-readable storage media" and "computer-readable signal media."

[0096] "Computer-readable storage media" may refer to media and/or devices that enable persistent and/or non-transitory storage of information in contrast to mere signal transmission, carrier waves, or signals per se. Thus, computer-readable storage media refers to non-signal bearing media. The computer-readable storage media includes hardware such as volatile and non-volatile, removable and non-removable media and/or storage devices implemented in a method or technology suitable for storage of information such as computer readable instructions, data structures, program modules, logic elements/circuits, or other data. Examples of computer-readable storage media may include, but are not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, hard disks, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or other storage device, tangible media, or article of manufacture suitable to store the desired information and which may be accessed by a computer.

[0097] "Computer-readable signal media" may refer to a signal-bearing medium that is configured to transmit instructions to the hardware of the computing device **1202**, such as via a network. Signal media typically may embody computer readable instructions, data structures, program modules, or other data in a modulated data signal, such as carrier waves, data signals, or other transport mechanism. Signal media also include any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media include wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared, and other wireless media.

[0098] As previously described, hardware elements **1210** and computer-readable media **1206** are representative of modules, programmable device logic and/or fixed device logic implemented in a hardware form that may be employed in some embodiments to implement at least some aspects of the techniques described herein, such as to perform one or more instructions. Hardware may include components of an integrated circuit or on-chip system, an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA), a complex programmable logic device (CPLD), and other implementations in silicon or other hardware. In this context, hardware may operate as a processing device that performs program tasks defined by instructions and/or logic embodied by the hardware as well as a hardware utilized to store instructions for execution, e.g., the computer-readable storage media described previously.

[0099] Combinations of the foregoing may also be employed to implement various techniques described herein. Accordingly, software, hardware, or executable modules may be implemented as one or more instructions and/or logic embodied on some form of computer-readable storage media and/or by one or more hardware elements **1210**. The computing device **1202** may be configured to implement particular instructions and/or functions corresponding to the software and/or hardware modules. Accordingly, implementation of a module that is executable by the computing device **1202** as software may be achieved at least partially in hardware, e.g., through use of computer-readable storage media and/or hardware elements **1210** of the processing system **1204**. The instructions and/or functions may be executable/operable by one or more articles of manufacture (for example, one or more computing devices **1202** and/or processing systems **1204**) to implement techniques, modules, and examples described herein.

[0100] The techniques described herein may be supported by various configurations of the computing device **1202** and are not limited to the specific examples of the techniques described herein. This functionality may also be implemented all or in part through use of a distributed system, such as over a "cloud" **1214** via a platform **1216** as described below.

[0101] The cloud **1214** includes and/or is representative of a platform **1216** for resources **1218**. The platform **1216** abstracts underlying functionality of hardware (e.g., servers) and software resources of the cloud **1214**. The resources **1218** may include applications and/or data that can be utilized while computer processing is executed on servers that are remote from the computing device **1202**. Resources **1218** can also include services provided over the Internet and/or through a subscriber network, such as a cellular or Wi-Fi network.

[0102] The platform **1216** may abstract resources and functions to connect the computing device **1202** with other computing devices. The platform **1216** may also serve to abstract scaling of resources to provide a corresponding level of scale to encountered demand for the resources **1218** that are implemented via the platform **1216**. Accordingly, in an interconnected device embodiment, implementation of functionality described herein may be distributed throughout the system **1200**. For example, the functionality may be implemented in part on the computing device **1202** as well as via the platform **1216** that abstracts the functionality of the cloud **1214**.

CONCLUSION

[0103] Although the invention has been described in language specific to structural features and/or methodological acts, it is to be understood that the invention defined in the appended claims is not necessarily limited to the specific features or acts described. Rather, the specific features and acts are disclosed as example forms of implementing the claimed invention.

What is claimed is:

1. In a digital medium environment to initiate and output a search, a method implemented by at least one computing device, the method comprising:
- detecting, by the at least one computing device, user selection of a physical object in a physical environment of the at least one computing device;
- determining, by the at least one computing device, a search query context for the text search query based on one or more characteristics of the physical object;
- generating, by the at least one computing device, a search query that includes the text search query and the search query context; and
- outputting, by the at least one computing device, a result of a search performed using the search query having the text search query and the search query context.

2. The method as described in claim **1**, wherein the user input is manually input by the user or provided via a spoken utterance.

3. The method as described in claim **1**, further comprising repeating the detecting, the determining, the generating, and the outputting in response to one or more additional user selections of physical objects that refine the search query context of the test search query.

4. The method as described in claim **1**, wherein the one or more characteristics define a type of the object.

5. The method as described in claim **1**, wherein the one or more characteristics define a color, texture, or shape of the object.

6. In a digital medium environment to initiate and output a search, a method implemented by at least one computing device, the method comprising:
- receiving, by at least one computing device, a user input defining a text search query;
- detecting, by the at least one computing device, one or more environmental conditions of a physical environment of the at least one computing device;
- determining, by the at least one computing device, a search query context for the text search query based on the one or more environmental conditions;
- generating, by the at least one computing device, a search query that includes the text search query and the search query context; and
- outputting, by the at least one computing device, a result of a search performed using the search query having the text search query and the search query context.

7. The method as described in claim **6**, wherein the one or more environmental conditions of the physical environment describe at least one object disposed in the physical environment.

8. The method as described in claim **7**, wherein the one or more environmental conditions also describe at least one characteristic of the at least one object.

9. The method as described in claim **8**, wherein the at least one characteristic is a color, a number of the at least one object present, or brand of the object.

10. The method as described in claim **6**, wherein the one or more environmental conditions of the physical environment describe a room type of the physical environment.

11. The method as described in claim **6**, wherein the one or more environmental conditions describe whether the physical environment is likely part of a home or work environment.

12. The method as described in claim **6**, wherein the detecting is performed in response to the receiving of the user input of the text search query.

13. The method as described in claim **6**, further comprising transmitting the search query over a network to a search service and receiving the result from the search service via the network.

14. The method as described in claim **6**, further comprising searching one or more items of digital content stored locally by the at least one computing device and wherein the result is formed based on the searching.

15. In a digital medium environment to initiate and output a search, a system comprising:
- an object detection module implemented at least partially in hardware of a computing device to detect a type of object in an image of a physical environment, in which, the computing device is disposed; and
- an application launch module implemented at least partially in hardware of a computing device to:
  - identify an application that corresponds to the detected type of object; and
  - launch the identified application for execution by the computing device.

16. The system as described in claim **15**, further comprising a user interaction detection module implementation at least partially in hardware of the computing device to detect user interaction with the object in the physical envi-

ronment and wherein the detecting of the type of object is performed by the object detection module in response to the detected user interaction.

17. The system as described in claim **16**, wherein the detecting of the user interaction includes recognizing that a user has likely gazed at the object over a threshold amount of time.

18. The system as described in claim **16**, wherein the detecting of the user interaction includes recognizing that a user has performed a gesture.

19. The system as described in claim **18**, wherein the application launch module is further configured to initiate an operation of the identified application that corresponds to the recognized gesture.

20. The system as described in claim **15**, wherein the object is incapable of transmitting data to the computing device.

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