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Jun et al.

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(54) **ANIMAL EXERCISER SYSTEM**

(71) Applicant: **Petronics Inc.**, Champaign, IL (US)

(72) Inventors: **David Jun**, Urbana, IL (US); **Michael Friedman**, Champaign, IL (US); **David Cohen**, Champaign, IL (US)

(73) Assignee: **Petronics Inc.**, Champaign, IL (US)

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Related U.S. Application Data

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(51) **Int. Cl.**

A01K 15/02	(2006.01)
H04M 1/725	(2006.01)
G05D 1/00	(2006.01)
G01C 21/20	(2006.01)

(52) **U.S. Cl.**

CPC ***A01K 15/027*** (2013.01); ***A01K 15/021*** (2013.01); ***G01C 21/206*** (2013.01); ***G05D 1/0016*** (2013.01); ***H04M 1/72544*** (2013.01)

(58) **Field of Classification Search**

CPC .. A01K 15/027; A01K 15/021; G01C 21/206; G05D 1/0016; H04M 1/72544

See application file for complete search history.

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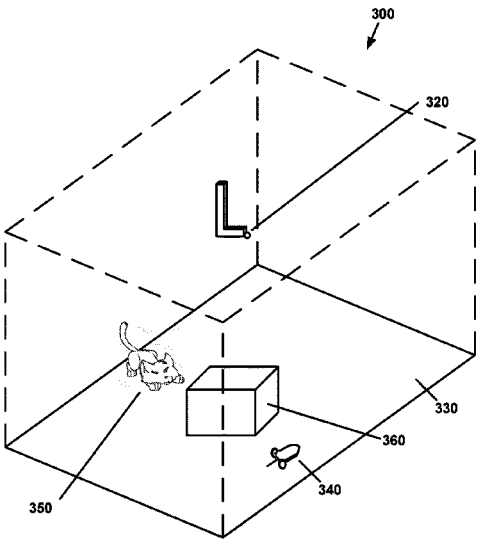
Primary Examiner — Calvin Cheung
(74) *Attorney, Agent, or Firm* — David Grossman

(57) **ABSTRACT**

A system comprises a mobile device, a spatial profiling device, and a mobile device manager. The mobile device comprises a platform, a first communications circuit that receives navigation instructions, and a motion drive that propels the platform according to the navigation instructions. The spatial profiling device captures a spatial profile of a motion area. The mobile device manager comprises at least one second communications circuit that communicates with the first communications circuit and the spatial profiling device, processor(s), and memory storing processing instructions. The instructions, when executed, cause the mobile device manager to receive spatial profiles, locate the mobile object, locate the mobile device, plan a movement for the mobile device which avoids the mobile object, and communicate the movement to the mobile device as navigation instructions.

20 Claims, 15 Drawing Sheets



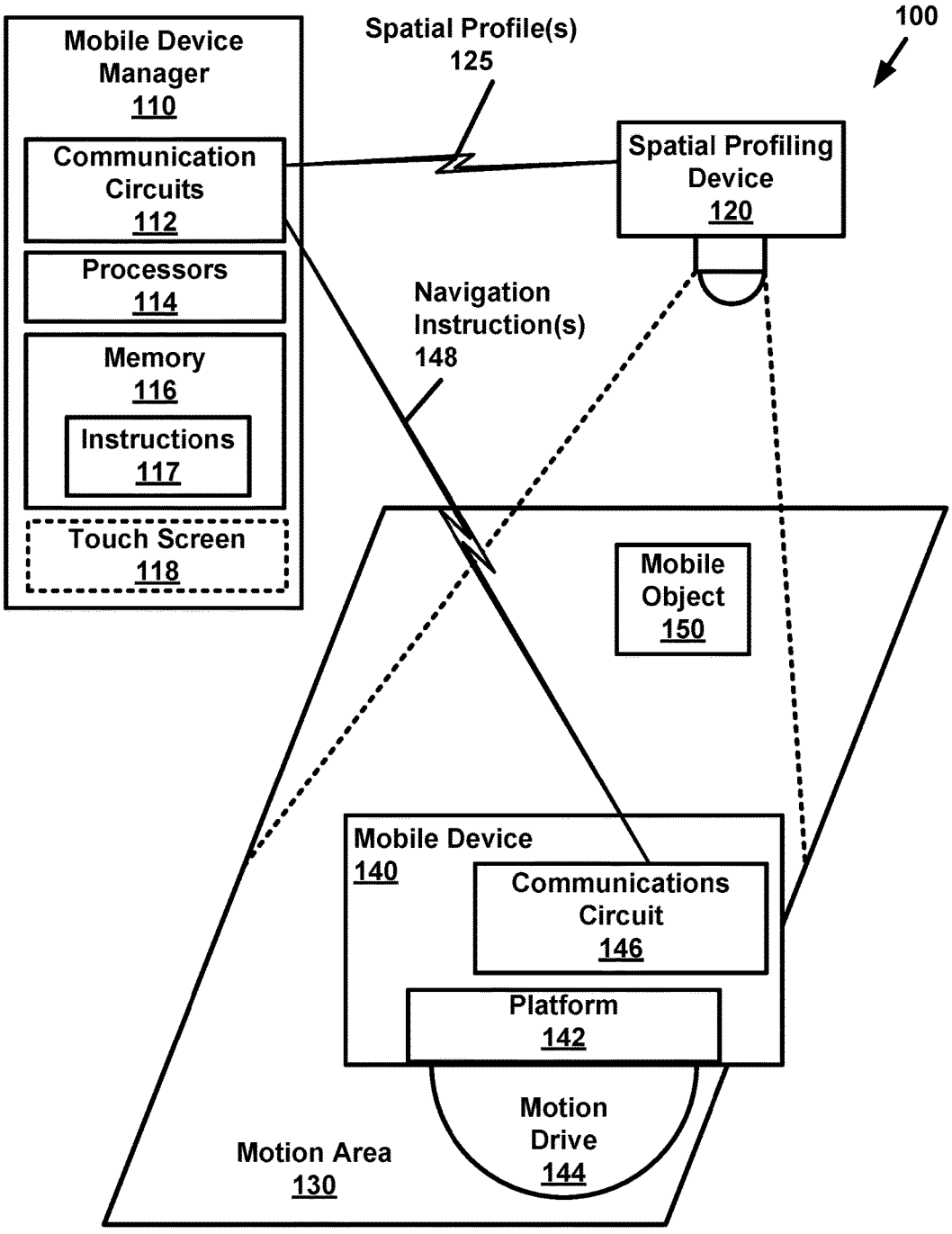

Mobile Device Manager
110
Communication Circuits
112
Processors
114
Memory
116
Instructions
117
Touch Screen
118
Spatial Profile(s)
125
100
Spatial Profiling Device
120
Navigation Instruction(s)
148
Mobile Object
150
Mobile Device
140
Communications Circuit
146
Platform
142
Motion Drive
144
Motion Area
130

FIG. 1

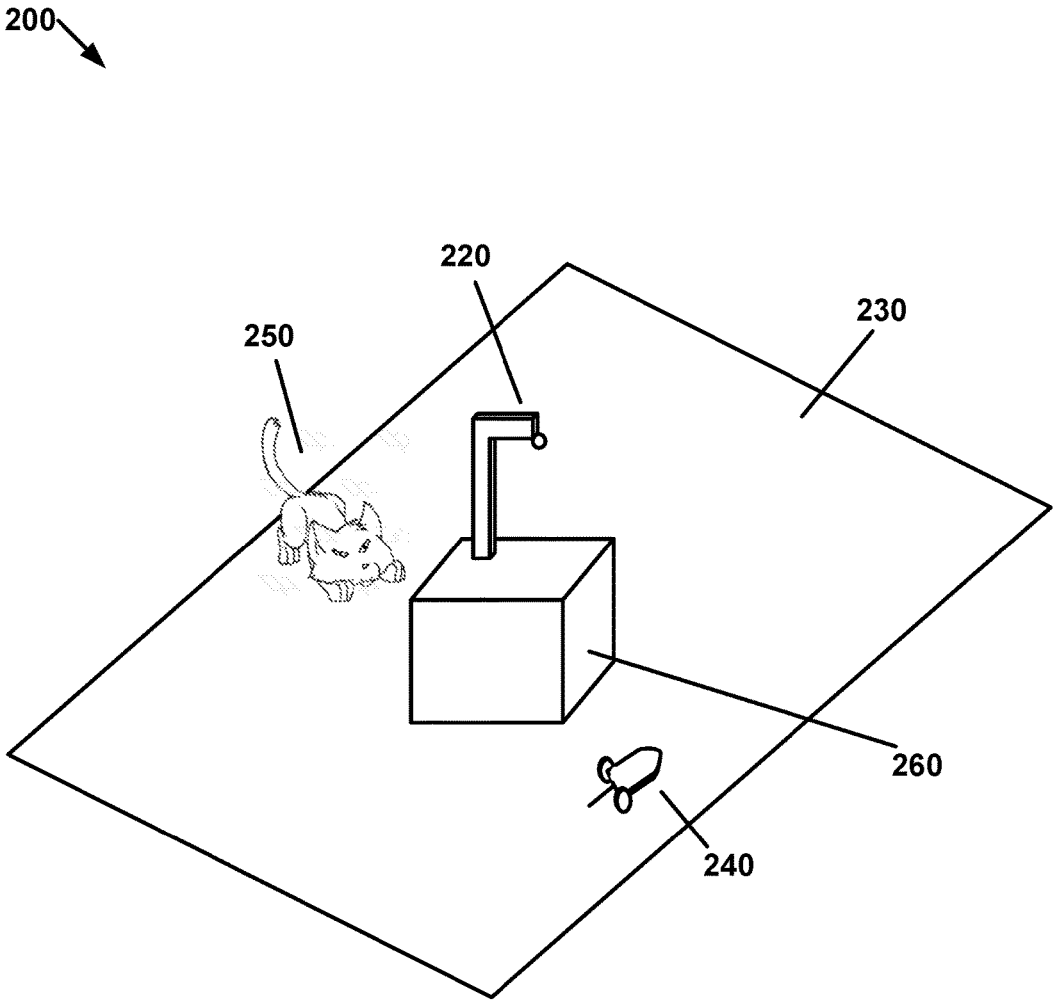


FIG. 2

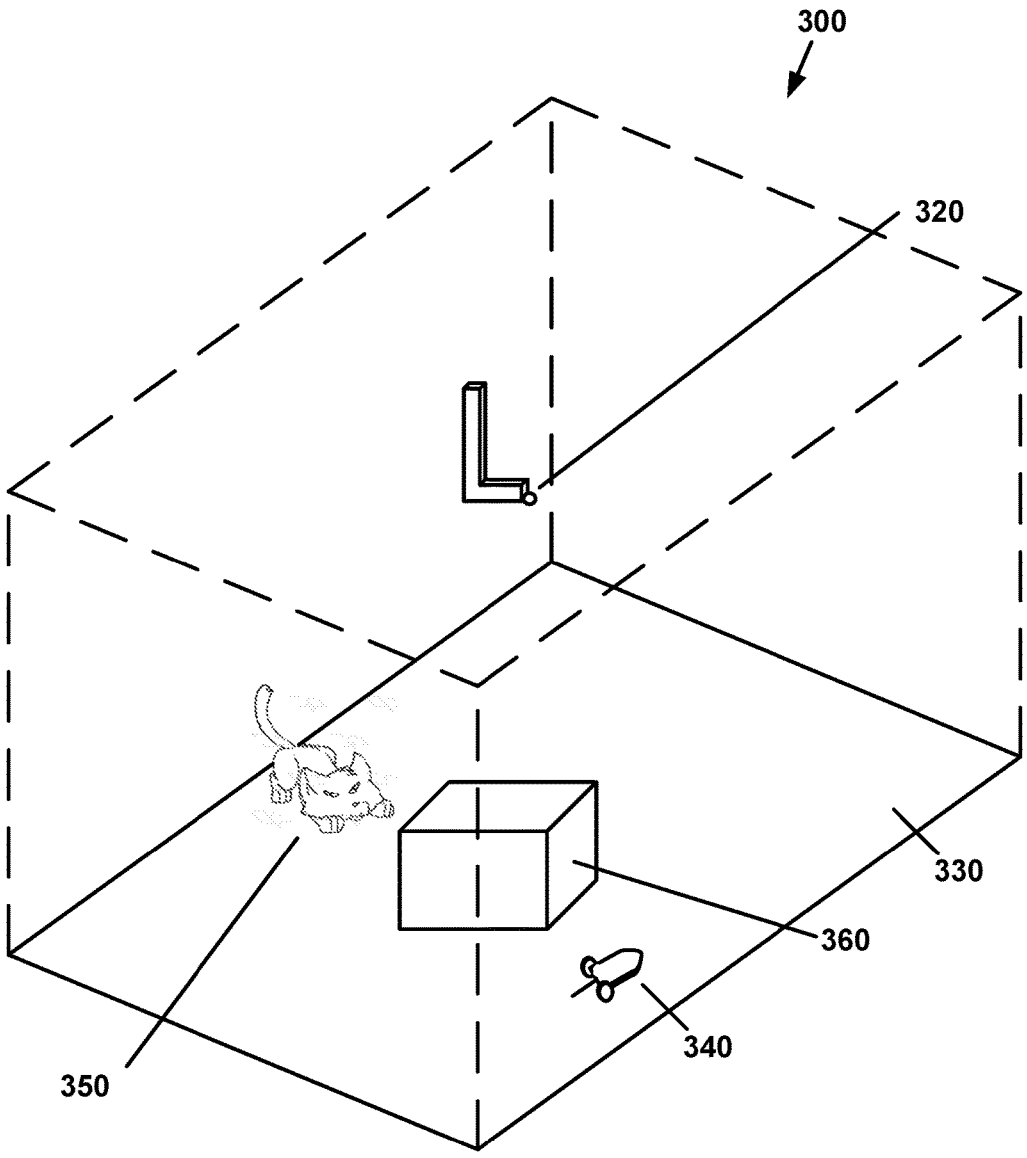


FIG. 3

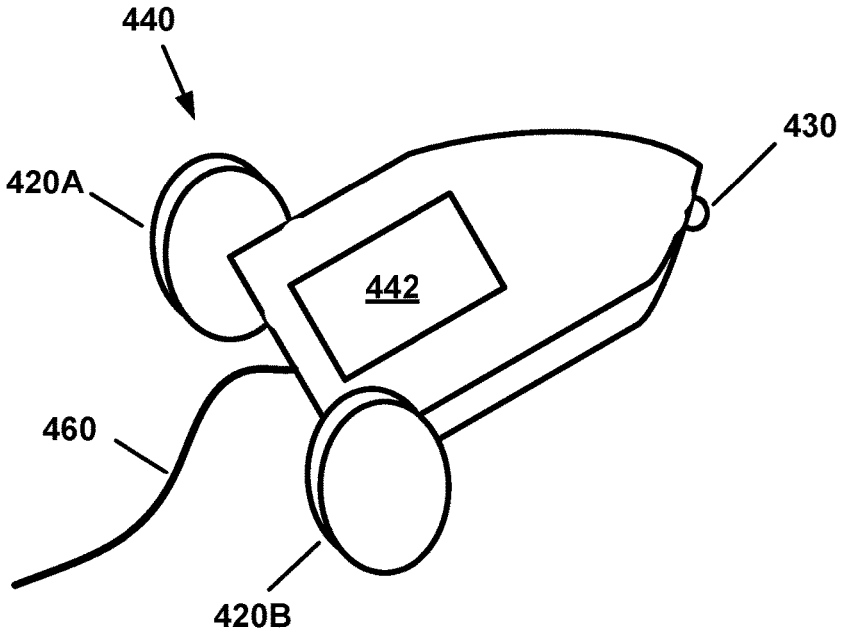

440
430
420A
442
460
420B

FIG. 4A

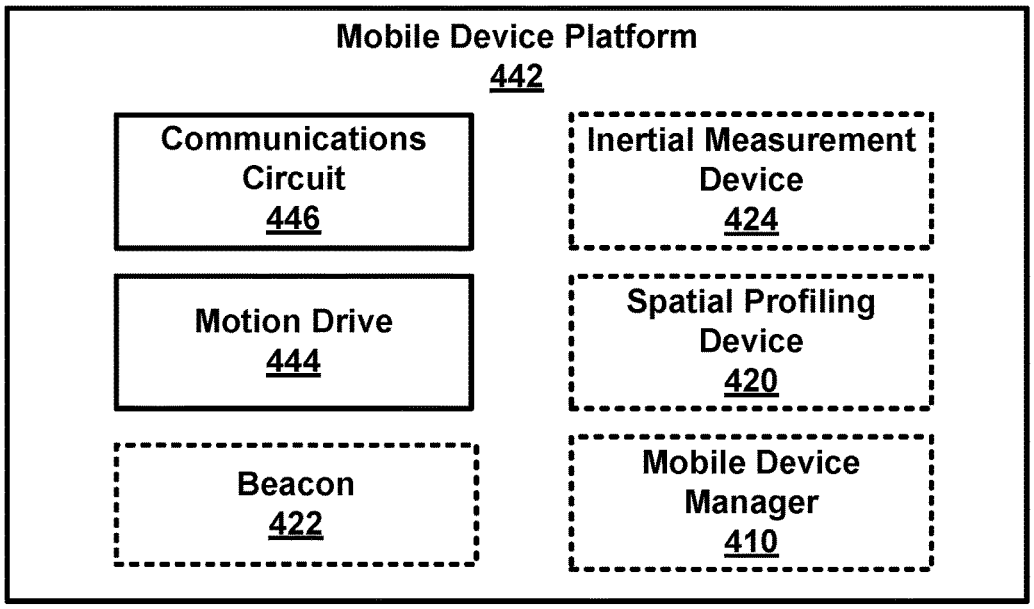

Mobile Device Platform
442
Communications Circuit
446
Inertial Measurement Device
424
Motion Drive
444
Spatial Profiling Device
420
Beacon
422
Mobile Device Manager
410

FIG. 4B

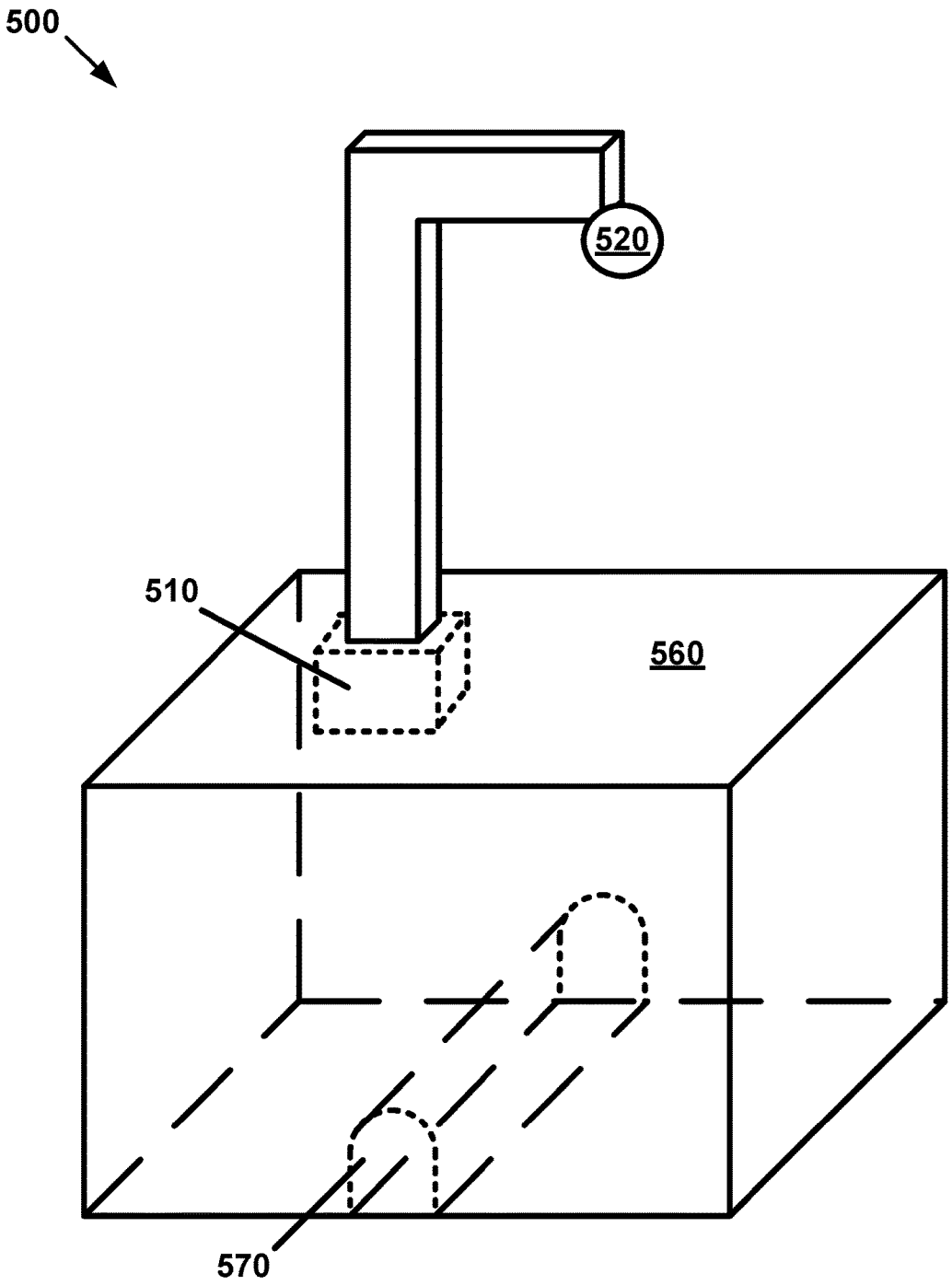


FIG. 5

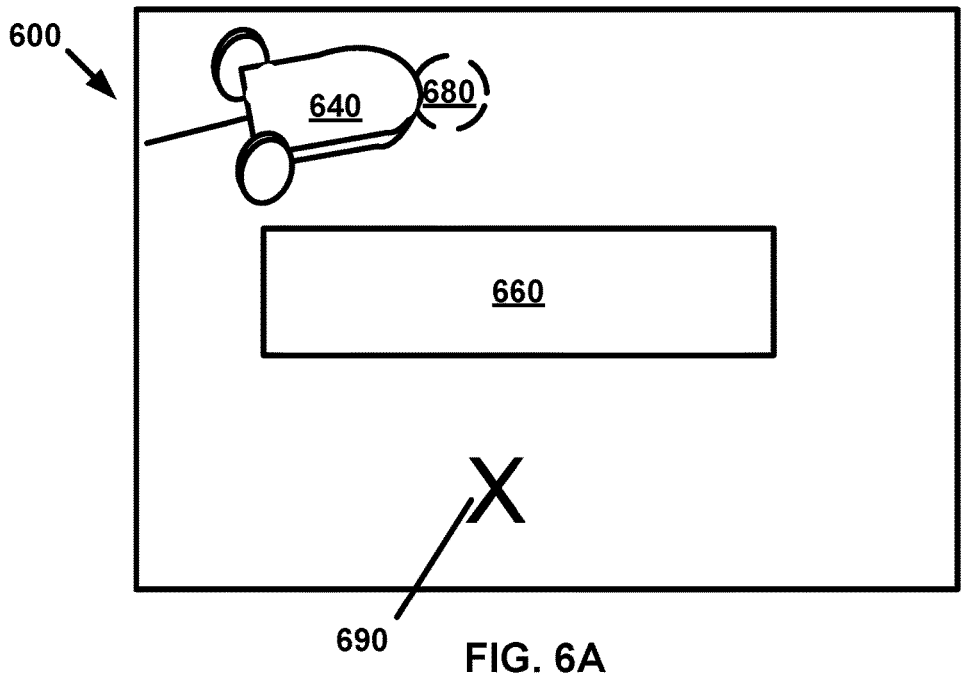


FIG. 6A

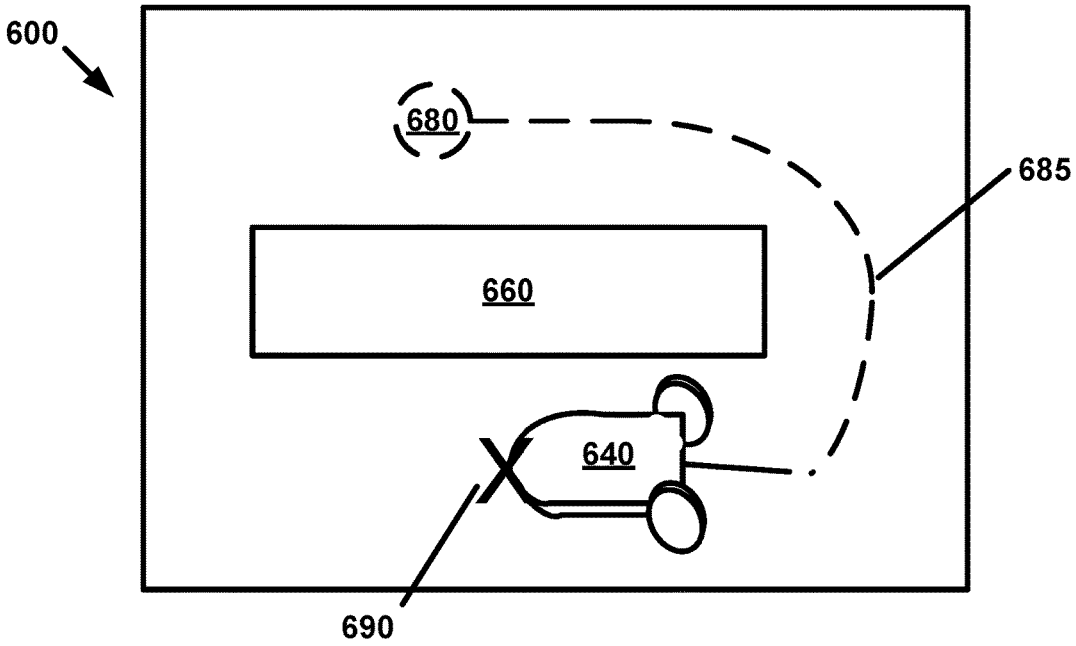


FIG. 6B

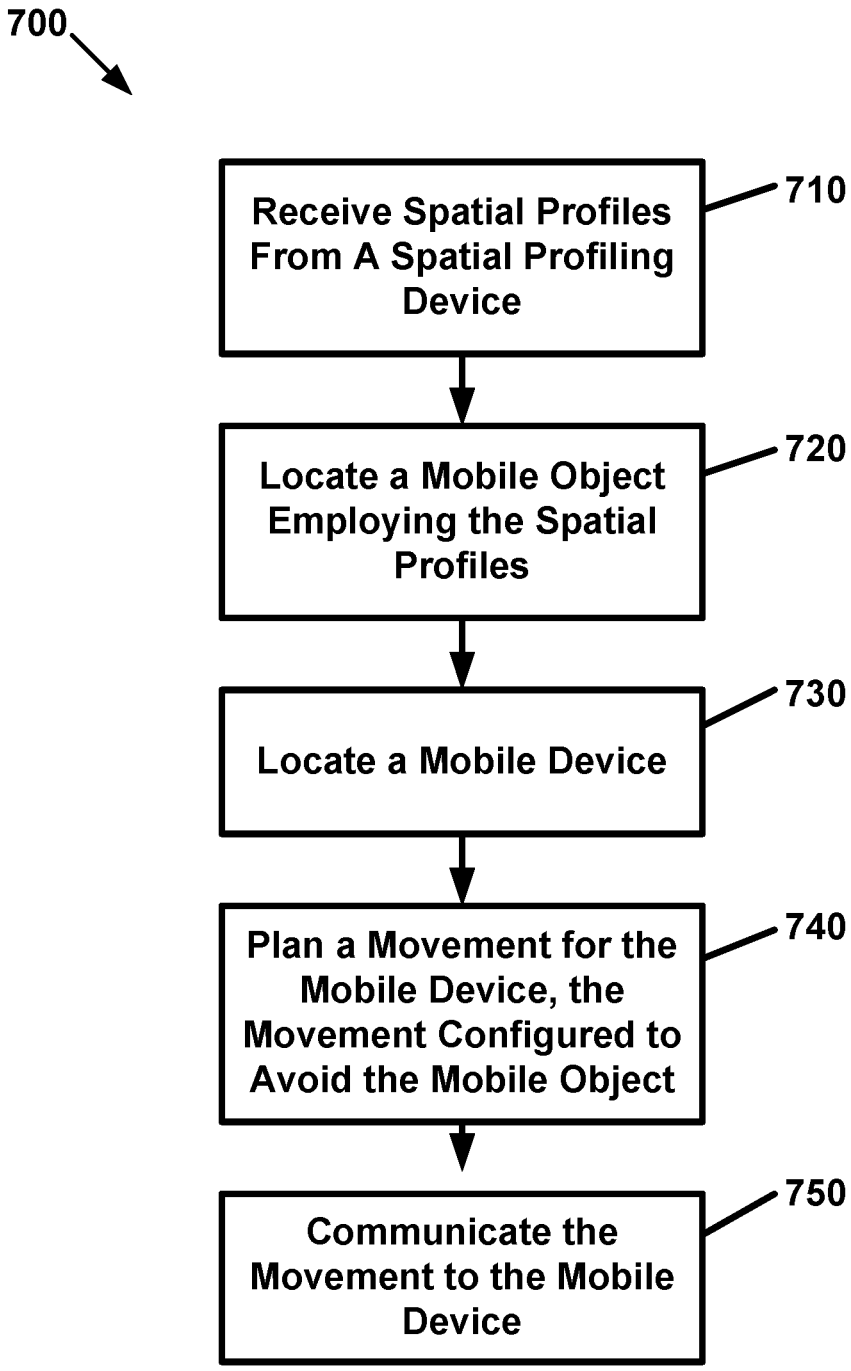

700
Receive Spatial Profiles From A Spatial Profiling Device
710
Locate a Mobile Object Employing the Spatial Profiles
720
Locate a Mobile Device
730
Plan a Movement for the Mobile Device, the Movement Configured to Avoid the Mobile Object
740
Communicate the Movement to the Mobile Device
750

FIG. 7

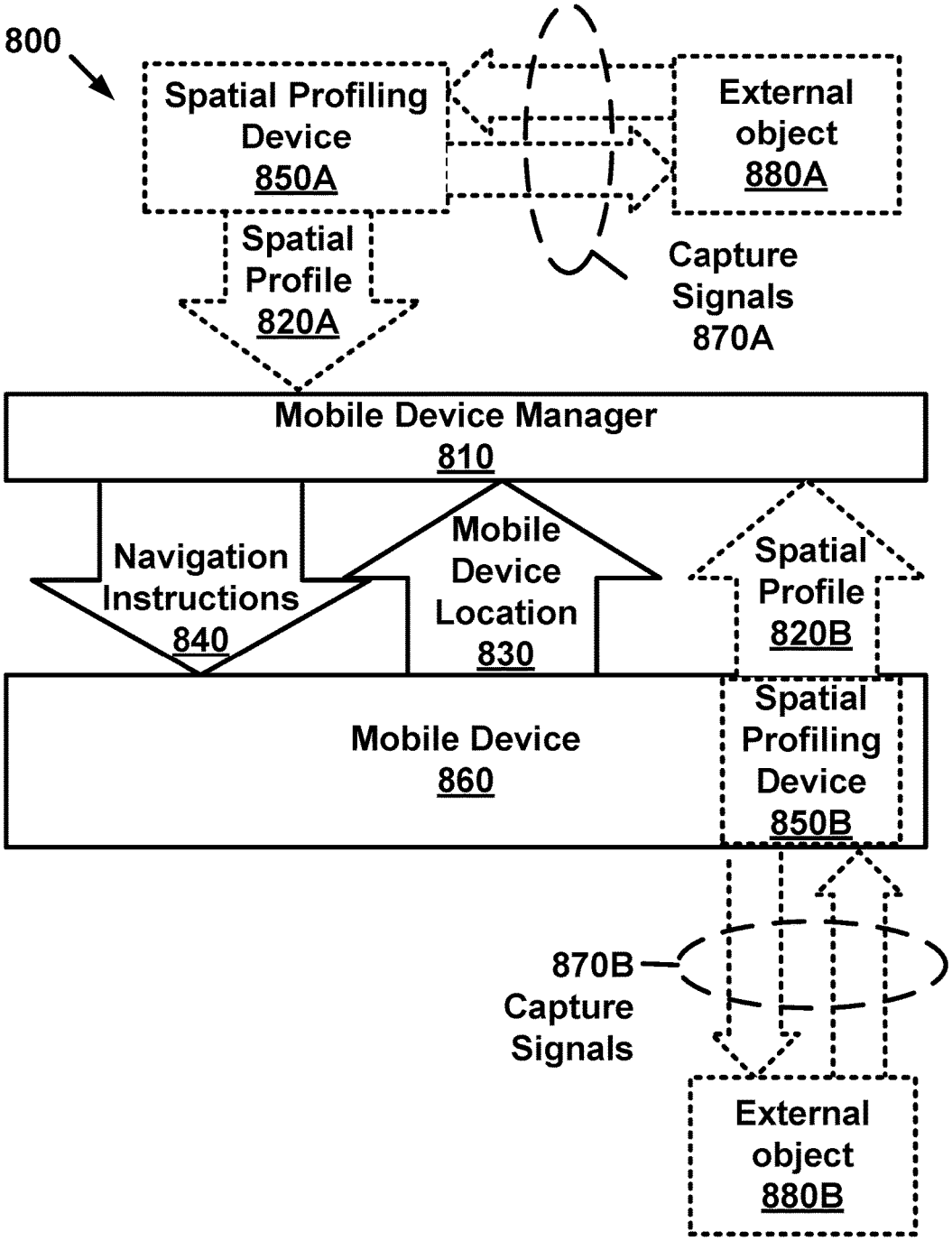

800
Spatial Profiling Device 850A
External object 880A
Spatial Profile 820A
Capture Signals 870A
Mobile Device Manager 810
Navigation Instructions 840
Mobile Device Location 830
Spatial Profile 820B
Mobile Device 860
Spatial Profiling Device 850B
870B Capture Signals
External object 880B

FIG. 8

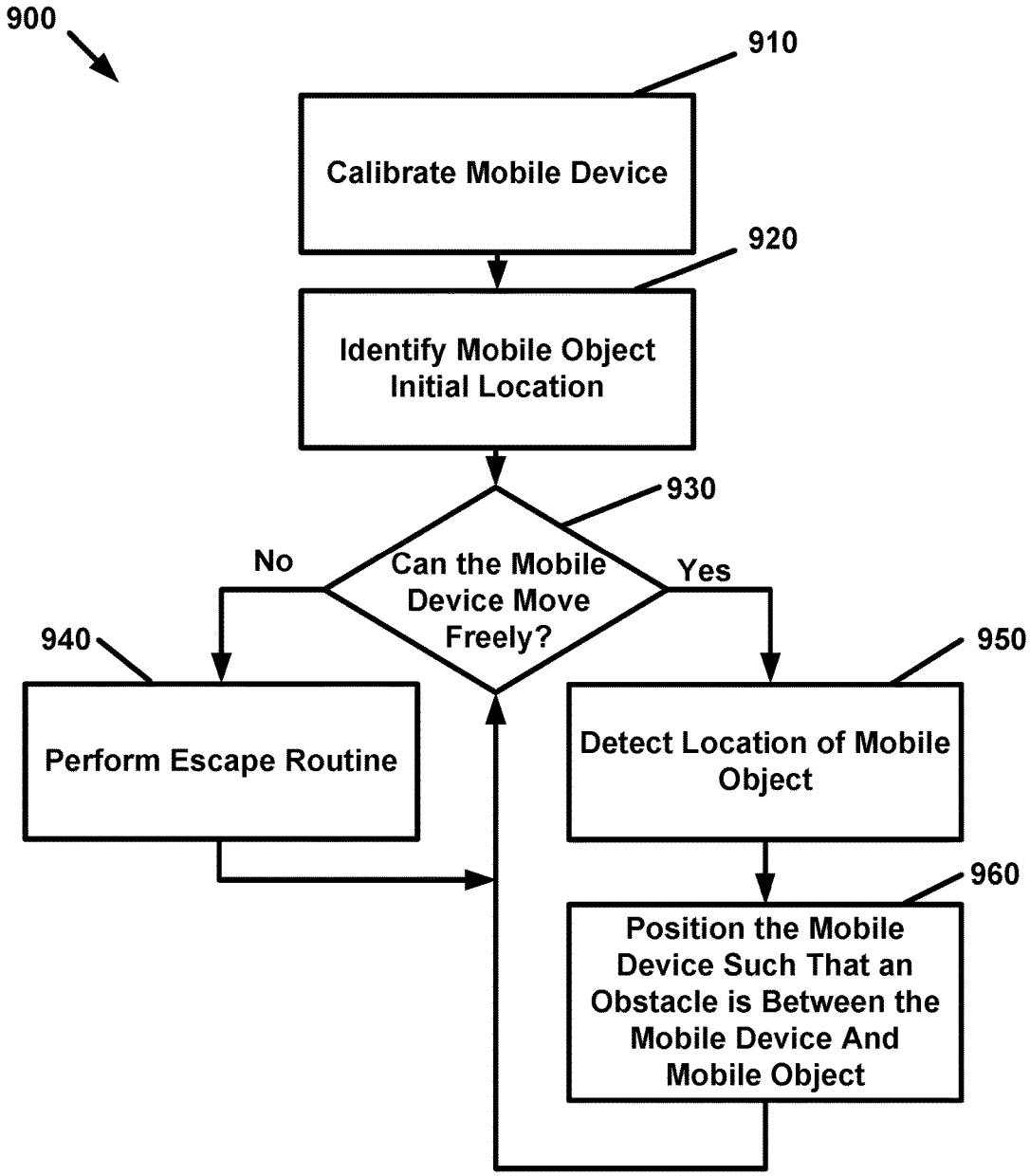

900
910
Calibrate Mobile Device
920
Identify Mobile Object Initial Location
930
Can the Mobile Device Move Freely?
No
Yes
940
Perform Escape Routine
950
Detect Location of Mobile Object
960
Position the Mobile Device Such That an Obstacle is Between the Mobile Device And Mobile Object

FIG. 9

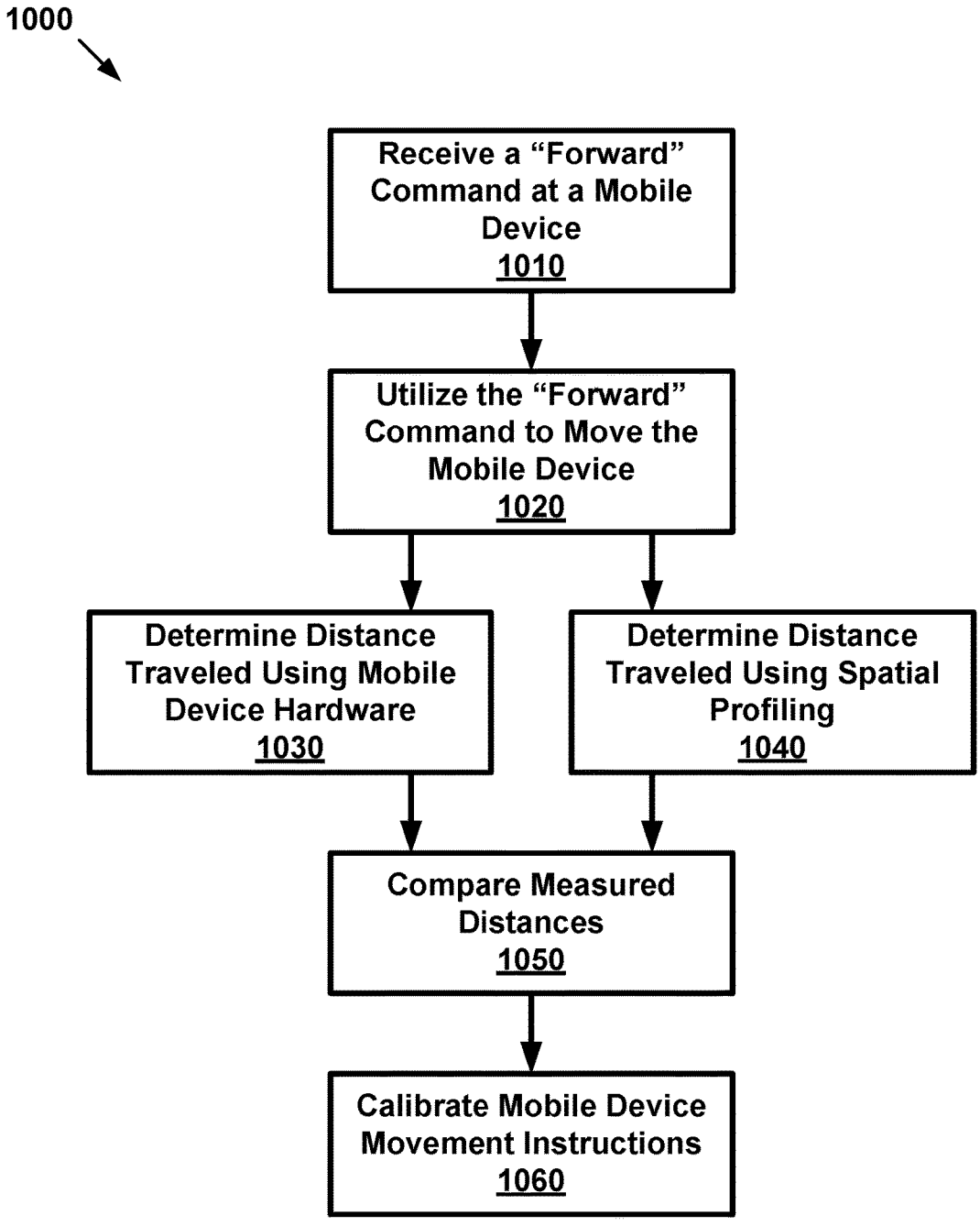

1000
Receive a "Forward" Command at a Mobile Device
1010
Utilize the "Forward" Command to Move the Mobile Device
1020
Determine Distance Traveled Using Mobile Device Hardware
1030
Determine Distance Traveled Using Spatial Profiling
1040
Compare Measured Distances
1050
Calibrate Mobile Device Movement Instructions
1060

FIG. 10

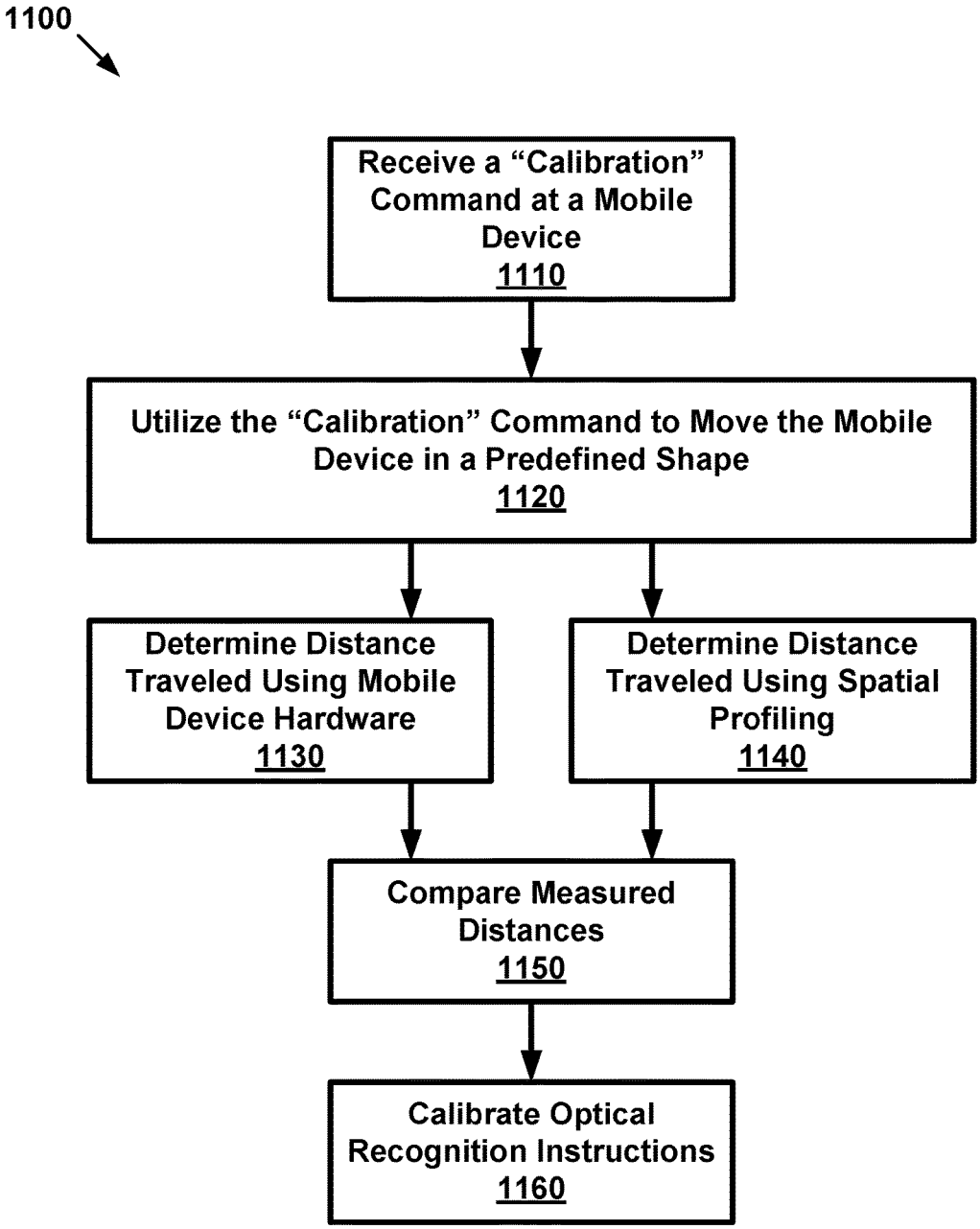

1100
Receive a "Calibration" Command at a Mobile Device
1110
Utilize the "Calibration" Command to Move the Mobile Device in a Predefined Shape
1120
Determine Distance Traveled Using Mobile Device Hardware
1130
Determine Distance Traveled Using Spatial Profiling
1140
Compare Measured Distances
1150
Calibrate Optical Recognition Instructions
1160

FIG. 11

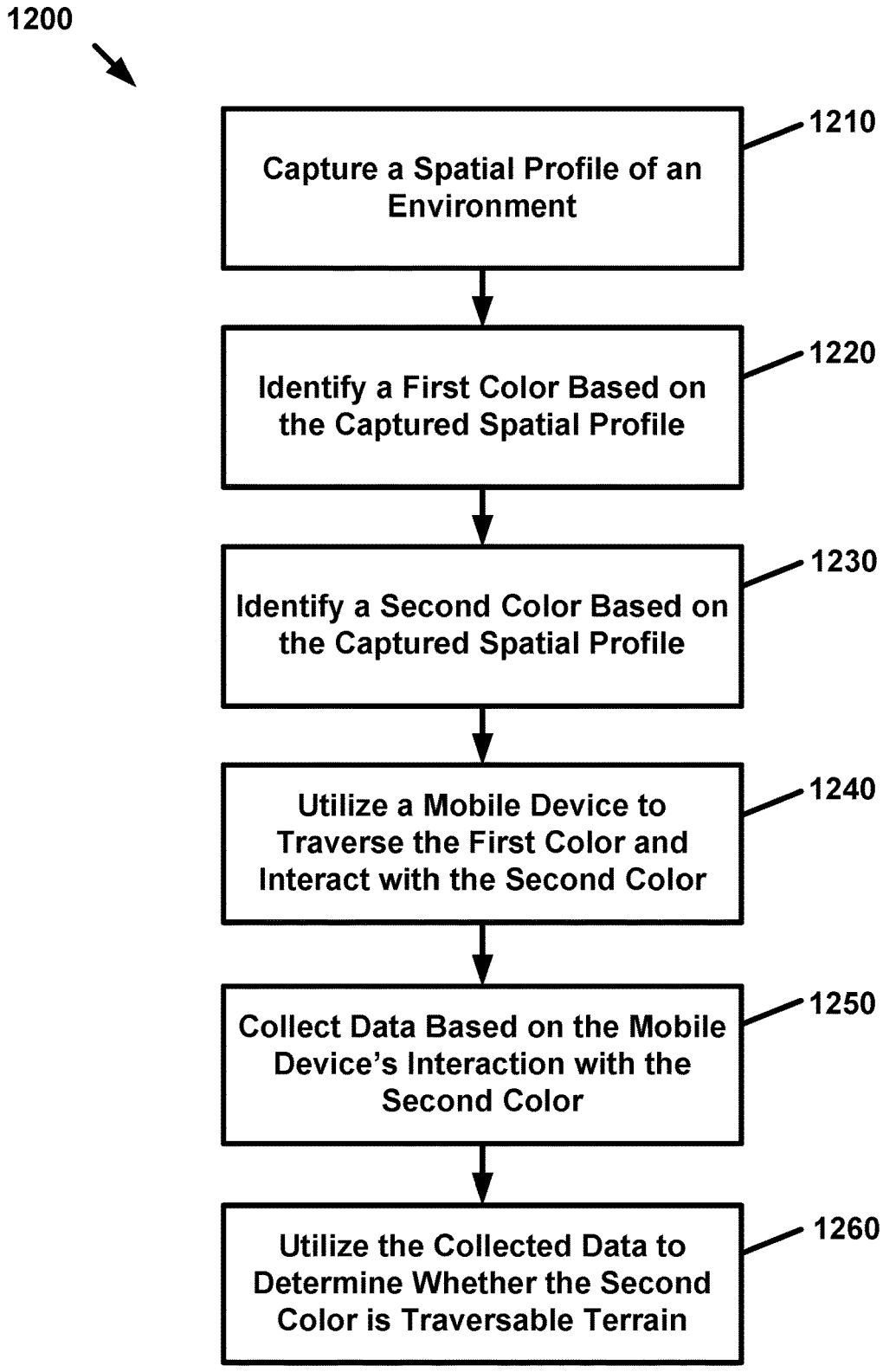

1200
Capture a Spatial Profile of an Environment
1210
Identify a First Color Based on the Captured Spatial Profile
1220
Identify a Second Color Based on the Captured Spatial Profile
1230
Utilize a Mobile Device to Traverse the First Color and Interact with the Second Color
1240
Collect Data Based on the Mobile Device's Interaction with the Second Color
1250
Utilize the Collected Data to Determine Whether the Second Color is Traversable Terrain
1260

FIG. 12

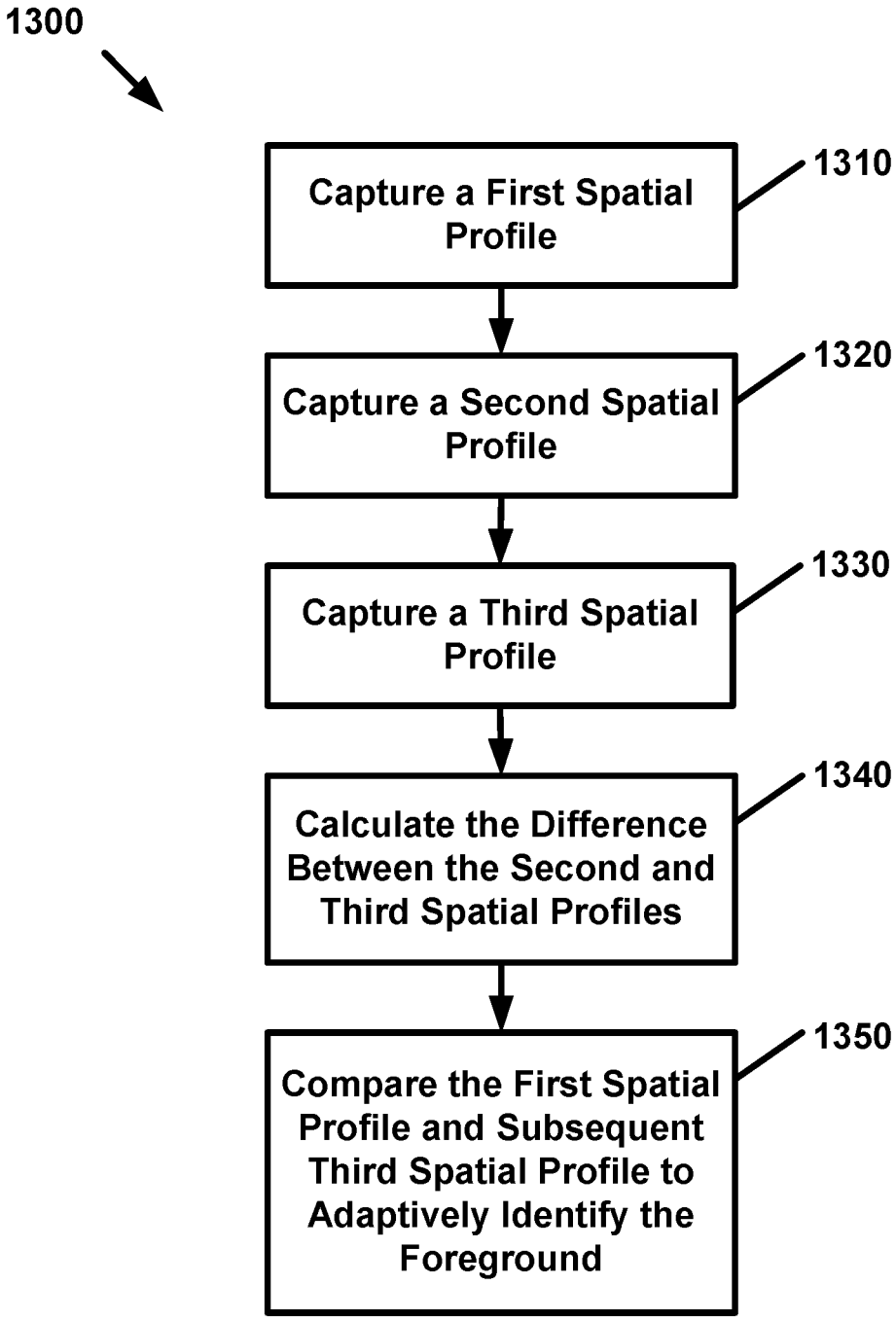

1300
Capture a First Spatial Profile
1310
Capture a Second Spatial Profile
1320
Capture a Third Spatial Profile
1330
Calculate the Difference Between the Second and Third Spatial Profiles
1340
Compare the First Spatial Profile and Subsequent Third Spatial Profile to Adaptively Identify the Foreground
1350

FIG. 13

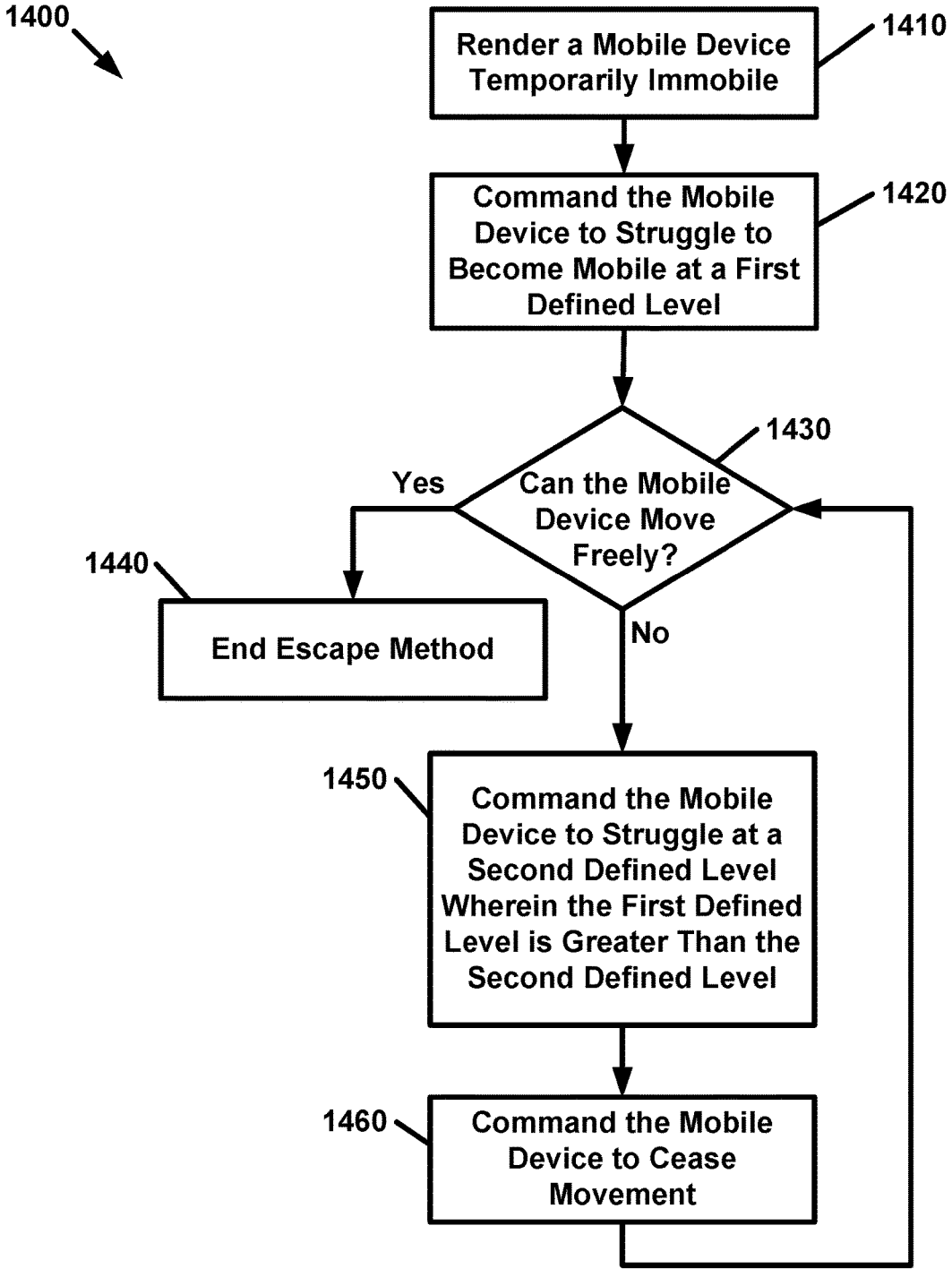

1400
Render a Mobile Device Temporarily Immobile
1410
Command the Mobile Device to Struggle to Become Mobile at a First Defined Level
1420
Can the Mobile Device Move Freely?
1430
Yes
No
1440
End Escape Method
1450
Command the Mobile Device to Struggle at a Second Defined Level Wherein the First Defined Level is Greater Than the Second Defined Level
1460
Command the Mobile Device to Cease Movement

FIG. 14

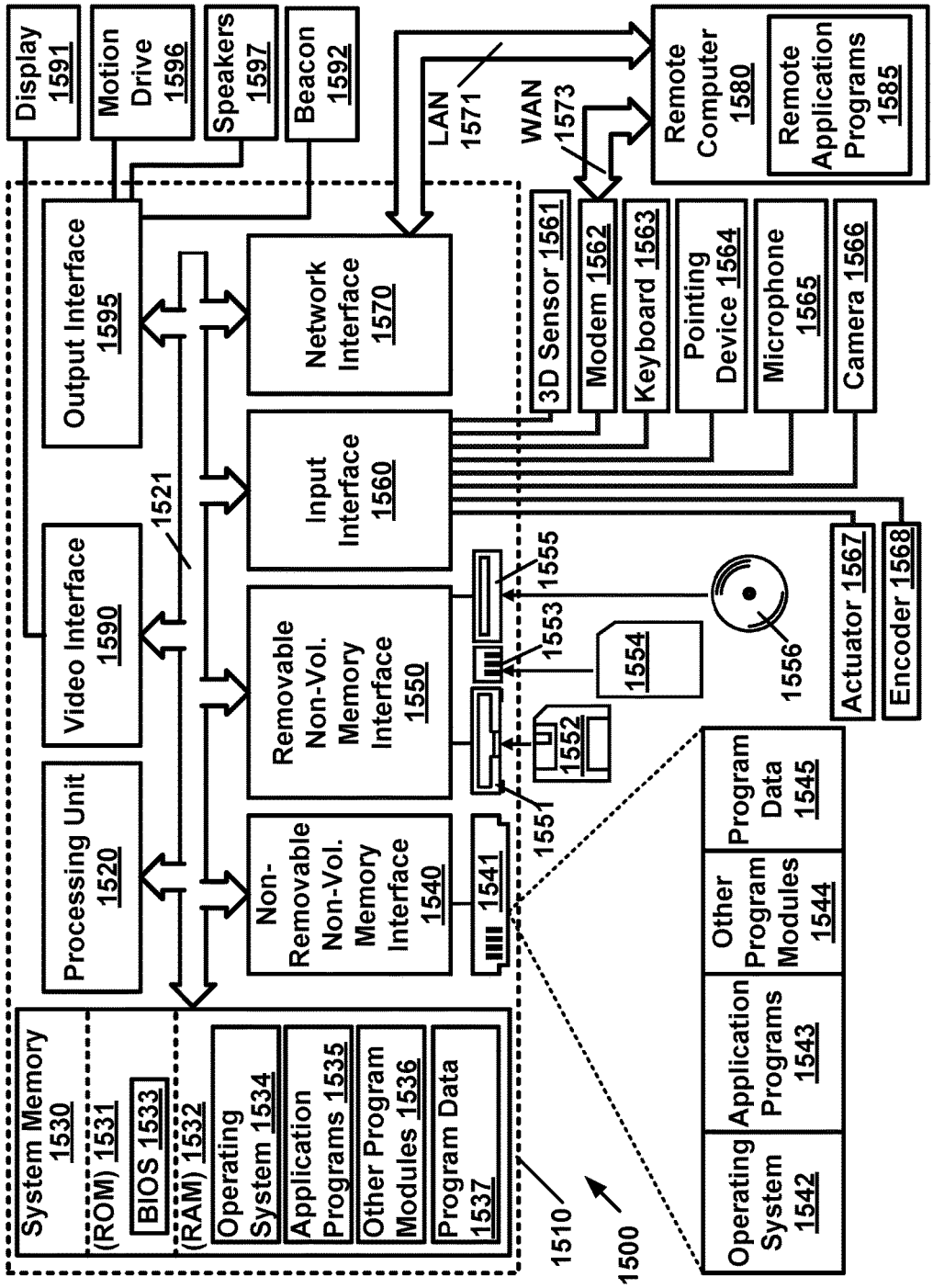

Display 1591
Motion Drive 1596
Speakers 1597
Beacon 1592
Output Interface 1595
Network Interface 1570
LAN 1571
WAN 1573
Remote Computer 1580
Remote Application Programs 1585
3D Sensor 1561
Modem 1562
Keyboard 1563
Pointing Device 1564
Microphone 1565
Camera 1566
Input Interface 1560
1521
Video Interface 1590
Removable Non-Vol. Memory Interface 1550
1555
1553
1554
1556
Actuator 1567
Encoder 1568
Processing Unit 1520
1552
1551
Non-Removable Non-Vol. Memory Interface 1540
1541
System Memory 1530
(ROM) 1531
BIOS 1533
(RAM) 1532
Operating System 1534
Application Programs 1535
Other Program Modules 1536
Program Data 1537
1510
1500
Operating System 1542
Application Programs 1543
Other Program Modules 1544
Program Data 1545

FIG. 15

ANIMAL EXERCISER SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 62/278,233, filed Jan. 13, 2016, entitled "Animal Exerciser," and U.S. Provisional Application No. 62/357,974, filed Jul. 2, 2016, entitled "Animal Exerciser," which are both hereby incorporated by reference in their entirety.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying figures are included to provide a further understanding, and are incorporated in and constitute a part of this specification. The drawings illustrate one or more embodiments. As such, the disclosure will become more fully understood from the following detailed description, taken in conjunction with the accompanying figures, in which:

FIG. **1** is a system diagram of an animal exerciser system as per an aspect of an embodiment of the present invention.

FIG. **2** is a system diagram of an animal exerciser system as per an aspect of an embodiment of the present invention.

FIG. **3** is a system diagram of an animal exerciser system as per an aspect of an embodiment of the present invention.

FIG. **4**A is a system diagram of a mobile device as per an aspect of an embodiment of the present invention.

FIG. **4**B is a block diagram of a mobile device platform as per an aspect of an embodiment of the present invention.

FIG. **5** is a system diagram of an obstacle system as per an aspect of an embodiment of the present invention.

FIG. **6**A is a system diagram of a screen display as per an aspect of an embodiment of the present invention.

FIG. **6**B is a system diagram of a screen display as per an aspect of an embodiment of the present invention.

FIG. **7** is a flow diagram of an avoidance process as per an aspect of an embodiment of the present invention.

FIG. **8** is a block diagram of a system interaction as per an aspect of an embodiment of the present invention.

FIG. **9** is a flow diagram of an avoidance process as per an aspect of an embodiment of the present invention.

FIG. **10** is a flow diagram of a calibration process as per an aspect of an embodiment of the present invention.

FIG. **11** is a flow diagram of a calibration process as per an aspect of an embodiment of the present invention.

FIG. **12** is a flow diagram of an obstacle detection process as per an aspect of an embodiment of the present invention.

FIG. **13** is a flow diagram of a mobile object detection process as per an aspect of an embodiment of the present invention.

FIG. **14** is a flow diagram of an escape process as per an aspect of an embodiment of the present invention.

FIG. **15** is a block diagram of a computer system as per an aspect of an embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

Embodiments may be employed to exercise and/or entertain an animal such as a cat and/or a dog.

Embodiments comprise a system that may comprise a mobile device, a spatial profiling device, and a mobile device manager. The mobile device may comprise a platform, a first communications circuit that receives navigation instructions, and a motion drive configured to propel the platform according to the navigation instructions. The spatial profiling device may capture a spatial profile of a motion area. The mobile device manager may comprise at least one second communications circuit that communicates with the first communications circuit and the spatial profiling device, processor(s), and memory storing processing instructions. The instructions, when executed, may cause the mobile device manager to receive spatial profiles, locate the mobile object, locate the mobile device, plan a movement for the mobile device which avoids the mobile object, and communicate the movement to the mobile device as navigation instructions.

Embodiments may comprise a process that may comprise receiving a spatial profile from a spatial profiling device, locating a mobile object employing the spatial profiles, locating a mobile device, planning a movement for the mobile device between a first location and a second location, and communicating the movement to the mobile device as navigation instructions employing a communications circuit. The movement may be configured to avoid the mobile object.

Embodiments may comprise a non-transitory tangible computer readable medium containing instructions configured to cause one or more processors to execute a process comprising: receiving spatial profiles from a spatial profiling device, locating a mobile object employing the spatial profiles, locating a mobile device, planning a movement for the mobile device between a first location and a second location, and communicating the movement to the mobile device as navigation instructions employing a communications circuit. The movement may be configured to avoid the mobile object.

This disclosure will now be described more fully with reference to the accompanying drawings, in which embodiments of this document are shown. This document should be read to include embodiments of many different forms and should not be construed as being limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the concepts contained within this document to those skilled in the art.

Referring to FIG. **1**, an animal exerciser system **100** is shown. According to an embodiment, the system **100** may comprise a mobile device **140**, a spatial profiling device **120**, and a mobile device manager **110**. According to an embodiment, at least the mobile device **140** and a mobile object **150** may be disposed within a motion area **130**.

The mobile device **140** may further comprise a platform **142**, a motion drive **144**, and a communications circuit **146**. In an embodiment, the motion drive **144** and communications circuit **146** may be disposed on the platform **142**.

Motion drive **144** may be configured to receive navigation instructions and to propel platform **142** according to the navigation instructions. To accomplish this movement, motion drive **144** may comprise a battery to supply electricity, DC or AC motors, and control mechanisms such as, for example, an H bridge. Motion drive **144** may propel the platform using mechanisms such as wheels, flopping wheels, tracks, plungers, legs, magnets, compressed air, a combination thereof, and/or the like.

The at least one communications circuit **146** may be configured to communicate with communications circuit **112** disposed on the mobile device manager **110** via navigation instructions **148**. This communication may occur via a wired interface, a wireless interface, a combination thereof, and/or the like. The communication may utilize wireless communication protocols such as Bluetooth®, LTE, Wi-Fi, radio waves, a combination thereof, and/or the

like. The communications circuit **146** may send and/or receive navigation instructions **148**. According to the navigation instructions **148**, the motion drive **144** may be configured to propel the platform **142** to move mobile device **140**.

The spatial profiling device **120** may comprise one or more sensors configured to collect spatial information in and/or around the motion area **130**. Examples of sensors comprise cameras, proximity sensors, motion sensors, a combination thereof, and/or the like. The spatial profiling device **120** may comprise a webcam, infrared projector, 3D scanner systems, such as, for example, a Microsoft Kinect™, a combination thereof, and/or the like. The spatial profiling device **120** may operate using pairs of emitters and detectors to detect objects. The spatial profiling device may capture spatial profiles **125** of the motion area **130**. Spatial profiles **125** may comprise images captured by sensors, such as a camera, or composites of the motion area **130** created using proximity sensors, motion sensors, a combination thereof, and/or the like. The spatial profiles **125** may be updatable and represent a depiction of the motion area **130**.

The mobile device manager **110** may comprise at least one communications circuit **112**, one or more processors **114**, and memory **116**. The at least one communications circuit **112** may be configured to receive spatial profiles **125** from the spatial profiling device **120**. The at least one communications circuit **112** may be configured to communicate with communications circuit **146** disposed on the mobile device **140** via navigation instructions **148**. According to an embodiment, the communications circuit **146** may direct the movement of mobile device **140** employing the navigation instructions **148**. Processors **114** may comprise a microprocessor produced by microprocessor manufacturers such as Advanced Micro Devices, Inc. (AMD) of Sunnyvale, Calif., Atmel Corporation of San Jose, Calif., Intel Corporation of Santa Clara, Calif., or Texas Instruments Inc. of Dallas, Tex. Processors **114** may comprise and/or be other logic-based controllers such as FPGAs or PLCs. Memory **116** may comprise nonvolatile memory configured to store processing instructions. Examples of memory **116** comprise ROM, EEPROM, Flash, a combination thereof, and/or the like. Memory **116** may comprise volatile memory such as, for example, RAM.

Contained within memory **116** may be instructions **117** that, when executed, may cause the mobile device manager **110** to receive spatial profiles **125** from the spatial profiling device and locate mobile object **150** employing the spatial profiles **125**. Mobile device manager **110** may locate mobile device **140**. Mobile device manager **110** may plan a movement for mobile device **140** between a first location and a second location in motion area **130**. The movement may be configured to avoid mobile object **150**. The movement may be communicated to mobile device **140** as navigation instructions **148** by employing communications circuit **112**. The processing instructions **117** may cause the mobile device manager **110** to plan the movement employing an expected movement of mobile object **150**. The mobile device **140** may be located using infrared light. The mobile device **140** may be located employing a wheel encoder. Mobile device manager **110** may distinguish colors in received spatial profiles **125**. Mobile device manager **110** may detect a distance of at least one of the mobile device **140** and the mobile object **150** from a known location in the received spatial profiles **125**. The mobile object **150** may be located employing motion detection and background detection techniques.

According to an embodiment, mobile device manager **110** may comprise a touch screen display **118**. According to an embodiment, the mobile device manager **110** may comprise a device containing a touch screen display such as, for example, a mobile phone, tablet, desktop, a laptop computer, a combination thereof, and/or the like. In embodiments utilizing touch screen display **118**, memory **116** may contain instructions that, when executed, cause the mobile device manager **110** to show at least one of the spatial profiles on touch screen display **118**. The mobile device manager **110** may also determine a second location via a selection on touch screen display **118**.

The mobile object **150** may be an animal such as a cat, a dog, a human, and/or the like. The mobile object **150** may comprise a second mobile device. The second mobile device may be similar to mobile device **140**. Essentially, mobile object **150** may be an item that has the capacity to move.

The motion area **130** may comprise a region of space in which the mobile device **140** and/or the mobile object **150** may operate. The mobile device **140** and/or the mobile object **150** may move in motion area **130**. Further, spatial profiling device **120** may be configured to capture portions of motion area **130** and/or the entirety of motion area **130**. According to an embodiment, motion area **130** may be a space within a home dwelling, a room, and/or the like.

Referring to FIG. **2**, an animal exerciser system **200** is shown. According to an embodiment, system **200** may comprise a mobile device **240** and an obstacle **260**. A spatial profiling device **220**, that may be configured to capture a two or three dimensional spatial profile, may be positioned relative to and/or on the obstacle **260**. System **200** may operate within motion area **230** and interact with mobile object **250**. Mobile object **250** may comprise, as illustrated in this example, a cat.

In system **200**, mobile device **240** may move to avoid mobile object **250** by positioning itself (mobile device **240**) such that obstacle **260** is between mobile device **240** and mobile object **250**. To accomplish this objective, obstacle **260**, which may comprise processing features, may utilize a spatial profile of motion area **230**. The spatial profile may be created employing spatial profiling device **220**. According to an embodiment, obstacle **260** may comprise a preexisting piece of furniture either in a dwelling and/or outdoors. The processing may be performed in an attachment to the preexisting obstacle **260**. According to an embodiment, spatial profiling device **220** may comprise a camera and the spatial profiles captured may comprise images. To capture motion area **230**, the spatial profiling device **220** may utilize a wide-angle lens. In terms of positioning, spatial profiling device **220** may be positioned vertically above obstacle **260** so that spatial profiling device **220** may identify obstacle **260** within motion area **230**. According to an embodiment, spatial profiling device **220** may be affixed on an arm that is attached to obstacle **260** at a height that allows spatial profiling device **220** to obtain a spatial profile of motion area **230**. According to an embodiment, spatial profiling device **220** may identify mobile device **240** and mobile object **250** using spatial profiling assist equipment. For example, mobile device **240** may emit a beacon using a light emitting diode that may be in the visible and/or infrared spectrum that spatial profiling device **220** is configured to detect. In terms of tracking mobile object **250**, the spatial profiling device **220** may utilize motion detection techniques. Thus, as mobile object **250** moves around obstacle **260**, mobile device **240** may move to a position such that obstacle **260** is positioned between mobile device **240** and mobile object **250**.

Referring to FIG. **3**, an animal exerciser system **300** is shown. In an embodiment, system **300** may comprise a mobile device **340**, an obstacle **360**, and a spatial profiling device **320**. System **300** may operate within motion area **330** and interact with a mobile object **350**. Mobile object **350** may be an animal such as the illustrated cat.

In contrast to system **200** depicted in FIG. **2**, system **300** may utilize a spatial profiling device **320** that is detached from obstacle **360**. According to an embodiment, spatial profiling device **320** may be attached to, for example, the ceiling of a room in order to capture motion area **330**. Spatial profiling device **320** may comprise one or more sensors such as cameras, proximity sensors, motion sensors, a combination thereof, and/or the like. Motion area **330** may be a two and/or three dimensional space. Spatial profiling device **320** may also reside in alternative locations, such as, for example, on a tabletop, a counter, a shelf, other existing furniture within a room, a combination thereof, and/or the like. Further, for outdoor applications, spatial profiling device **320** may be mounted outside of a building, such as on the exterior of a building and/or home.

Referring to FIG. **4**A, mobile device **440** is shown. According to an embodiment, mobile device **440** may comprise a mobile device platform **442**, wheels **420**A and **420**B coupled to wheel encoders, a stability nub **430**, and a tail **460**. Mobile device platform **442** may be a surface upon which circuitry may be disposed. For example, platform **442** may be an insulated sheet and/or a type of circuit board. Mobile device platform **442** may be disposed with a plastic casing while wheels **420**A and **420**B may reside on the sides of the casing. The wheel encoders coupled to wheels **420**A and **420**B may provide information to the mobile device **440** circuitry and may be utilized, at least in part, to determine distance, speed, acceleration, combination thereof, and/or the like. Stability nub **430** may be positioned to balance the movement of mobile device **440**. According to an embodiment, stability nub **430** may be a wheel. According to an embodiment, stability nub **430** may be a spherically shaped plastic. In terms of operation, platform **442** and wheels **420**A and **420**B may be placed in a manner configured to allow mobile device **440** to remain mobile even when in a flipped orientation. That is, the motion drive **444** may be configured to keep mobile device **440** functional and to propel platform **442** even when platform **442** is in a flipped orientation. According to an embodiment, tail **460** may comprise an attachment to entice the attention of a mobile object, such as a cat. Tail **460** may be a string but may also comprise various colors, noise makers such as a bell, other attention generating items, a combination thereof, and/or the like.

FIG. **4**B is a block diagram of mobile device platform **442**. According to an embodiment, platform **442** may comprise a communications circuit **446** and/or a motion drive **444**. Communications circuit **446** may comprise circuitry configured to interface with other components contained on mobile device platform **442**. Communication circuit **446** may be configured to communicate with systems external to the mobile device. For example, communications circuit **446** may send data concerning mobile device **440** such as distance measurements, speed measurements, inertial measurements, a combination thereof, and/or the like. Further, communications circuit **446** may be configured to receive instructions from an external system that may direct the movement of mobile device **440**.

Motion drive **444** may be configured to receive navigation instructions and to move wheels **420**A and **420**B according to those instructions. To accomplish this movement, motion drive **444** may comprise a battery to supply electricity, DC or AC motors, and/or control mechanisms such as an H bridge. Motion drive **444** may also operate without employing wheels **420**A and **420**B and still propel platform **442** using such mechanisms such as tracks, plungers, legs, magnets, compressed air, a combination thereof, and/or the like.

Platform **442** may house a beacon **422**. Beacon **422** may emit an electromagnetic signal. An electromagnetic signal may comprise a modulated wave or synchronized oscillations of electric and magnetic fields. Examples of electromagnetic signals comprise a signal in the ultraviolet, visible light, infrared, radio wave spectrum, a combination thereof, and/or the like. The signal emitted by beacon **422** may allow an external imaging device to detect mobile device **440**.

Platform **442** may house an inertial measurement device **424**. The inertial measurement device **424** may comprise, for example, a device configured to measure changes in acceleration, magnitude, and/or direction. Examples comprise an accelerometer and/or gyroscope configured to measure changes in acceleration of the mobile device **440**. This information may be employed to determine the orientation of mobile device **440**, collisions, unlevel terrain, other types of interactions that mobile device **440** may have with the environment, a combination thereof, and/or the like.

Platform **442** may operate without reference to an external system and house a spatial profiling device **420** along with a mobile device manager **410**. This autonomous embodiment may utilize spatial profiling device **420** to generate spatial profile(s) of the environment in which mobile device **440** operates. Spatial profiling device **420** may comprise a camera mounted such that the lens captures visual information above mobile device **440**. Spatial profiles may be created employing the images captured by the lens. Spatial profiling device **420** may comprise a light emitter and detector pair to generate a spatial profile. In this embodiment, a light emitter such as a light emitting diode may produce electromagnetic waves such as infrared light, ultraviolet light, visible light, a combination thereof, and/or the like. The detector may be, for example, a light emitting diode, a photodiode, a phototransistor, a combination thereof, and/or the like. The detector may be configured to capture reflections of the emitted light, and using the reflections, create a spatial profile of the environment surrounding mobile device **440**. That is, the spatial profiles may map the locations of objects as well as predict the location of obstacles. According to an embodiment, spatial profiling device **420** may comprise several emitter/detector pairs.

Utilizing the spatial profiles, mobile device manager **410** may direct the movement of mobile device **440** to avoid obstacles as well as other mobile objects that may obstruct the movement of mobile device **440**. Mobile device manager **410** may utilize communications circuit **446** to control motion drive **444** to execute these maneuvers. Mobile device manager **410**, however, may also utilize instructions received by the communications circuit with or without information from the spatial profiling device **420** in order to direct the movement of mobile device **440**. Mobile device **440** may operate without the need for any external navigation instructions but may still have the capability to receive and utilize commands or instructions sent from an external system.

Referring to FIG. **5**, an obstacle system **500** is shown. In an embodiment, obstacle system **500** may comprise a base obstacle **560**, a spatial profiling device **520**, a mobile device manager **510**, and one or more tunnels **570**. Base obstacle **560** may comprise preexisting furniture within a home and/or outdoors, but may also be a specially designed structure. In an embodiment, spatial profiling device **520**

may attach to base obstacle **560** by, for example, an arm that supports the spatial profiling device **520**. Spatial profiling device **520** may communicate with mobile device manager **510**. Utilizing captured spatial profiles, mobile device manager **510** may detect the locations of mobile objects and/or mobile devices and plot navigation procedures for mobile devices. Further, mobile device manager **510** may be configured to communicate with mobile devices, transmitting and/or receiving information such as navigation instructions, spatial profile information generated by the mobile device, mobile device location information, mobile object location information, a combination thereof, and/or the like.

Obstacle system **500** may comprise one or more tunnels **570** that may be utilized by a mobile device. According to an embodiment, tunnels **570** may take various shapes and may be large enough to house the mobile device. Tunnels **570** may also pass completely through or only partially through base obstacle **560**.

Referring to FIG. **6**A, a screen display **600** is shown. Screen display **600** may appear on a desktop or laptop computer. Screen display **600** may appear on a device with a touch screen interface such as a mobile phone, a tablet, and/or the like. Screen display **600** may display an image generated from a camera. Screen display **600** may display an image that is being captured in real-time. In an embodiment, screen display **600** may display a mobile device **640**, an obstacle **660**, a starting location **680**, and a final location **690**.

Mobile device **640** may be a remotely controlled device. A user may direct the movement of mobile device **640** based on the visual information provided to the user on screen display **600**. The user may provide an input and specify a final location **690** for the mobile device **640** to move. User input may come from a selection using computer periphery such as a mouse click and/or a tap on a touch screen display. A user could potentially shift the area displayed on the screen, allowing the user to make a final location **690** selection beyond the initial frame shown. FIG. **6**A illustrates a user selection of a final location **690** on the opposite side of obstacle **660** relative to the starting location **680** of the mobile device **640**.

FIG. **6**B shows screen display **600** after the mobile device **640** has moved from starting location **680** to final location **690**. To complete this movement, mobile device **640** may follow path **685**. In an embodiment, path **685** may be curved and may curve around obstacle **660** so that mobile device **640** may arrive at final location **690** without colliding with obstacle **660**. Proximity sensors on mobile device **640** may be employed to avoid collision.

Image recognition, employing the imaging device used to generate the image displayed on screen display **600**, may be employed to plan a movement based on visually recognizing obstacle **660**. Computation to plan and execute the mobile device **640** movement may occur on a mobile device manager that may be disposed on the user input device, the mobile device **640**, or within obstacle **660**.

FIG. **7** is a flow diagram of an avoidance method **700**. According to an embodiment, spatial profiles may be received from a spatial profiling device at **710**. At **720**, the received spatial profiles may be employed in locating a mobile object. At **730**, a mobile device may be located. At **740**, a movement for the mobile device may be planned. The movement may be configured to avoid the mobile object. According to an embodiment, the avoidance may comprise identifying a hiding location that may be outside of the view of the mobile object. In another embodiment, the movement may be planned such that an obstacle may be positioned between the mobile device and the mobile object. At **750**, the planned movement may be communicated to the mobile device.

FIG. **8** is a block diagram of system interaction **800**. According to an embodiment, information may flow into and out of mobile device manager **810**. For example, spatial profiles (e.g., **820**A and/or **820**B) may flow from spatial profiling device (e.g., **850**A and/or **850**B) into mobile device manager **810**. Further, mobile device manager **810** may receive information concerning the mobile device location **830** from mobile device **860**. In terms of transmitted information, mobile device manager **810** may send navigation instructions **840** to mobile device **860**.

A spatial profile (e.g., **820** and/or **820**B), may be generated employing a spatial profiling device (e.g., **850**A and/or **850**B). Spatial profiling device **850**B may reside on mobile device **860**. Spatial profiling device **850**A may reside external to mobile device manager **810** and mobile device **860**. In either embodiment, spatial profiling device (e.g., **850**A and/or **850**B) may utilize capture signals (e.g., **870**A and/or **870**B) to interface with an external object (e.g., **880**A and/or **880**B). Capture signals (e.g., **870**A and/or **870**B) may represent the capturing of an image when spatial profiling device (e.g., **850**A and/or **850**B) is in view of a camera. Capture signals (e.g., **870**A and/or **870**B) may employ emitter/detector pairs which utilize emitted infrared, visible, or ultraviolet light to detect proximity. Spatial profiling device (e.g., **850**A and/or **850**B) may utilize a detector to measure the amount of light reflected by external object (e.g., **880**A and/or **880**B) to formulate a spatial profile (e.g., **820**A and/or **820**B).

FIG. **9** is a flow diagram of avoidance method **900**. According to an embodiment, avoidance method **900** may calibrate a mobile device at **910**. At **920**, a mobile object's initial location may be identified. At **930**, a check may be made to determine whether the mobile device can move freely. If the mobile device cannot move freely, an escape routine may be performed at **940**. If the mobile device can move freely, the location of a mobile object may be detected at **950** and the mobile device may be positioned such that an obstacle is between the mobile device and the mobile object at **960**.

FIG. **10** is a flow diagram of calibration method **1000**. According to an embodiment, a "forward" command may be received at a mobile device at **1010**. At **1020**, the "forward" command may be utilized to move the mobile device. According to an embodiment, the utilization of the "forward" command may cause the mobile device to move in a straight line. At **1030**, the distance traveled may be determined employing the mobile device sensing hardware. This determination may be accomplished, for example, employing counts from a wheel encoder. At **1040**, distance traveled may be determined employing spatial profiling. This determination may be accomplished employing a spatial profiling device such as a camera. The camera may be onboard the mobile device and/or externally mounted in a manner such that the mobile device is visible to the lens of the camera. At **1050**, two measured distances may be compared. According to an embodiment, the comparison may result in a difference between the measured distances. At **1060**, the difference between the measured distances may be employed to calibrate the navigation instructions commanding the movement of the mobile device. In an embodiment, calibration may adjust either the instructions used by the spatial profiling device, the instructions used in formulating a navigation instruction, or both.

FIG. **11** is a flow diagram of a calibration method **1100**. According to an embodiment, a "calibration" command may be received at a mobile device at **1110**. At **1120**, the "calibration" command may be utilized to move the mobile device in a predefined path. In an embodiment, the predefined path may follow a circle, square, a triangle, a combination thereof, and/or the like. At **1130**, the distance traveled may be determined employing the mobile device hardware. This determination may be accomplished employing counts from a wheel encoder. At **1140**, the distance traveled may be determined employing spatial profiling. This determination may be accomplished employing a spatial profiling device such as, for example, a camera which may be onboard the mobile device and/or externally mounted in a manner such that the mobile device is visible to the lens of the camera. By moving along a predefined path, the measurement captured employing spatial profiling may provide additional information, which may include information concerning the positioning of the spatial profiling device. For example, moving along a predefined shape may yield differing results between spatial profiling devices that are pointed directly toward the ground versus a spatial profiling device that is tilted. At **1150**, the two measured distances may be compared. According to an embodiment, the comparison may result in a difference between the measured distances. At **1160**, the difference between the measured distances may be employed to calibrate the instructions used in commanding the movement of the mobile device. According to an embodiment, the calibration may adjust either the instructions employed by the spatial profiling device, the instructions employed in formulating a navigation instruction, or both.

FIG. **12** is a flow diagram of an obstacle detection method **1200**. According to an embodiment, a spatial profile of an environment may be captured at **1210**. At **1220**, a first color may be identified based on the captured spatial profile. At **1230**, a second color may be identified based on the captured spatial profile. At **1240**, a mobile device may be employed to traverse the first color and interact with the second color. According to an embodiment, the interaction with the second color may occur by commanding the mobile device to drive into the second color. In another embodiment, a mobile device equipped with proximity sensors may drive close to the edge of the area labeled as the second color. The mobile device may interact with the second color employing an emitter/detector pair of infrared light, visible light, ultraviolet light, a combination thereof, and/or the like. At **1250**, data may be collected based on the mobile device's interaction with the second color. In an embodiment where the mobile device is driven into the second color, the data collected may be an inertial measurement from accelerometers, gyroscopes, a combination thereof, and/or the like. This data may reflect a collision with the area marked as a second color. In the embodiment where the interaction occurs based on an emitter/detector pair, the detector may or may not detect a reflection. At **1260**, the collected data may be employed to determine whether the second color is traversable terrain. In an embodiment where the mobile device is driven into the second color, a sudden change in acceleration may reflect a collision with an obstacle. In this case, the second color may be labeled as terrain that may not be traversable. In an embodiment where the interaction occurs based on an emitter/detector pair, a strong detected reflection may indicate the presence of an obstacle that may not be traversable while a lack of detected reflection may indicate that an obstacle may not be present and the terrain may be traversable. Both of these embodiments, along with others, may be employed to detect obstacles.

FIG. **13** is a flow diagram of a mobile object detection method **1300**. According to an embodiment, a first spatial profile may be captured at **1310**. At **1320**, a second spatial profile may be captured. At **1330**, a third spatial profile may be captured. At **1340**, the difference between the second and third spatial profiles may be calculated. Motion detection techniques may be employed where, for example, spatial profiles are images. At **1350**, the first spatial profile may be compared with the third spatial profile to adaptively identify the foreground. Step **1350** may be repeated in order to adaptively identify the foreground to compare with the background generated from the first spatial profile and other continuously updated first spatial profiles. According to an embodiment, mobile object detection method **1300** may be completed employing computer vision techniques. Computer vision techniques may comprise foreground detection techniques such as, for example, background detection, temporal average filters, training times, Gaussian adaptation, 3D data acquisition and reconstruction, a combination thereof, and/or the like.

FIG. **14** is a flow diagram of an escape method **1400**. According to an embodiment, a mobile device may be temporarily rendered immobile at **1410**. A mobile device may be rendered temporarily immobile by a force external to the mobile device such as, for example, a cat grabbing or blocking the mobile device. At **1420**, the mobile device may be commanded to struggle at a first defined level to become mobile. At **1430**, a check may be performed to determine if the mobile device is able to move freely. If the mobile device is able to move freely, escape method **1400** may end **1440**. If the mobile device is unable to move freely, at **1450**, the mobile device may be commanded to struggle at a second defined level. The first defined level may be greater than the second define level. At **1460**, the mobile device may be commanded to cease movement. This movement pattern may simulate a "dying" effect seen when a larger animal catches a smaller animal—for example, when a cat catches a mouse. As the smaller animal is caught, the smaller animal may lose life until the smaller animal ceases to move or struggle. After recognizing this behavior, the larger animal may lose interest in the smaller animal, allowing the smaller animal to become mobile again. This behavior is reflected by checking to see whether the mobile device is free again at **1430**.

Referring to FIG. **15**, an example system **1500** for implementing some embodiments includes a computing device **1510**. Components of computer **1510** may include, but are not limited to, a processing unit **1520**, a system memory **1530**, and a system bus **1521** that may couple various system components including the system memory to the processing unit **1520**.

Computing device **1510** may comprise a variety of computer readable media. Computer readable media may be media that may be accessed by computing device **1510** and may comprise volatile and/or nonvolatile media, and/or removable and/or non-removable media. By way of example, and not limitation, computer readable media may comprise computer storage media and communication media. Computer storage media may comprise volatile and/or nonvolatile, and/or removable and/or non-removable media implemented in a method and/or technology for storage of information such as computer readable instructions, data structures, program modules or other data. Computer storage media comprises, but is not limited to, random

access memory (RAM), read-only memory (ROM), electrically erasable programmable read-only memory (EEPROM), flash memory or other memory technology, compact disc read-only memory (CD-ROM), digital versatile disks (DVD) or other optical disk 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 computer **1510**. Communication media typically embodies computer readable instructions, data structures, program modules 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" 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 may comprise wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, radio frequency (RF), infrared and other wireless media configured to communicate modulated data signal(s). Combinations of any of the above may also be included within the scope of computer readable media.

The system memory **1530** may comprise computer storage media in the form of volatile and/or nonvolatile memory such as ROM **1531** and RAM **1532**. A basic input/output system (BIOS) and/or extensible Firmware Interface (EFI) **1533** comprising basic routines that may help to transfer information between elements within computer **1510**, such as during start-up, may be stored in ROM **1531**. RAM **1532** may comprise data and/or program modules that may be immediately accessible to and/or presently being operated on by processing unit **1520**. By way of example, and not limitation, FIG. **15** illustrates operating system **1534**, application programs **1535**, other program modules **1536**, and/or program data **1537** that may be stored in RAM **1532**.

Computing device **1510** may comprise other removable/non-removable volatile/nonvolatile computer storage media. By way of example, FIG. **15** illustrates a hard disk drive **1541** that may read from and/or write to non-removable, nonvolatile magnetic media, a magnetic disk drive **1551** that may read from or writes to a removable, nonvolatile magnetic disk **1552**, a flash drive reader **1557** that may read flash drive **1558**, and an optical disk drive **1555** that may read from or write to a removable, nonvolatile optical disk **1556** such as a Compact Disc Read Only Memory (CD ROM), Digital Versatile Disc (DVD), Blue-ray Disc™ (BD) or other optical media. Other removable/non-removable, volatile/nonvolatile computer storage media that may be employed in the example operating environment include, but are not limited to, magnetic tape cassettes, flash memory cards, digital versatile disks, digital video tape, solid state RAM, solid state ROM, and the like. The hard disk drive **1541** may be connected to the system bus **1521** through a non-removable memory interface such as interface **1540**, and magnetic disk drive **1551** and optical disk drive **1555** may be connected to the system bus **1521** by a removable memory interface, such as interface **1550**.

The drives and their associated computer storage media discussed above and illustrated in FIG. **15** may provide storage of computer readable instructions, data structures, program modules and other data for the computing device **1510**. In FIG. **15**, for example, hard disk drive **1541** is illustrated as storing operating system **1542**, application programs **1543**, program data **1545**, and other program modules **1544**. Additionally, for example, non-volatile memory may include instructions to, for example, discover and configure IT device(s); the creation of device neutral user interface command(s); combinations thereof, and/or the like.

A user may enter commands and information into computing device **1510** through input devices such as a keyboard **1563**, a microphone **1565**, a camera **1566**, actuator **1567**, and a pointing device **1564**, such as a mouse, trackball, touch pad, and/or a touch screen interface. These and other input devices may be connected to the processing unit **1520** through a input interface **1560** that may be coupled to the system bus, but may be connected by other interface and bus structures, such as a parallel port, game port or a universal serial bus (USB).

Actuator **1567** may be connected to the system bus **1521** via Input Interface **1560**. A 3D sensor **1561** may be connected to the system bus **1521** via Input **1560**. Examples of 3D sensor(s) **1561** comprise an accelerometer, an inertial navigation unit, a 3D digitizer, and/or the like. A modem **1562** may be connected to the system bus **1521** via input interface **1560**.

Encoder **1568** may be connected to system bus **1521** via input interface **1560**. Encoder **1568** may be coupled to wheels and/or provide rotational data.

A monitor **1591** or other type of display device may be connected to the system bus **1521** via an interface, such as a video interface **1590**. Other devices, such as, for example, speakers **1597** and motion drive **1596** may be connected to the system via output interface **1595**. Motion drive **1596** may comprise a battery to supply electricity, DC or AC motors, and any necessary control mechanisms such as, for example, an H bridge.

Computing device **1510** may be operated in a networked environment using logical connections to one or more remote computers, such as a remote computer **1580**. The remote computer **1580** may be a personal computer, a mobile device, a hand-held device, a server, a router, a network PC, a medical device, a peer device or other common network node, and may comprise many or all of the elements described above relative to the computing device **1510**. The logical connections depicted in FIG. **15** include a local area network (LAN) **1571** and a wide area network (WAN) **1573**, but may also comprise other networks such as, for example, a cellular network. Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the Internet.

When used in a LAN networking environment, computing device **1510** may be connected to the LAN **1571** through a network interface or adapter **1570**. When used in a WAN networking environment, computing device **1510** typically includes a modem **1562** or other means for establishing communications over the WAN **1573**, such as the Internet. The modem **1562**, which may be internal or external, may be connected to the system bus **1521** via the input interface **1560**, or other appropriate mechanism. The modem **1562** may be wired or wireless. Examples of wireless devices may comprise, but are limited to: Wi-Fi, Near-field Communication (NFC) and Bluetooth®. In a networked environment, program modules depicted relative to computing device **1510**, or portions thereof, may be stored in a remote computer **1580**. By way of example, and not limitation, FIG. **15** illustrates remote application programs **1585** as residing on remote computer **1580**. It will be appreciated that the network connections shown are exemplary and other means of establishing a communications link between the computers may be used. Additionally, for example, LAN **1571** and WAN **1573** may provide a network interface to communicate with other distributed infrastructure management

device(s); with IT device(s); with users remotely accessing input interface **1560**; combinations thereof, and/or the like.

While various embodiments have been described above, it should be understood that they have been presented by way of example, and not limitation. It will be apparent to persons skilled in the relevant art(s) that various changes in form and detail can be made therein without departing from the spirit and scope. In fact, after reading the above description, it will be apparent to one skilled in the relevant art(s) how to implement alternative embodiments. Alternative embodiments may comprise include utilizing multiple mobile devices to create a game. The game may be played on a tabletop or on the ground. The game may involve user control of multiple mobile devices. Alternative embodiments may comprise utilizing mobile devices to entertain children and/or adults. Children and/or adults may chase mobile devices. Thus, the present embodiments should not be limited by any of the above described embodiments.

In addition, it should be understood that the figures and algorithms, which highlight the functionality and advantages of the present invention, are presented for example purposes only. The architecture of the present invention is sufficiently flexible and configurable, such that it may be utilized in ways other than that shown in the accompanying figures and algorithms. For example, the steps listed in any flowchart may be re-ordered or only optionally used in some embodiments.

It should be noted the terms "including" and "comprising" should be interpreted as meaning "including, but not limited to".

In this specification, "a" and "an" and similar phrases are to be interpreted as "at least one" and "one or more." References to "the," "said," and similar phrases should be interpreted as "the at least one", "said at least one", etc. References to "an" embodiment in this disclosure are not necessarily to the same embodiment.

It is the applicant's intent that only claims that include the express language "means for" or "step for" be interpreted under 35 U.S.C. 112. Claims that do not expressly include the phrase "means for" or "step for" are not to be interpreted under 35 U.S.C. 112.

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What is claimed is:

1. A system, comprising:

a mobile device comprising:

a platform;

a first communications circuit configured to receive navigation instructions; and

a motion drive configured to propel the platform according to the navigation instructions;

a spatial profiling device configured to capture a spatial profile of a motion area; and

a mobile device manager comprising:

at least one second communications circuit configured to communicate with the first communications circuit and the spatial profiling device;

one or more processors; and

memory storing processing instructions that, when executed, cause the mobile device manager to:

receive spatial profiles from the spatial profiling device;

locate a mobile object employing the spatial profiles;

locate the mobile device;

plan a movement for the mobile device between a first location and a second location in the motion area, the movement configured to avoid the mobile object; and

communicate the movement to the mobile device as navigation instructions employing the second communications circuit.

2. The system according to claim **1**, wherein the mobile device further comprises an inertial measurement device connected to the first communications circuit.

3. The system according to claim **1**, wherein the mobile device further comprises an infrared beacon connected to the first communications circuit.

4. The system according to claim **1**, wherein the motion drive is configured to propel the platform in a flipped orientation.

5. The system according to claim **1**, wherein the mobile device further comprises a tail.

6. The system according to claim **1**, further comprising an obstacle located within the motion area.

7. The system according to claim **6**, wherein the obstacle further comprises tunnels sized to house the mobile device.

8. The system according to claim **1**, wherein the spatial profiling device is affixed on least one of the following:

a ceiling;

a wall; or

a countertop.

9. The system according to claim **6**, wherein the spatial profiling device is affixed on the obstacle.

10. The system according to claim **6**, wherein the mobile device manager is disposed within the obstacle.

11. The system according to claim **1**, wherein the mobile object is at least one of the following:

an animal;

a person;

a cat; or

a second mobile device.

12. The system according to claim **1**, wherein the mobile device manager further comprises a touch screen display and the processing instructions, when executed, further cause the mobile device manager to:

show at least one of the spatial profiles on the touch screen display; and

determine the second location via a selection on the touch screen display.

13. The system according to claim **1**, wherein the processing instructions, when executed, further cause the mobile device manager to plan the movement employing an expected movement of the mobile object.

14. The system according to claim **1**, wherein the processing instructions, when executed, cause the mobile device manager to locate the mobile device employing infrared light.

15. The system according to claim 1, wherein the processing instructions, when executed, cause the mobile device manager to locate the mobile device employing a wheel encoder.

16. The system according to claim 1, wherein the processing instructions, when executed, further cause the mobile device manager to distinguish colors in the received spatial profiles.

17. The system according to claim 1, wherein the processing instructions, when executed, further cause the mobile device manager to detect a distance of at least one of the mobile device and the mobile object from a known location in the received spatial profiles.

18. The system according to claim 1, wherein the processing instructions, when executed, cause the mobile device manager to locate the mobile object employing motion detection and background detection.

19. The system according to claim 1, wherein the spatial profiling device and the mobile device manager are disposed on the platform of the mobile device.

20. A mobile device, comprising:

a platform;

a motion drive configured to propel the platform according to navigation instructions; and

a first communications circuit configured to receive navigation instructions from a second communications circuit disposed on a mobile device manager, the mobile device manager configured to communicate with a spatial profiling device and comprise memory storing processing instructions that, when executed, cause the mobile device manager to

receive spatial profiles from the spatial profiling device;

locate a mobile object employing the spatial profiles;

locate the mobile device;

plan a movement for the mobile device between a first location and a second location in a motion area, the movement configured to avoid the mobile object; and

communicate the movement to the mobile device as navigation instructions employing the second communications circuit.

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