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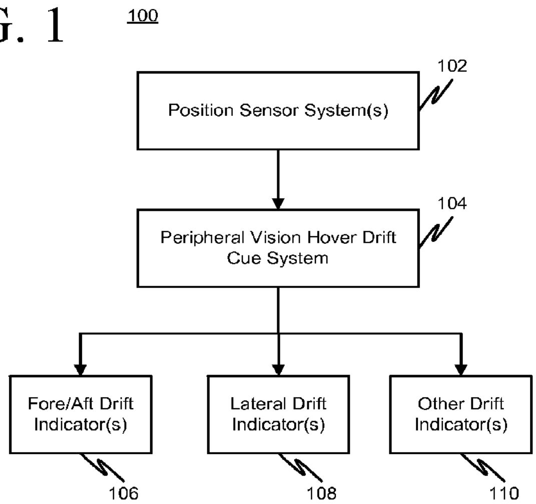
FIG. 1



(57) Abstract: Peripheral vision hover drift cueing methods, systems and computer readable media are disclosed. For example, a system can include one or more sensors, and a peripheral vision hover drift cueing controller coupled to the one or more sensors and configured to determine hover drift and to control a plurality of indicators in response to determined hover drift. The system can also include a first hover drift indicator coupled to the controller and mounted on an inside surface of a vehicle cockpit; and a second hover drift indicator coupled to the controller and mounted on an inside surface of the vehicle cockpit.

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PERIPHERAL VISION HOVER DRIFT CUEING

[0001] Some implementations relate generally to avionics and, more particularly, to methods, systems and computer readable media for peripheral vision hover drift cueing.

[0002] Rotary wing aircraft (and tilt rotor aircraft such as the V-22 Osprey) are routinely required to approach and land at sites without navigation guidance and/or in limited visibility conditions. Often the topography, ground hazards, obstacles and weather in the area are unknown or changing. Upon arrival at a landing or hover site, the pilot typically makes critical judgments based on incomplete or inaccurate data in order to determine the proper procedure to approach and land. If the terrain condition is such that dust, snow, sand, or the like will be stirred by rotor downwash, the aircraft may become engulfed in a cloud of visually-restrictive material. This is commonly referred to as a degraded visual environment (DVE) or a "brownout/whiteout" situation.

[0003] Spatial disorientation in a DVE is a common cause of incidents according to some literature reviews, pilot interviews, and military incident reports. During approach to hover and landing, the pilot may manipulate the aircraft controls to conduct a constant deceleration of longitudinal velocity while coordinating a rate of descent to the ground (or hover point) in such a way as to arrive with little or no forward velocity and a low rate of descent. In addition to controlling a rate of descent, the pilot must also typically compensate for forward, aft, lateral, and heading drift.

[0004] In a DVE, such as instrument meteorological conditions (IMC) or brownout/whiteout situations, a pilot may be denied both his peripheral vision cues and relative speed and drift sensations provided by his/her subconscious vision channels. Some conventional instrument flight displays may require a pilot to use the central portion of his/her visual known as the fovea centralis. The fovea centralis occupies a small portion of the central field of view (e.g., 1% of the visual area of the retina), but may use 50% of the visual cortex in the brain. Thus, by presenting critical hover drift information to this area of a pilot's visual field, a mental processing bandwidth constraint is created in highly task loaded environments. Some implementations were conceived in light of the above-mentioned problems and limitations, among other things.

[0005] Some implementations can include a system comprising one or more sensors and a peripheral vision hover drift cueing controller coupled to the one or more sensors and configured to determine hover drift and to control a plurality of indicators in response to determined hover drift. The system can also include a first hover drift indicator coupled to the controller and mounted on an inside surface of an aircraft cockpit and a second hover drift indicator coupled to the controller and mounted on an inside surface of the aircraft cockpit.

[0006] The sensors/information sources can include one or more of a radar altimeter, an air data system, an inertial navigation system, a traffic alert and collision avoidance system, an Enhanced Ground Proximity Warning System (EGPWS)/Controlled Flight Into Terrain (CFIT) system, a digital map, a terrain database, a Global Positioning System (GPS) receiver, a Differential Global Positioning System (DGPS) receiver, a microwave radar, a forward looking infrared (FLIR) camera, and/or a video camera.

[0007] The system can include a third hover drift indicator coupled to the controller. The first hover drift indicator can be configured to indicate fore/aft drift. The second hover drift indicator can be configured to indicate lateral drift. The first hover drift indicator can be mounted on a door frame of the aircraft adjacent a pilot's seat so as to be visible in a peripheral vision field of the pilot. The second hover drift indicator can be mounted adjacent to a central instrument panel of the aircraft so as to be visible in a peripheral vision field of the pilot.

[0008] Some implementations can include a method. The method can include receiving, at a processor, aircraft position information from one or more sensors disposed on the aircraft. The method can also include determining, at the processor, hover drift based on the received aircraft position information. The method can further include controlling, with the processor, one or more peripheral vision hover drift indicators based on the determined hover drift.

[0009] The one or more sensors can include one or more of a radar altimeter, an air data system, an inertial navigation system, a traffic alert and collision avoidance system, an Enhanced Ground Proximity Warning System (EGPWS)/Controlled Flight Into Terrain (CFIT) system, a digital map, a terrain database, a Global Positioning System (GPS) receiver, a Differential Global Positioning System (DGPS) receiver, a microwave radar, a forward looking infrared (FLIR) camera, and/or a video camera.

[0010] The one or more peripheral vision hover drift indicators can include a first hover drift indicator and a second hover drift indicator. The one or more peripheral vision hover drift indicators can further comprise a third hover drift indicator coupled to the processor.

[0011] The first hover drift indicator can be configured to indicate fore/aft drift. The second hover drift indicator can be configured to indicate lateral drift. The first hover drift indicator can be mounted on a door frame of the aircraft adjacent a pilot's seat so as to be visible in a peripheral vision field of the pilot. The second hover drift indicator can be mounted adjacent to a central instrument panel of the aircraft so as to be visible in a peripheral vision field of the pilot.

[0012] Some implementations can include a nontransitory computer readable medium having stored thereon software instructions that, when executed, cause a processor to perform operations. The operations can include receiving, at a processor, aircraft position information from one or more sensors disposed on the aircraft. The operations can also include determining, at the processor, hover drift based on the received aircraft position information. The operations can further include controlling, with the processor, one or more peripheral vision hover drift indicators based on the determined hover drift.

[0013] The one or more sensors can include one or more of a radar altimeter, an air data system, an inertial navigation system, a traffic alert and collision avoidance system, an Enhanced Ground Proximity Warning System (EGPWS)/Controlled Flight Into Terrain (CFIT) system, a digital map, a terrain database, a Global Positioning System (GPS) receiver, a Differential Global Positioning System (DGPS) receiver, a microwave radar, a forward looking infrared (FLIR) camera, and/or a video camera.

[0014] The one or more peripheral vision hover drift indicators can include a first hover drift indicator and a second hover drift indicator. The first hover drift indicator can be configured to indicate fore/aft drift and can be mounted on a door frame of the aircraft adjacent a pilot's seat so as to be visible in a peripheral vision field of the pilot. The second hover drift indicator can be configured to indicate lateral drift and can be mounted adjacent to a central instrument panel of the aircraft so as to be visible in a peripheral vision field of the pilot.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 shows a diagram of an example peripheral vision hover drift cueing system in accordance with some implementations.

[0016] FIG. 2 shows a flow chart of an example method for peripheral vision hover drift cueing in accordance with some implementations.

[0017] FIG. 3 is a diagram of an example aircraft cockpit having a peripheral vision hover drift cueing system in accordance with some implementations.

[0018] FIG. 4 is a diagram of an example computing system for peripheral vision hover drift cueing in accordance with some implementations.

DETAILED DESCRIPTION

[0019] FIG. 1 shows a diagram of an example peripheral vision hover drift cueing system in accordance with some implementations. The system 100 includes one or more position information systems 102, a peripheral vision hover drift cueing system 104 (or controller), one or more fore/aft drift indicators 106, one or more lateral drift indicators 108 and, optionally, one or more other drift indicators 110 for a parameter such as heading, altitude or the like.

[0020] In operation, the position sensor systems 102 generate position information, which is transmitted to the peripheral vision hover drift cueing system 104. The sensor systems 102 can include, for example, one or more of a radar altimeter, an air data system, an inertial navigation system, a traffic alert and collision avoidance system, an Enhanced Ground Proximity Warning System (EGPWS)/Controlled Flight Into Terrain (CFIT) system, a digital map, a terrain database, a Global Positioning System (GPS) receiver, a Differential Global Positioning System (DGPS) receiver, a microwave radar, a forward looking infrared (FLIR) camera, and/or a video camera. In addition to the above-mentioned example sensors, traditional avionics instruments (altimeter, vertical speed indicator, compass, air speed indicator or the like) could also be included in the sensor system 102.

[0021] The peripheral vision hover drift cueing system 104 uses the received position information to determine if the aircraft is drifting from hover. For example, the peripheral vision hover drift cueing system 104 can compare the position information received over time to determine if the aircraft is drifting in hover. Drifting from hover can occur in one or more directions and/or axes such as fore/aft, lateral, heading, altitude, yaw, pitch and/or roll.

[0022] If the peripheral vision hover drift cueing system 104 determines drift is occurring, the peripheral vision hover drift cueing system 104 can cause a signal to be sent to one or more peripheral vision indicators, such as the fore/aft drift indicator(s) 106, the lateral drift indicators 108 and/or the other drift indicator(s) 110.

[0023] The drift indicators (e.g., 106 – 110) can include one or more light emitting diodes (LEDs). In order to provide a peripheral vision cue, the indicator can cause the LEDs to appear to be moving (e.g., in a direction of the drift). For example, if the aircraft is drifting in an aft direction, the fore/aft indicator can be used to show this drift by causing the LEDs to appear to move in a direction that would suggest aft movement in the pilot's peripheral vision.

[0024] The indicators can be placed within the cockpit in locations for viewing by the pilot's peripheral vision. For example, the lateral drift indicator can be placed above or below the main instrument panel. The fore/aft indicator can be placed on a door or doorframe of the aircraft to an outside side of a pilot's seat. An example placement of peripheral vision hover drift cueing indicators is shown in FIG. 3 and described below. In addition to, or as an alternative to, using apparent motion, the indicators can use color change, brightness change, flashing or the like to indicate drift and/or amount or rate of drift.

[0025] FIG. 2 shows a flow chart of an example method for peripheral vision hover drift cueing in accordance with some implementations. Processing begins at 202, where position (or other) information is obtained. For example, position information from one or more sensors (e.g., 102) can be obtained by a peripheral vision hover drift cueing system (e.g., 104). The information can include flight information such as velocity, height above ground, groundspeed, ground track, wind direction, wind speed, location of a landing/hover zone, location of other aircraft, aircraft performance, or the like. Processing continues to 204.

[0026] At 204, the system determines if hover drift is occurring. For example, the system can compare current position information with previous position information. Processing continues to 206.

[0027] At 206, the system sends a signal to each indicator (e.g., 106 – 110) according to the determined amount of drift. It will be appreciated that 202-206 can be repeated in whole or in part in order to accomplish a contemplated peripheral vision hover drift cueing task.

[0028] FIG. 3 is a diagram of an example aircraft cockpit 300 having a peripheral vision hover drift cueing system in accordance with some implementations. In particular, the cockpit 300 includes a first fore/aft drift indicator 302 disposed on the port side door of the aircraft, a second fore/aft drift indicator 304 disposed on the starboard side door of the aircraft, a lateral drift indicator (306 or 308) disposed above or below the instrument panel 310.

[0029] In operation, the indicators (302 – 308) can be controlled by a peripheral vision hover drift cueing system (e.g., 104) in accordance with a method or process for peripheral vision hover drift cueing (e.g., 202 – 206).

[0030] FIG. 4 is a diagram of an example computing device for peripheral vision hover drift cueing in accordance with some implementations. The computing device 400 includes a processor 402, an operating system 404, a memory 406 and an I/O interface 408. The memory 406 can store a peripheral vision hover drift cueing application 410 and hover location, position and/or drift data 412.

[0031] In operation, the processor 402 may execute the peripheral vision hover drift cueing application 410 stored in the memory 406. The peripheral vision hover drift cueing application 410 can include software instructions that, when executed by the processor 402, cause the processor 402 to perform operations for peripheral vision hover drift cueing in accordance with the present disclosure (e.g., the peripheral vision hover drift cueing application 410 can cause the processor to perform one or more of steps 202-206 described above and, in conjunction, can access the hover location, aircraft position and/or drift data 412). The peripheral vision hover drift cueing application 410 can also operate in conjunction with the operating system 404.

[0032] The computer (e.g., 400) can include, but is not limited to, a single processor system, a multi-processor system (co-located or distributed), a cloud computing system, or a combination of the above.

[0033] A network can connect the sensors, the peripheral vision hover drift cueing system and the indicators. The network can be a wired or wireless network, and can include, but is not limited to, an aircraft signal bus, a WiFi network, a local area network, a wide area network, the Internet, or a combination of the above.

[0034] The data storage, memory and/or nontransitory computer readable medium can be a magnetic storage device (hard disk drive or the like), optical storage device (CD, DVD or the like), electronic storage device (RAM, ROM, flash, or the like). The software instructions can also be contained in, and provided as, an electronic signal, for example in the form of software as a service (SaaS) delivered from a server (e.g., a distributed system and/or a cloud computing system).

[0035] Moreover, some implementations of the disclosed method, system, and computer readable media can be implemented in software (e.g., as a computer program product and/or nontransitory computer readable media having stored instructions for performing one or more peripheral vision hover drift cueing tasks as described herein). The stored software instructions can be executed on a programmed general purpose computer, a special purpose computer, a microprocessor, or the like.

[0036] The computing device 400 can be a standalone computing device or a device incorporated in another system, such as an avionics system or flight computer.

[0037] It is, therefore, apparent that there is provided, in accordance with the various implementations disclosed herein, methods, systems and computer readable media for peripheral vision hover drift cueing.

[0038] While the invention has been described in various embodiments where the vehicle is an aircraft, the invention is also contemplated for use in alternative vehicles. For example, the vehicle may be a rotary wing aircraft, a fixed wing aircraft, a vertical take off aircraft, or a ground vehicle. The vehicle may alternatively be a watercraft such as, for example, a surface ship, a submarine, or a hovercraft.

[0039] While the invention has been described in conjunction with a number of embodiments, it is evident that many alternatives, modifications and variations would be or are apparent to those of ordinary skill in the applicable arts. Accordingly, Applicant intends to embrace all such alternatives, modifications, equivalents and variations that are within the spirit and scope of the invention.

CLAIMS

What is claimed is:

1. A system comprising:

one or more sensors;

a peripheral vision hover drift cueing controller coupled to the one or more sensors and configured to determine hover drift and to control a plurality of indicators in response to determined hover drift; and

one or more hover drift indicators coupled to the controller and mounted on an inside surface of a vehicle cockpit including a peripheral vision area.

2. The system of claim 1, wherein the sensors include one or more of a radar altimeter, an air data system, an inertial navigation system, a traffic alert and collision avoidance system, an Enhanced Ground Proximity Warning System (EGPWS)/Controlled Flight Into Terrain (CFIT) system, a digital map, a terrain database, a Global Positioning System (GPS) receiver, a Differential Global Positioning System (DGPS) receiver, a microwave radar, a forward looking infrared (FLIR) camera, and/or a video camera.

3. The system of claim 1, further comprising a second hover drift indicator coupled to the controller.

4. The system of claim 3, wherein the first hover drift indicator is configured to indicate fore/aft drift and the second hover drift indicator or is configured to indicate lateral drift.

5. The system of claim 1, wherein the vehicle is an aircraft.

6. The system of claim 5, wherein the vehicle is a helicopter.

7. The system of claim 1, wherein the vehicle is a watercraft.

8. The system of claim 4, wherein the first hover drift indicator is mounted on a door frame of an aircraft adjacent a pilot's seat so as to be visible in a peripheral vision field of the pilot and the second hover drift indicator is mounted adjacent to a central instrument panel of the aircraft so as to be visible in a peripheral vision field of the pilot.

9. A method comprising:

receiving, at a processor, vehicle position information from one or more sensors disposed on the aircraft;

determining, at the processor, hover drift based on the received vehicle position information; and

controlling, with the processor, one or more peripheral vision hover drift indicators based on the determined hover drift.

10. The method of claim 9, wherein the one or more peripheral vision hover drift indicators includes a first hover drift indicator and a second hover drift indicator.

11. The method of claim 9, wherein the vehicle is a watercraft.

12. The method of claim 9, wherein the vehicle is an aircraft.

13. The method of claim 10, wherein the first hover drift indicator is configured to indicate fore/aft drift and the second hover drift indicator is configured to indicate lateral drift.

14. The method of claim 13, wherein the first hover drift indicator is mounted on a door frame of an aircraft adjacent a pilot's seat so as to be visible in a peripheral vision field of the pilot.

15. The method of claim 13, wherein the second hover drift indicator is mounted adjacent to a central instrument panel of the vehicle so as to be visible in a peripheral vision field of the pilot.

16. A nontransitory computer readable medium having stored thereon software instructions that, when executed, cause a processor to perform operations including:

receiving, at a processor, vehicle position information from one or more sensors disposed on the aircraft;

determining, at the processor, hover drift based on the received vehicle position information; and

controlling, with the processor, one or more peripheral vision hover drift indicators based on the determined hover drift.

17. The nontransitory computer readable medium of claim 16, wherein the one or more sensors include one or more of a radar altimeter, an air data system, an inertial navigation system, a

traffic alert and collision avoidance system, an Enhanced Ground Proximity Warning System (EGPWS)/Controlled Flight Into Terrain (CFIT) system, a digital map, a terrain database, a Global Positioning System (GPS) receiver, a Differential Global Positioning System (DGPS) receiver, a microwave radar, a forward looking infrared (FLIR) camera, and/or a video camera.

18. The nontransitory computer readable medium of claim 16, wherein the one or more peripheral vision hover drift indicators includes a first hover drift indicator and a second hover drift indicator.

19. The nontransitory computer readable medium of claim 18, wherein the first hover drift indicator is configured to indicate fore/aft drift and is mounted on a door frame of the aircraft adjacent a pilot's seat so as to be visible in a peripheral vision field of the pilot.

20. The nontransitory computer readable medium of claim 18, wherein the second hover drift indicator is configured to indicate lateral drift and is mounted adjacent to a central instrument panel of the aircraft so as to be visible in a peripheral vision field of the pilot.

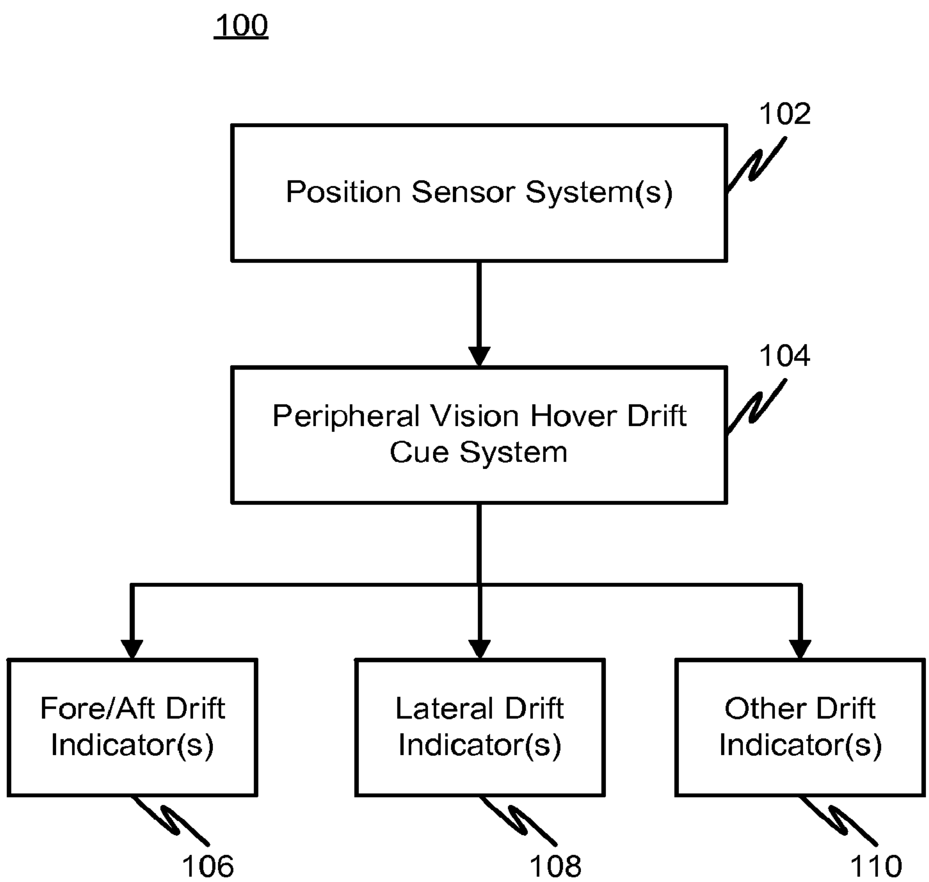
100
Position Sensor System(s)
102
Peripheral Vision Hover Drift Cue System
104
Fore/Aft Drift Indicator(s)
Lateral Drift Indicator(s)
Other Drift Indicator(s)
106
108
110

FIG. 1

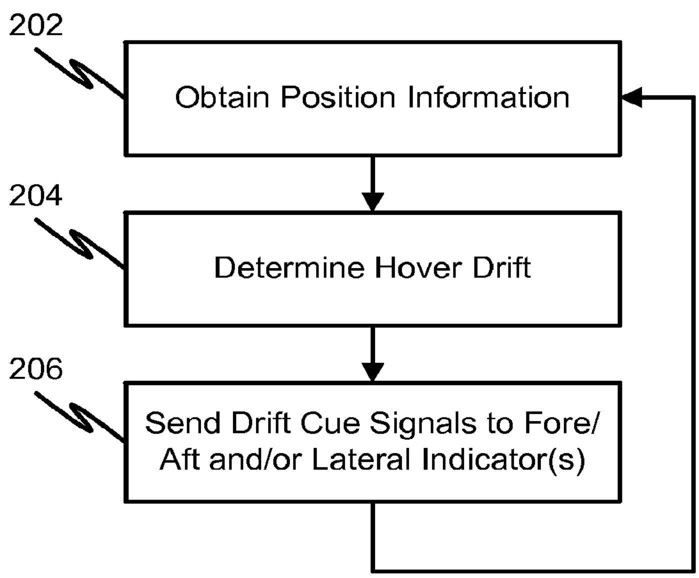
202
Obtain Position Information
204
Determine Hover Drift
206
Send Drift Cue Signals to Fore/ Aft and/or Lateral Indicator(s)

FIG. 2

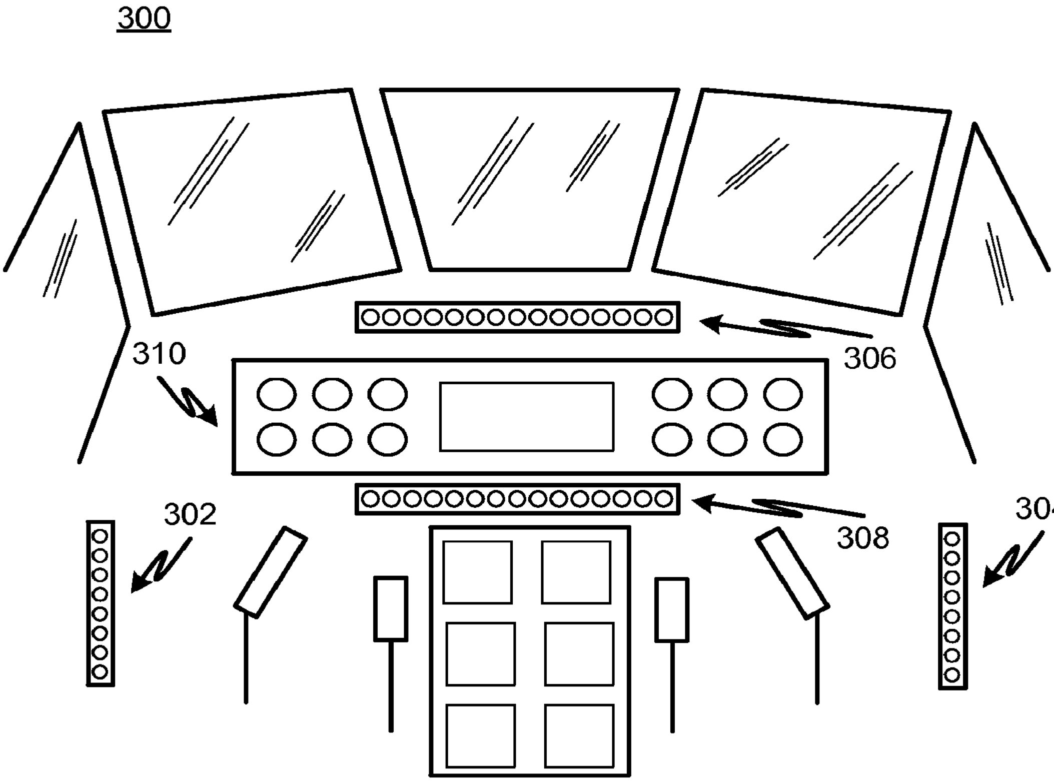

FIG. 3

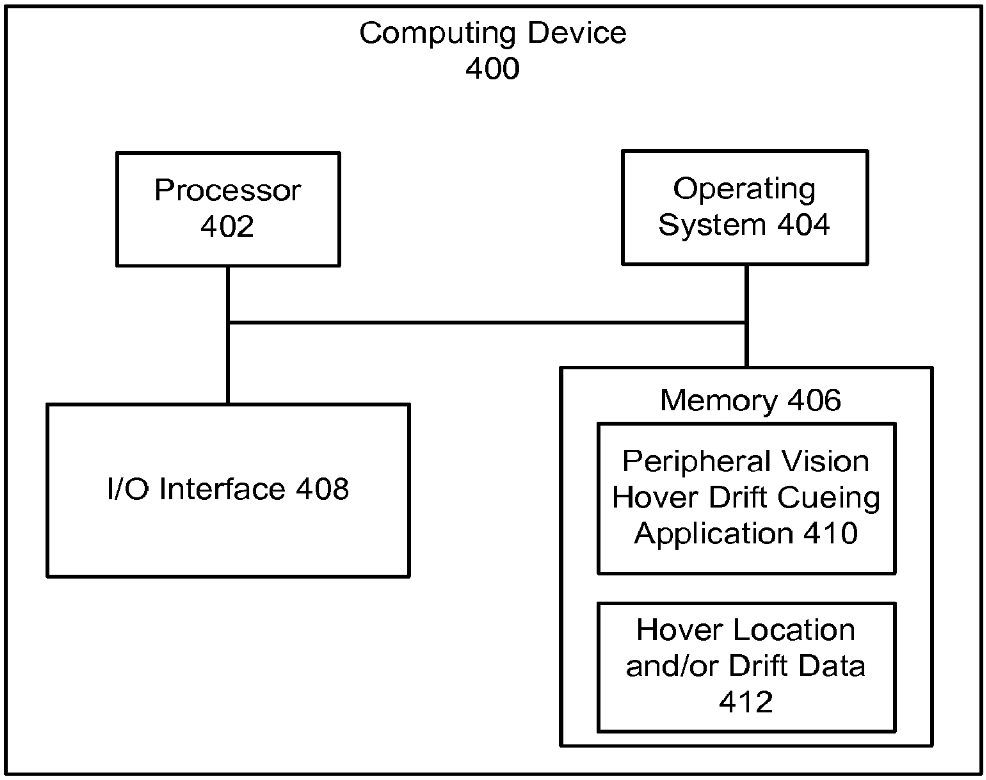
Computing Device
400
Processor
402
Operating
System 404
I/O Interface 408
Memory 406
Peripheral Vision
Hover Drift Cueing
Application 410
Hover Location
and/or Drift Data
412

FIG. 4