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(54) ECOLOGICAL AIDED MARINE NAVIGATION

(57) A system for presenting environment alerts for a watercraft is provided. The system includes a display, a processor, and a memory having computer program code. The computer program code is configured to, when executed, cause the processor to receive position data for the watercraft including a current watercraft position, receive environment data, determine a status of the watercraft at the current watercraft position, perform an analysis of the position data, the environment data, and the status of the watercraft, determine a notification based on the analysis, and cause presentation of the notification on the display. The notification is related to the environment data or the status of the watercraft at the current watercraft position.

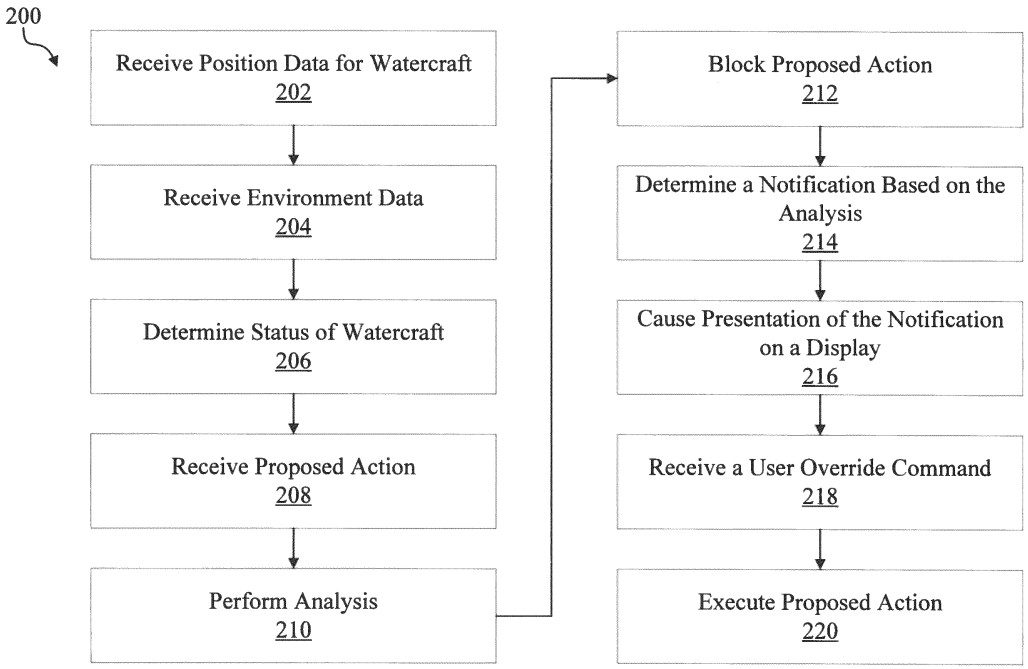

FIG. 2

EP 4 328 127 A1

Description

FIELD OF THE INVENTION

[0001] Embodiments of the present invention relate generally to systems, devices, and methods for generating notifications and map images to promote ecologically friendly navigational decisions as well as decisions that comply with applicable regulatory restrictions.

BACKGROUND OF THE INVENTION

[0002] Where watercraft are used in certain manners, the watercraft may have a negative impact on the surrounding environment. For example, the watercraft or those on the watercraft may cause issues related to the acidification of water, pollution, overfishing, and/or population decline of fish, but other issues may also arise. Current systems on watercraft are limited in their ability to alert users regarding these issues and local regulatory restrictions.

[0003] A modern watercraft is typically a complex system with many subsystems and automatic routines. A user of a watercraft often has a large number of tasks to perform, and the user usually has a limited amount of time and attention to devote to each task. Further, displays are often provided on watercraft, with limited space available for the presentation of information related to the operation of the watercraft.

BRIEF SUMMARY OF THE INVENTION

[0004] Various systems described herein may enable ecologically friendly behaviors to be recommended or automatically taken to reduce any negative impacts of the watercraft on the surrounding environment. Recommended ecologically friendly behaviors may be presented as notifications to the user in a display to inform the user of the potential changes. Further, notifications may be provided of regulatory restrictions at or near the current watercraft position. Notifications may be presented in a concise manner in a display so that the user may be informed about important matters without unduly interfering with the operation of the watercraft. The concise manner in which notifications are presented may enable the notifications to be presented in small displays where limited space is available.

[0005] Systems described herein may analyze position data from a watercraft, environment data, and data regarding the status of the watercraft, and this analysis may be used to determine notifications that are presented on a display. Data may be obtained from onboard sensors that are located on the watercraft and from other sources regarding the status of the watercraft. This data may be used alongside environment data in the form of map (or chart) information to generate notifications and corrective actions related to ecological items of interest and regulatory restrictions.

[0006] The notifications may assist in enforcing eco-friendly behaviors, avoiding behaviors that may conflict with the navigational context, and avoiding behaviors that may conflict with the relevant restrictions and regulations. In some embodiments, the systems may block certain actions from being executed based on the analysis, or the systems may determine ways to automatically correct undesirable behaviors based on any analysis - for example, the systems may reduce the volume of onboard speakers and/or reduce the noise level generated by other component on the watercraft to reduce the noise level to a more appropriate level, with the systems determining the components that need to be adjusted and how the components should be adjusted.

[0007] Map (e.g., chart) images may also be generated that may be presented in a display on the watercraft. The map images may present information to the user in a consolidated manner where the user may quickly make well-informed navigational decisions that are ecologically friendly and that comply with applicable regulatory restrictions. Relevant items near the watercraft may be identified such as ecological items of interest and areas or locations where regulatory restrictions apply, and these items may be represented in the display as environment representations. These environment representations may be emphasized relative to other material in the map images.

[0008] In an example embodiment, a system for presenting environment alerts for a watercraft is provided. The system includes a display, a processor, and memory including computer program code. The computer program code is configured to, when executed, cause the processor to receive position data for the watercraft including a current watercraft position, to receive environment data, to determine a status of the watercraft at the current watercraft position, to perform an analysis of the position data, the environment data, and the status of the watercraft, to determine a notification based on the analysis, and to cause presentation of the notification on the display. The notification is related to the environment data or the status of the watercraft at the current watercraft position. The environment data may include at least one of regulatory data or ecological data.

[0009] Various notifications may be provided. In some embodiments, the notification may be an alert that discharge is prohibited in the current watercraft position, an alert that the watercraft is in a reduced noise area, an alert that a watercraft noise level exceeds a permissible level at the current watercraft position, an alert indicating the speed limit at the current watercraft position, an alert indicating that the watercraft is travelling at a speed that exceeds the speed limit at the current watercraft position, or an alert that deployment of a marine device (e.g. an anchor, a discharge valve, a primary motor) is prohibited at the current watercraft position. In some related embodiments, the notification may be an alert that the watercraft noise level exceeds the permissible level at the current watercraft position, and the watercraft noise level

may be attributable to a motor, a sonar, a sounder, or an onboard speaker on the watercraft. In some related embodiments, the environment data may include regulatory data in the form of watercraft noise level restrictions at the current watercraft position.

[0010] Other notifications may also be provided. In some embodiments, the notification may be an alert that an animal could be located near the watercraft, and the environment data may include ecological data regarding a known location of one or more animals. Information obtained from storage of previous sightings in the area may be used to generate the alert. Additionally, in some embodiments, the notification may be an alert that the watercraft is required to operate in an electric mode at the current watercraft position, and the environment data may include regulatory data regarding locations where various watercraft are required to operate in electric mode. Furthermore, in some embodiments, the notification may be an alert that the watercraft is not permitted to discharge material in the current watercraft position, the environment data may include regulatory data regarding positions where material discharge is not permitted, and the status of the watercraft may indicate that a command has been made to discharge material from the watercraft.

[0011] In some embodiments, the environment data may be saved in the memory. The task of receiving environment data may occur by retrieving the environment data from the memory. In some related embodiments, the environment data saved in the memory may be updated periodically. In some embodiments, the computer program code may be configured to, when executed, cause the processor to analyze the position data, the environment data, and a proposed action and to block the proposed action from being performed. The notification may indicate that the proposed action was not performed.

[0012] In some embodiments, the computer program code may be configured to, when executed, cause the processor to receive a user command providing a proposed action, to analyze the user command, the position data, and the environment data to evaluate whether the proposed action is permitted in the current watercraft position, and to block the proposed action from being performed. The notification may indicate that the proposed action was not performed. In some related embodiments, the computer program code may be configured to, when executed, cause the processor to receive a user override command and execute the proposed action.

[0013] In some embodiments, one or more onboard sensors may be located on the watercraft that are configured to provide onboard sensor data. The onboard sensors may include at least one of a radar, a position sensor, a direction sensor, a sonar transducer element, an air temperature sensor, a water temperature sensor, a current sensor, a light sensor, a wind sensor, a noise sensor, or a speed sensor. The onboard sensor data may be analyzed as part of the analysis. In another example embodiment, a method is provided for presenting environment alerts for a watercraft. The method includes receiving position data for the watercraft including a current watercraft position, receiving environment data, determining a status of the watercraft at the current watercraft position, performing an analysis of the position data, the environment data, and the status of the watercraft, determining a notification based on the analysis, and causing presentation of the notification on a display. The environment data may include at least one of regulatory data or ecological data.

[0014] In some embodiments, the method may also include receiving a user command providing a proposed action, analyzing the user command, the position data, and the environment data to evaluate whether the proposed action is permitted in the current watercraft position, and blocking the proposed action from being performed. The notification may indicate that the proposed action was not performed.

[0015] In another example embodiment, a non-transitory computer readable medium is provided having stored thereon software instructions. When executed by a processor, the software instructions cause the processor to receive position data for a watercraft including a current watercraft position, to receive environment data, to determine a status of the watercraft at the current watercraft position, to perform an analysis of the position data, the environment data, and the status of the watercraft, to determine a notification based on the analysis, and to cause presentation of the notification on a display. The notification may be related to the environment data or the status of the watercraft at the current watercraft position.

[0016] In some embodiments, the environment data may include at least one of regulatory data or ecological data. Additionally, in some embodiments, the environment data may include regulatory data in the form of watercraft noise level restrictions at the current watercraft position.

[0017] In another example embodiment, a system is provided for presenting environment alerts for a watercraft. The system includes a display, a processor, and a memory including computer program code. The computer program code is configured to, when executed, cause the processor to receive position data for the watercraft including a current watercraft position, to receive environment data, to perform an analysis of the position data and the environment data, to generate a map image based on the position data and the environment data, and to cause presentation of the map image in the display. The map image includes a watercraft representation and representations of a surrounding environment around the watercraft. The map image also includes one or more environment representations that are emphasized relative to the representations of the surrounding environment in the map image. The environment data may include regulatory data or ecological data, and the environment representation(s) may be related to the reg-

ulatory data or the ecological data. Additionally, the map image may be a two-dimensional image or a three-dimensional image.

[0018] In some embodiments, the environment representation(s) may emphasize at least one of a coast line, a closest point of the coast line, a fish sanctuary, an ecological reserve, a low speed zone, a reduced noise area, a prohibited discharge area, a reef area, a shipwreck area, or a shallow water area.

[0019] In some embodiments, the environment representation(s) may include a first environment representation. A first distance may be a distance from the current watercraft position to an actual position of the first environment representation. The computer program code may be configured to, when executed, cause the processor to cause presentation of the first distance in the display.

[0020] In some embodiments, the computer program code may be configured to, when executed, cause the processor to cause presentation of the environment representation(s) in one or more colors. The colors may indicate a proximity of an item associated with the environment representation(s) in some embodiments. The colors may indicate an item type for the item that is being represented by the environment representation(s) in the display in some embodiments. In some embodiments, the colors may indicate an importance level for the item that is being represented by the environment representation(s) in the display.

[0021] In some embodiments, the computer program code may be configured to, when executed, cause the processor to receive a selection of a first environment representation and to cause presentation of additional information regarding an item represented by the first environment representation. In some related embodiments, the computer program code may be configured to, when executed, cause the processor to cause presentation of the map image in a first area in the display and to cause presentation of the additional information in a second area in the display. The first area may be separate from the second area. In other related embodiments, the computer program code may be configured to, when executed, cause the processor to cause presentation of the map image in a first area in the display and to cause presentation of the additional information as a pop-up window within the first area.

[0022] In some embodiments, the computer program code may be configured to, when executed, cause the processor to determine a status of the watercraft at the current watercraft position, to perform the analysis by analyzing the position data, the environment data, and the status of the watercraft, to determine a notification based on the analysis, and to cause presentation of the notification on the display. The notification may be related to the environment data at the current watercraft position.

[0023] In another example embodiment, a method is provided for generating and presenting a map image. The method includes receiving position data for the watercraft including a current watercraft position and receiving environment data. The method also includes performing an analysis of the position data and the environment data, generating a map image based on the analysis, and causing presentation of the map image in a display. The map image includes a watercraft representation, representations of a surrounding environment around the watercraft, and at least one environment representation that is emphasized relative to the representations of the surrounding environment. The environment data may include regulatory data or ecological data, and the environment representation(s) may be related to the regulatory data or the ecological data.

[0024] In some embodiments, the environment representation(s) may be presented in one or more colors. The colors may indicate a proximity of an item associated with the environment representation(s), an item type for the item that is being represented by the environment representation(s) in the display, or an importance level for the item that is being represented by the environment representation(s) in the display.

[0025] In another example embodiment, a non-transitory computer readable medium is provided having stored thereon software instructions. When executed by a processor, the software instructions cause the processor to receive position data for a watercraft including a current watercraft position, to receive environment data, to perform an analysis of the position data and the environment data, to generate a map image based on the analysis, and to cause presentation of the map image in a display. The map image includes a watercraft representation and representations of a surrounding environment around the watercraft. The map image also includes at least one environment representation that is emphasized relative to the representations of the surrounding environment. The environment data may include regulatory data or ecological data, and the environment representation(s) may be related to the regulatory data or the ecological data.

[0026] In some embodiments, the software instructions, when executed by a processor, may cause the processor to cause presentation of the environment representation(s) in one or more colors. The colors may indicate a proximity of an item associated with the at least one environment representation, an item type for the item that is being represented by the at least one environment representation in the display, or an importance level for the item that is being represented by the at least one environment representation in the display.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

FIG. 1 illustrates an example watercraft including

various marine devices, in accordance with some embodiments discussed herein;

FIG. 2 is a flow chart illustrating an example method for presenting notifications regarding environment data for a watercraft, in accordance with some embodiments discussed herein;

FIGs. 3A-3C illustrate example notifications that may be presented on a display, in accordance with some embodiments discussed herein;

FIG. 3D illustrates an example alarm that may be presented on a display when multiple notifications are available at the same time, in accordance with some embodiments discussed herein;

FIG. 3E illustrates an example display having a map image in a first area and a notification in a second area, in accordance with some embodiments discussed herein;

FIG. 3F illustrates an example display having a map image in a first area and a notification provided in a pop-up window within the first area, in accordance with some embodiments discussed herein;

FIG. 4 is a flow chart illustrating an example method for generating and presenting a map image, in accordance with some embodiments discussed herein;

FIG. 5A illustrates an example map image having environment representations emphasized thereon, in accordance with some embodiments discussed herein;

FIG. 5B illustrates an example display presenting a map image in a first area, consolidated information in a second area, and additional information regarding a selected environment representation in a third area, in accordance with some embodiments discussed herein; and

FIG. 6 is a block diagram illustrating an example system with various electronic devices, marine devices, and secondary devices, in accordance with some embodiments discussed herein.

DETAILED DESCRIPTION

[0028] Example embodiments of the present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, the invention may be embodied in many different forms and should not be construed as limited to the example embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like reference numerals generally refer to like elements throughout. For example, reference numerals 332, 532, and 632 each refer to similar displays. Additionally, any connections or attachments may be direct or indirect connections or attachments unless specifically noted otherwise.

[0029] FIG. 1 illustrates an example watercraft 100 including various marine devices, in accordance with some embodiments discussed herein. As depicted in FIG. 1, the watercraft 100 (e.g., a vessel) is configured to traverse a marine environment, e.g. body of water 101, and may use one or more sonar transducer assemblies 102a, 102b, and 102c disposed on and/or proximate to the watercraft. Notably, example watercraft contemplated herein may be surface watercraft, submersible watercraft, or any other implementation known to those skilled in the art. The transducer assemblies 102a, 102b, and 102c may each include one or more transducer elements (such as in the form of the example assemblies described herein) configured to transmit sound waves into a body of water, receive sonar returns from the body of water, and convert the sonar returns into sonar return data. Various types of sonar transducers may be provided - for example, a linear downscan sonar transducer, a conical downscan sonar transducer, a sonar transducer array, or a sidescan sonar transducer may be used.

[0030] Depending on the configuration, the watercraft 100 may include a primary motor 105, which may be a main propulsion motor such as an outboard or inboard motor. Additionally, the watercraft 100 may include a trolling motor 108 configured to propel the watercraft 100 or maintain a position. Motors may also take the form of a hybrid propulsion system (using electric and endothermic systems) and an electric propulsion system. The one or more transducer assemblies (e.g., 102a, 102b, and/or 102c) may be mounted in various positions and to various portions of the watercraft 100 and/or equipment associated with the watercraft 100. For example, the transducer assembly may be mounted to the transom 106 of the watercraft 100, such as depicted by transducer assembly 102a. The transducer assembly may be mounted to the bottom or side of the hull 104 of the watercraft 100, such as depicted by transducer assembly 102b. The transducer assembly may be mounted to the trolling motor 108, such as depicted by transducer assembly 102c.

[0031] The watercraft 100 may also include one or more marine electronic devices 160, such as may be utilized by a user to interact with, view, or otherwise control various aspects of the various sonar systems described herein. In the illustrated embodiment, the marine electronic device 160 is positioned proximate the helm (e.g., steering wheel) of the watercraft 100 - although other positions on the watercraft 100 are contemplated. Likewise, additionally or alternatively, a remote device (such as a user's mobile device) may include functionality of a marine electronic device.

[0032] The watercraft 100 may also comprise other components within the one or more marine electronic devices 160 or at the helm. In FIG. 1, the watercraft 100 comprises a radar 116, which is mounted at an elevated position (although other positions relative to the watercraft are also contemplated). The watercraft 100 also comprises an AIS transceiver 118, a direction sensor 120, and a camera 122, and these components are each positioned at or near the helm (although other positions relative to the watercraft are also contemplated). Additionally, the watercraft 100 comprises a rudder 110 at the

stern of the watercraft 100, and the rudder 110 may be positioned on the watercraft 100 so that the rudder 110 will rest in the body of water 101. In other embodiments, these components may be integrated into the one or more electronic devices 160 or other devices. Another example device on the watercraft 100 may be a temperature sensor 112 that may be positioned so that it will rest within or outside of the body of water 101. Other example devices include a wind sensor, a noise sensor, one or more speakers, and various vessel devices/features (e.g., doors, bilge pump, fuel tank, etc.), among other things. Additionally, one or more sensors may be associated with marine devices; for example, a sensor may be provided to detect the position of the primary motor 105, the trolling motor 108, or the rudder 110. In some embodiments, a display may be provided at the marine electronic device 160, but the display may be provided outside of any marine electronic device 160 in other embodiments.

[0033] In various embodiments, notifications may be presented on a display to enable the user to make more ecologically friendly navigational decisions and to make navigational decisions that comply with regulatory restrictions. These notifications may take a wide variety of forms. For example, the notifications may be an alert that discharge is prohibited in the current watercraft position, an alert that the watercraft is in a reduced noise area, an alert that a watercraft noise level exceeds a permissible level at the current watercraft position, an alert indicating the speed limit at the current watercraft position, an alert indicating that the watercraft is travelling at a speed that exceeds the speed limit at the current watercraft position, or an alert that deployment of a marine device is prohibited at the current watercraft position. Notifications may also be provided to encourage actions that would reduce carbon emissions or water pollution (e.g. adjusting operation of a motor).

[0034] Other notifications may also be presented. For example, an alert may be presented that an animal could be located near the watercraft, and the relevant environment data may include ecological data regarding a known location of one or more animals. Information obtained from storage of previous sightings in the area may be used to generate the alert. Additionally, an alert may be provided that the watercraft is required to operate in an electric mode at the current watercraft position, and the relevant environment data in this example may include regulatory data regarding locations where various watercraft are required to operate in electric mode. FIG. 2 is a flow chart illustrating an example method 200 for presenting notifications regarding environment data for a watercraft. This method 200 may be used to inform the user so that the user may make informed decisions that are ecologically friendly and/or that comply with relevant regulations that apply.

[0035] At operation 202, position data is received for a watercraft. This position data may include a current watercraft position. Position data may be received using global positioning system (GPS) data and/or data from other onboard sensors. Environment data is received at operation 204. The environment data may include regulatory data or ecological data. The regulatory data may include any relevant regulatory restrictions and the locations where those restrictions are applicable. Regulatory restrictions may include speed limits, prohibitions on discharge of material, noise level restrictions, or requirements to operate in electric mode. However, other regulatory restrictions may be used. Ecological data may include ecological items of interest and locations where those ecological items of interest are located. Ecological data may also include ecological concerns and locations or areas that are affected by the ecological concerns. In some embodiments, environment data may be saved in the memory, and receiving the environment data may occur by retrieving the environment data from the memory. Where this is the case, environment data saved in memory may be updated periodically. Environment data may be obtained using onboard sensors in some embodiments so that information may be collected regarding the characteristics of the area (in particular restrictions and regulations), and environment data may be obtained by accessing digital geospatial data such as a digital nautical chart or database. In some embodiments, regulatory data, ecological data, and/or environment data may be obtained via one or more networks, such as a local watercraft network, a wireless network, or other network.

[0036] At operation 206, the status of the watercraft is determined at the current watercraft position. The status of the watercraft may relate to various components of the watercraft. For example, the status of the watercraft may relate to the position or orientation of a motor, a rudder, a sonar transducer assembly, an anchor, or a valve. The status may be the volume of speakers on the watercraft, the noise generated by a particular component on the watercraft, or the noise generated by the watercraft as a whole. The status of the watercraft may additionally or alternatively be an indication that component such as a motor, rudder, sonar transducer assembly, a generator, a light, or some other device is functioning properly, that a component is fully charged, that a component is operating at a certain efficiency level, that a component is damaged in some manner, etc. Furthermore, the status of the watercraft may indicate that a command has been made to discharge material from the watercraft. The status may be provided by real-time data from various sensors, such as navigation sensors (e.g. position, speed, heading, etc.). In some embodiments, the status of the watercraft may reflect the status of some other component, or the status may provide other information regarding the components on the watercraft.

[0037] At operation 208, a proposed action may be received. For example, a user command may be received via a user command at the marine electronic device 660 *(see* FIG. 6), at a user interface 668 *(see* FIG. 6), at a display 632 *(see* FIG. 6), via a remote device 678 *(see* FIG. 6), or through some other manner (e.g. through voice commands using a microphone). In some embod-

iments, the proposed action may be automatically determined or formed, such as without user interaction. For example, the proposed action may be related to an automatic function of the watercraft (e.g., a navigation system, a timer, a cleaning system, etc.). However, in some embodiments, operation 208 may not be performed and the method 200 may proceed from operation 206 to operation 210.

[0038] At operation 210, an analysis is performed. This analysis may be an analysis of the position data for the watercraft, the environment data for the watercraft, and/or the status of the watercraft. However, where operation 208 is performed, the proposed action may be analyzed as part of the analysis. The analysis may be performed to determine whether a proposed action is permitted, prohibited, or discouraged in the current watercraft position. The analysis may alternatively be performed to determine a corrective action and/or to determine an appropriate notification to be presented on a display.

[0039] A proposed action may be blocked based on the analysis at operation 212, such as where the analysis indicates that the proposed action is prohibited or discouraged at the current watercraft position. However, where the proposed action is permitted, operation 212 may not be performed, and the method may instead proceed from operation 210 to operation 214. Operation 212 may not be performed in embodiments where operation 208 is not performed.

[0040] At operation 214, a notification is determined based on the analysis. The notification may be related to the environment data or the status of the watercraft at the current watercraft position. The notification may provide a suggested corrective action or inform the user of a regulatory restriction or an ecological item of interest. However, other notifications may be provided. For example, a notification may be provided that a proposed action is blocked. Where the proposed action is blocked, a notification may be provided to indicate that the proposed action was not performed, and the notification may or may not permit the user to provide a user override command. In some embodiments, the notification may also provide the reason that the proposed action was blocked. Presentation of the notification may be caused on a display at operation 216.

[0041] In some embodiments, a user may be permitted to override a blockage of a proposed action. For example, the method 200 includes operations 218 and 220 to permit a user to override a blockage of a proposed action. At operation 218, a user override command is received. This may be done by receiving an input from a user at a selection button *(see, e.g.,* FIG. 2A, 224B). At operation 220, the proposed action may be executed. The ability to override blockages of proposed actions may be beneficial where a proposed action is blocked but is not restricted by regulations. For example, when a user attempts to discharge material in an area where discharge may be harmful to the environment but the discharge is not prohibited by regulations, the user may be provided with the option of overriding the blockage of the proposed action. Further, the ability to override blockages of proposed actions may be beneficial in emergencies. For example, where a user command to increase the speed is blocked due to the presence of speed limits, the user may be permitted to override the blockage in the event of an emergency. However, in some embodiments, the user is not permitted to override a blockage of a proposed action (e.g. where the proposed action is illegal), and operations 218 and 220 will not be performed in these embodiments.

[0042] The computer program code may also cause the processor to receive environment data. The environment data may include regulatory data or ecological data. The regulatory data may include any relevant regulatory restrictions and the locations where those restrictions are applicable. Regulatory restrictions may include speed limits, prohibitions on discharge of material, noise level restrictions, or requirements to operate in electric mode. However, other regulatory restrictions may be used. Ecological data may include ecological items of interest and locations where those ecological items of interest are located. Ecological data may also include ecological concerns and areas that are affected by the ecological concerns.

[0043] Various notifications may be presented to a user to enable the user to make more ecologically friendly navigational decisions and to make navigational decisions that comply with regulatory restrictions. FIGs. 3A-3C illustrate example notifications that may be presented on a display. Starting with FIG. 3A, a notification 324 is provided indicating that the user is trying to discharge material in a restricted area and that the discharge of material in the current watercraft position is blocked. Discharge may be blocked by closing certain outlet valves in the watercraft. In the illustrated embodiment, the notification 324 provides selection buttons 324A, 324B, which permit the user to determine how to proceed. Selection of selection button 324A causes the proposed action to be aborted. Further, selection of selection button 324B causes the blockage to be overridden to permit the user to proceed with the proposed action of discharging material. In some embodiments, a selection made at selection button 324A or a selection button 324B may only be detected if the relevant selection button is pressed for a certain period of time. For example, in the embodiment illustrated in FIG. 3A, the selection button 324B will only permit the user to override blockages if the selection button 324B is pressed for three seconds. However, in other embodiments, a selection may be identified where the selection button is pressed for an instant, or the selection may be identified where the selection button is pressed for a different period of time. For notification 324, the environment data may include regulatory data regarding positions where material discharge is prohibited due to regulatory restrictions.

[0044] Looking now at FIG. 3B, another notification 326

is provided indicating that the user is entering into a silent area and that it is recommended to reduce the noises emitted from the boat. This notification may provide an alert that the watercraft noise level exceeds the permissible level at the current watercraft position in some embodiments, and the noise limit may be provided in the notification in some cases. The watercraft noise level may be generated by a variety of components, including but not limited to a motor, a sonar, a sounder, or an onboard speaker on the watercraft. In the illustrated embodiment, the notification 326 provides selection buttons 326A, 326B, which permit the user to determine how to proceed. Selection of selection button 326A causes the proposed action to be automatically applied, with the proposed action being provided by the system and the processor therein. Various proposed actions may be developed by the processor, and the proposed action may depend upon the type of notification and the issue being corrected. For the example notification 326 of FIG. 3B, the proposed action may be to turn off a component that is generating the noise (e.g. a sounder, an onboard speaker, sonar) or to reduce the power level of a component that is generating the noise (e.g. a trolling motor, a primary motor, etc.). Selection of the selection button 326B may cause the proposed action to be skipped, allowing the watercraft to proceed without any changes being made. Watercraft noise level restrictions at the current watercraft position may serve as environment data. More specifically, the watercraft noise level restrictions and the locations where those restrictions are applicable may be provided as regulatory data.

[0045] Turning now to FIG. 3C, another notification 328 is provided indicating that the watercraft needs to reduce its speed to under 10 Kn. Unlike the other notification 324 of FIG. 3A and the notification 326 of FIG. 3B, the notification 328 is provided without any selection buttons. However, in some embodiments, the notification 328 may be provided with selection buttons. For example, a selection button may be provided to ignore the notification 328, and another selection button may be provided to reduce the speed to under 10 Kn automatically. This reduction in speed may be accomplished by acting directly on the engine throttle.

[0046] In some embodiments, certain alarms may be presented on a display to inform the user that the notifications are available. FIG. 3D illustrates an example alarm 330 that may be presented on a display when multiple notifications are provided at the same time. In the illustrated embodiment, the alarm 330 indicates that two different notifications are currently applicable. Furthermore, selection buttons 330A, 330B are provided in the alarm 330. Selection of the selection button 330A causes the notifications to be presented, and selection of the selection button 330B causes the alarm 330 to be closed without opening the notifications. In some embodiments, any available notifications may be presented automatically without the alarm 330 being presented. However, the alarm 330 may be used to reduce the number of open screens that are presented on a display to reduce distractions for users. The alarm 330 may be used for less urgent notifications where an immediate action from the user is not necessary. Notifications may be presented in a display in a variety of ways, and FIGS. 3E and 3F illustrate two exemplary ways that notification may be presented. In the display 332 of FIG. 3E, the map image 342 is presented in a first area 340A, and the notification 328 is presented in a second area 340B that is separate from the first area 340A. In some embodiments, the second area 340B may present some other type of information (e.g. sonar images, radar images, text, numerical data, etc.), and the notification 328 may appear when available. However, the notification 328 may be presented in other ways. For example, FIG. 3F illustrates an example display 332 having the map image 342 in a first area 340A and the notification 328 provided in a pop-up window within the first area 340A. This approach may be beneficial to maximize the size of the map image on the screen and to present information within a limited space where the display is small.

[0047] FIGS. 3E and 3F also illustrate a map image 342 that provides the user with helpful ecological and regulatory information so that the user may make well-informed navigational decisions. The map image 342 includes representations of the surrounding environment around a watercraft, with a land and water being illustrated in the map image 342. The map image 342 also includes a watercraft representation 334, with the watercraft representation 334 provided at or near the center of the map image 342. In other embodiments, the map image may present further information regarding the surrounding environment. For example, the map image may provide topographical information to show the water depth at certain locations.

[0048] Various environment representations 338 are illustrated in the map image 342. The environment representations 338 may be locations or areas where regulatory data indicates that a regulatory restriction applies. Environment representations 338 may also be locations or areas where an ecological item of interest is located. Regulatory restrictions may include a reduced speed limit, a requirement to operate the watercraft in an electric mode, a requirement to maintain the noise level generated by a watercraft below a specified level, a restriction on discharging material at a specific location, a restriction on dropping an anchor (e.g. due to the presence of a coral reef below), or a restriction on fishing at a specific location (e.g. in a fish sanctuary or an ecological reserve). However, environment representations 338 may represent numerous other types of regulatory restrictions. Where the environment representation 338 is representing a relevant regulatory restriction, the environment representation 338 may be positioned at one or more locations on the map image 342. This position may be the closest position to the watercraft where the regulatory restriction applies in some embodiments. However, in other embodiments, the environment representations

338 may be provided for a larger area where a regulatory restriction applies (e.g. all areas within a specified distance from the coastline, areas where a coral reef is located, etc.). Where environment representations 338 are provided for a larger area, the relevant area may be emphasized in the map image by using highlighting, providing an outline around the area, etc.

[0049] Environment representations 338 may be locations where certain ecological items of interest are located. Ecological items of interest may include areas highly populated by fish or other animals, a coastline or a closest location for a coastline, etc. However, other ecological items of interest may be represented by environment representations 338. While the ecological items are presented in the same color in FIGS. 3E and 3F, the ecological items may be presented in different colors in other embodiments. Different colors may be used to indicate proximity of an item associated with an environment representation, an item type for an item that is being represented by an environment representation in the display, or an importance level for an item that is being represented by the environment representation in the display. The importance level may be tied to the critical nature of an item generally. In some embodiments, the importance level may also be high where the item represented by the environment representation is very close to the watercraft.

[0050] In the illustrated embodiment, lines 338A extend from the watercraft representation 334 to the environment representations 338 to provide a visual aid, but these lines 338A may be omitted in other embodiments.

[0051] A grid 336 is provided in the map image 342, and the watercraft representation 334 is provided at or near the center of the grid 336. The grid 336 may assist in determining the distance and angular position of various items in the surrounding environment. For example, the grid 336 may permit the distance and angular position of a coastline to be easily determined, and the grid 336 may also permit the distance and angular position of an environment representation to be easily determined.

[0052] Additionally, methods are contemplated for the generation and presentation of a map image. FIG. 4 is a flow chart illustrating one such example method 400. The method 400 may be used to generate and present map images similar to the map image 342 of FIG. 3E or the map image 542 of FIG. 5A. At operation 402, position data is received for a watercraft. This position data may include a current watercraft position. Position data may be received from a GPS on a watercraft and/or other onboard sensor. Additionally, environment data is received for the watercraft at operation 404. The environment data may include regulatory data or ecological data. The regulatory data may include any relevant regulatory restrictions and the locations where those restrictions are applicable. Regulatory restrictions may include speed limits, prohibitions on discharge of material, noise level restrictions, or requirements to operate in electric mode. However, other regulatory restrictions may be used. Ecological data may include ecological items of interest and locations where those ecological items of interest are located. Ecological data may also include ecological concerns and areas that are affected by the ecological concerns.

[0053] At operation 406, an analysis is performed. This analysis may be an analysis of the position data for the watercraft and the environment data for the watercraft. The analysis may be performed to assist in generating a map image. At operation 408, a map image is generated based on the analysis. The map image includes a watercraft representation and representations of a surrounding environment around the watercraft. The map image also includes an environment representation that is emphasized relative to the representations of the surrounding environment. Multiple environment representations may be included in the map image in some embodiments. The environment representation may be related to the environment data received at operation 404. Various environment representation may be used, including but not limited to a coast line, a closest point of a coast line, a fish sanctuary, an ecological reserve, a low speed zone, a reduced noise area, a prohibited discharge area, a reef area where a coral reef is located, a shipwreck area, or a shallow water area. The map image may be a two-dimensional image or a three-dimensional image.

[0054] Presentation of the map image may be caused in a display at operation 410. The map image may be presented in the display in different ways. As a first example, the map image may be presented in a first area in the display, and additional information may be presented in a second area in the display that is separate from the first area. As a second example, the map image may be presented in a first area in the display, and additional information may be presented as a pop-up window within the first area. Environment representations may be presented in any map image, and these environment representations may be emphasized in the map image relative to other representations of the surrounding environment, and distances associated with the environment representations may be provided for some or all of the environment representations in the map image.

[0055] The environment representations may be presented in different colors in some embodiments, with the colors indicating some characteristic of the environment representation(s). For example, the color(s) may indicate a proximity of an item associated with an environment representation, the color(s) may indicate an item type for the item that is being represented by the environment representation(s) in the display, or the color(s) may indicate an importance level for the item that is being represented by the environment representation(s) in the display. Colors may be selected to indicate other information regarding an environment representation. Further, each of the environment representations may be presented in the same color in some embodiments.

[0056] In some embodiments, operations 412 and 414 may also be executed in the method 400. Performance

of these operations may permit additional information to be presented about an environment representation. At operation 412, a selection of an environment representation may be received. At operation 414, presentation of additional information regarding the item represented by the selected environment representation may be presented. For example, looking at the display 532 illustrated in FIG. 5B, the second environment representation 544B may be selected, and this may cause additional information to be presented in the third area 540C regarding the fish sanctuary that is represented by the second environment representation.

[0057] For the methods 200 and 400 of FIGS. 2 and 4, the presented operations may be performed in any order unless otherwise noted. Additionally, certain operations may be performed simultaneously in some embodiments. Operations may be added or certain operations may be omitted. For example, operations 218 and 220 may be omitted in some embodiments of the method 200. The methods 200 and 400 may be executed by a processor 664 *(see* FIG. 6) within a marine electronic device 660 *(see* FIG. 6), but the methods may be executed by other computing devices. In some embodiments, both the methods 200 and 400 may be performed simultaneously so that both notifications and map images are presented simultaneously. FIGS. 5A-5B illustrate another example map image 542 that has various environment representations emphasized thereon. FIG. 5A illustrates the map image 542 standing alone, and FIG. 5B illustrates the map image 542 in a display 532. The map image 542 includes representations of the surrounding environment around a watercraft, with a land and water being illustrated in the map image 542. The map image 542 also includes a watercraft representation 534, with the watercraft representation 534 provided at or near the center of the map image 542.

[0058] Various environment representations are illustrated in the map image 542. The environment representations may be location(s) where regulatory data indicates that regulatory restrictions apply or location(s) where an ecological item of interest is located. Where the environment representation 538 is representing a relevant regulatory restriction, the environment representation 538 may be positioned at one or more locations on the map image 542. This position may be the closest position to the watercraft where the regulatory restriction applies in some embodiments. However, in other embodiments, the environment representations 538 may be provided for a larger area where a regulatory restriction applies (e.g. all areas within a specified distance from the coastline, areas where a coral reef is located, etc.).

[0059] Environment representations may be locations where certain ecological items of interest are located. Ecological items of interest may include areas highly populated by fish or other animals, a coastline or a closest location for a coastline, etc. However, other ecological items of interest may be represented by environment representations. As noted elsewhere herein, the ecological items may be presented in different colors.

[0060] In the illustrated embodiment, a first environment representation 544A, a second environment representation 544B, and a third environment representation 544C are illustrated. However, a different number of environment representations may be emphasized in a map image 542. Each environment representation may have a distance associated with the environment representation, with the distance being the distance from the current watercraft position to an actual position of the item being represented by the environment representation. For example, a first distance may be associated with the first environment representation, and the first distance may be the distance from the current watercraft position to the actual position of the coastline represented by the first environment representation. The first distance and other relevant distances may be presented on the display - these distances may be presented adjacent to the environment representations and/or with condensed information at the bottom of the map image 542. A grid 536 is provided in the map image 542, and the watercraft representation 534 is provided at or near the center of the grid 536.

[0061] In the display 532 of FIG. 5B, a first area 540A is provided in the upper left portion of the display 532, a second area 540B is provided in the lower left portion of the display 532, and a third area 540C is provided in the right portion of the display 532. The map image 542 is presented in the first area 540A, condensed information regarding the environment representations is provided in the second area 540B, and expanded information regarding a particular environment representation is provided in the third area 540C. However, information regarding environment representations may be presented in other ways (e.g. as a pop-up window in the first area).

[0062] In other embodiments, an environment representation (e.g. second environment representation 544B) may be selected, and this selection may cause expanded information to appear in the second area 540B regarding the selected environment representation. This presentation approach may be beneficial to permit the map image 542 to be presented in the first area 540A with the largest size possible, and this presentation approach may be beneficial where limited space is available in the display 532. Once the user has finished viewing the expanded information, the user may switch to present condensed information regarding each of the environment representations in the second area 540B.

[0063] Different colors may be used to indicate a proximity of an item associated with an environment representation, an item type for an item that is being represented by an environment representation in the display, or an importance level for an item that is being represented by the environment representation in the display. In the illustrated embodiment, the first environment representation 544A is presented in a first color, with the first color indicating that the first environment representation 544A is associated with a coastline. Further, the second

environment representation 544B is presented in a second color, with the second color indicating that the second environment representation 544B is associated with a fish sanctuary. The third environment representation 544C is presented in a third color, with the third color indicating that the third environment representation 544C is associated with an ecological reserve. However, colors may be indicative of other items. Map images may be provided as two-dimensional images or three-dimensional images.

[0064] FIG. 6 illustrates a block diagram of an example system with various electronic devices, marine devices, and secondary devices shown. The system may include one or more sonar transducer assemblies. In this illustrated embodiment, a first sonar transducer assembly 602A, a second sonar transducer assembly 602B, and a final sonar transducer assembly 602N are provided. However, a greater or lesser number of sonar transducer assemblies may be used. The first sonar transducer assembly 602A may also include one or more sonar units therein. For example, the first sonar transducer assembly 602A includes a first sonar unit 646A, a second sonar unit 646B, and a final sonar unit 646N. However, a greater or lesser number of sonar units may be provided in the first sonar transducer assembly 602A. Other sonar transducer assemblies (e.g. second sonar transducer assembly 602B, final sonar transducer assembly 602N, etc.) may similarly have sonar units. The sonar units may each include a transceiver or a separate transmitter and receiver. Transmitters or transceivers of the sonar units may be arranged to operate alone or in one or more arrays.

[0065] In some embodiments, additional separate sonar transmitters or transceivers (arranged to operate alone, in an array, or otherwise) may be included. The sonar transducer assemblies 602A, 602B, 602N may also include a sonar signal processor or another processor configured to perform various sonar processing. Alternatively, a processor may be provided for each sonar unit. In some embodiments, the processor (e.g., at least one processor 664 in the marine electronic device 660, a controller (or processor portion) in the sonar transducer assemblies 602A, 602B, 602N, or a remote controller - or combinations thereof) may be configured to filter sonar return data and/or selectively control elements of the sonar transducer assemblies 602A, 602B, 602N. For example, various processing devices (e.g., a multiplexer, a spectrum analyzer, A-to-D converter, etc.) may be utilized in controlling or filtering sonar return data and/or transmission of sonar signals from the transmitter(s).

[0066] The sonar transducer assemblies 602A, 602B, 602N may also include one or more other systems, such as various sensor(s) 667. For example, the sonar transducer assemblies 602A, 602B, 602N may include an orientation sensor, such as gyroscope or other orientation sensor (e.g., accelerometer, MEMS, etc.) that can be configured to determine the relative orientation of the sonar transducer assemblies 602A, 602B, 602N, the relative orientation of a sonar unit, or the relative orientation of a transceiver, a transmitter, or a receiver. In some embodiments, additionally or alternatively, other types of sensor(s) are contemplated, such as, for example, a water temperature sensor, a current sensor, a light sensor, a wind sensor, a noise sensor, a speed sensor, or the like. The sensor(s) 667 may assist in determining the orientation of the sonar transducer assemblies 602A, 602B, 602N or certain components thereof. Sonar transducer assemblies 602A, 602B, 602N may each possess one or more sounders in some embodiments, but sounders may also be provided at other locations on the watercraft 100 *(see* FIG. 1).

[0067] The illustrated system includes a marine electronic device 660. The system may comprise numerous marine devices. The marine electronic device 660 may include at least one processor 664, a memory 666, a communication interface 672, a user interface 668, a display 632, and one or more devices or sensors 674 (e.g. position sensor, direction sensor, water temperature sensor, a current sensor, a light sensor, a wind sensor, a noise sensor, a speed sensor, other sensors, etc.). One or more of the components of the marine electronic device 660 may be located within a housing or could be separated into multiple different housings (e.g., be remotely located). One or more marine devices may be implemented on the marine electronic device 660. For example, a position sensor, a direction sensor, an autopilot, water temperature sensor, a current sensor, a light sensor, a wind sensor, a noise sensor, a speed sensor, and other devices or sensors 674 may be provided within the marine electronic device 660. These marine devices can be integrated within the marine electronic device 660, integrated on a watercraft at another location and connected to the marine electronic device 660, and/or the marine devices may be implemented at a remote device 678 in some embodiments.

[0068] The processor(s) 664 may be any means configured to execute various programmed operations or instructions stored in a memory device (e.g., memory 666) such as a device or circuitry operating in accordance with software or otherwise embodied in hardware or a combination of hardware and software (e.g. a processor operating under software control or the processor embodied as an application specific integrated circuit (ASIC) or field programmable gate array (FPGA) specifically configured to perform the operations described herein, or a combination thereof) thereby configuring the device or circuitry to perform the corresponding functions of the processor(s) 664 as described herein. In this regard, the processor(s) 664 may be configured to analyze electrical signals communicated thereto to provide or receive sonar data from one or more sonar transducer assemblies and additional data from other sources.

[0069] In some embodiments, the processor(s) 664 may be further configured to implement signal processing. The processor(s) 664 may further implement notices and alarms, such as those determined or adjusted by a

user, to reflect proximity of areas where regulatory restrictions apply or areas where ecological items of interest are located, to reflect proximity of other vehicles (e.g. watercraft), approaching storms, hazards, fish, etc.

[0070] In an example embodiment, the memory 666 may include one or more non-transitory storage or memory devices such as, for example, volatile and/or non-volatile memory that may be either fixed or removable. The memory 666 may be configured to store instructions, computer program code, sonar data, and additional data such as radar data, chart data, location/position data in a non-transitory computer readable medium for use, such as by the processor(s) 664 for enabling the marine electronic device 660 to carry out various functions in accordance with example embodiments of the present invention. For example, the memory 666 could be configured to buffer input data for processing by the processor(s) 664. Additionally or alternatively, the memory 666 could be configured to store instructions for execution by the processor(s) 664.

[0071] Other devices 679 may also be provided in the system such as primary motor, a trolling motor, a sounder, a radar, a rudder, a primary motor, a trolling motor, an autopilot, and additional sensors/devices may also be provided as marine devices. However, other marine devices may be provided as well. The system may comprise any number of different systems, modules, or components, and each of these may include any device or means embodied in either hardware, software, or a combination of hardware and software configured to perform one or more corresponding functions described herein.

[0072] The communication interface 672 may be configured to enable communication to external systems (e.g. an external network 676). In this manner, the marine electronic device 660 may retrieve stored data from a remote device 678 via the external network 676 in addition to or as an alternative to the onboard memory 666. In some embodiments, the communication interface 672 may be configured to enable a connection to the Internet of Things to enable easy control of the marine electronic device 660 and processors therein. Additionally or alternatively, the marine electronic device 660 may transmit or receive data, such as sonar signal data, sonar return data, sonar image data, or the like to or from a sonar transducer assembly 602A, 602B, 602N. In some embodiments, the marine electronic device 660 may also be configured to communicate with other devices or systems (such as through the external network 676 or through other communication networks, such as described herein). For example, the marine electronic device 660 may communicate with a propulsion system of the watercraft 100 *(see* FIG. 1A) (e.g., for autopilot control), a remote device (e.g., a user's mobile device, a handheld remote, etc.), or another system. Using the external network 676, the marine electronic device 660 may communicate with and send and receive data with external sources such as a cloud. The marine electronic device 660 may send and receive various types of data. For example, the system may receive weather data, map information, alert data, etc. However, this data is not required to be communicated using external network 676, and the data may instead be communicated using other approaches, such as through a physical or wireless connection via the communications interface 672.

[0073] The communications interface 672 of the marine electronic device 660 may also include one or more communications modules configured to communicate with one another in any of a number of different manners including, for example, via a network. In this regard, the communications interface 672 may include any of a number of different communication backbones or frameworks including, for example, Ethernet, the NMEA 2000 framework, GPS, cellular, Wi-Fi, Bluetooth, Bluetooth Low Energy ("BLE") or other suitable networks. The network may also support other data sources, including GPS, autopilot, engine data, compass, radar, etc. In this regard, numerous other peripheral devices (including other marine electronic devices or sonar transducer assemblies) may be included in the system.

[0074] The position sensor may be configured to determine the current position and/or location of the marine electronic device 660 (and/or the watercraft 100 *(see* FIG. 1A)). For example, the position sensor may comprise a GPS, bottom contour, inertial navigation system, such as machined electromagnetic sensor (MEMS), a ring laser gyroscope, or another location detection system. Alternatively or in addition to determining the location of the marine electronic device 660 or the watercraft 100 *(see* FIG. 1), the position sensor may also be configured to determine the position and/or orientation of an object outside of the watercraft 100.

[0075] The display 632 (e.g. one or more screens) may be configured to present images and may include or otherwise be in communication with a user interface 668 configured to receive input from a user. The display 632 may be, for example, a conventional LCD (liquid crystal display), a touch screen display, mobile device, or any other suitable display known in the art upon which images may be displayed.

[0076] In some embodiments, the display 632 may present one or more sets of data (or images generated from the one or more sets of data). Such data includes chart data, radar data, sonar data, weather data, location data, position data, orientation data, sonar data, or any other type of information relevant to the watercraft. Sonar data may be received from one or more sonar transducer assemblies 602A, 602B, 602N or from sonar devices positioned at other locations, such as remote from the watercraft. Additional data may be received from other devices and sensors 674 such as a radar, a primary motor or an associated sensor, a trolling motor or an associated sensor, an autopilot, a rudder or an associated sensor, a position sensor, a direction sensor, a remote device 678, onboard memory 666 (e.g., stored chart data, historical data, etc.), or other devices 679. The other sensors/devices 674 may include, for example, an air tem-

perature sensor, a water temperature sensor, a current sensor, a light sensor, a wind sensor, a noise sensor, a speed sensor, an onboard speaker or the like. Additionally, the user interface 668 may include, for example, a keyboard, keypad, function keys, mouse, scrolling device, input/output ports, touch screen, or any other mechanism by which a user may interface with the system.

[0077] Although the display 632 of FIG. 6 is shown as being directly connected to the processor(s) 664 and within the marine electronic device 660, the display 632 could alternatively be remote from the processor(s) 664 and/or marine electronic device 660. Likewise, in some embodiments, the position sensor and/or user interface 668 could be remote from the marine electronic device 660.

[0078] Onboard sensors 682 may be provided on the watercraft 100 *(see* FIG. 1) that are configured to provide onboard sensor data. The onboard sensors 682 may include a radar, a position sensor, a direction sensor, a sonar transducer element, an air temperature sensor, a water temperature sensor, a current sensor, a light sensor, a wind sensor, a noise sensor, or a speed sensor. The onboard sensors 682 are illustrated in FIG. 6 as being located on the watercraft but outside of the marine electronic device 660. However, some or all of the provided onboard sensors 682 may be provided in the marine electronic device 660 in some embodiments. Onboard sensor data from onboard sensors 682 may be analyzed as part of any of the analyses discussed herein (e.g. analysis to determine notifications to be presented, analysis to generate map images, etc.). FIG. 6 merely presents an exemplary arrangement of these components. The components presented in FIG. 6 may be rearranged to alter the connections between components. For example, in some embodiments, a marine device outside of the marine electronic device 660, such as the onboard sensors 682, may be directly connected to the communication interface 672 rather than being connected to the processor(s) 664. Some components may be removed and others may be added.

CONCLUSION

[0079] Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the embodiments of the invention are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the invention as claimed in the appended set of claims.

[0080] The following clauses represent a summary of some aspects of the invention and make integral part of the present description.

1. A system for presenting environment alerts for a watercraft, the system comprising:

a display;
a processor; and
a memory including computer program code configured to, when executed, cause the processor to:

receive position data for the watercraft including a current watercraft position;
receive environment data;
determine a status of the watercraft at the current watercraft position;
perform an analysis of the position data, the environment data, and the status of the watercraft;
determine a notification based on the analysis; and
cause presentation of the notification on the display,

wherein the notification is related to the environment data or the status of the watercraft at the current watercraft position.

2. The system of clause 1, wherein the environment data includes at least one of regulatory data or ecological data.

3. The system of clause 1, wherein the notification is:

an alert that discharge is prohibited in the current watercraft position;
an alert that the watercraft is in a reduced noise area;
an alert that a watercraft noise level exceeds a permissible level at the current watercraft position;
an alert indicating the speed limit at the current watercraft position;
an alert indicating that the watercraft is travelling at a speed that exceeds the speed limit at the current watercraft position; or
an alert that deployment of a marine device is prohibited at the current watercraft position.

4. The system of clause 3, wherein the notification is an alert that the watercraft noise level exceeds the permissible level at the current watercraft position, wherein the watercraft noise level is attributable to a motor, a sonar, a sounder, or an onboard speaker on the watercraft.

5. The system of clause 4, wherein the environment data includes regulatory data in the form of watercraft noise level restrictions at the current watercraft position.

6. The system of clause 1, wherein the notification is an alert that an animal could be located near the watercraft, wherein the environment data includes ecological data regarding a known location of one or more animals.

7. The system of clause 1, wherein the notification is an alert that the watercraft is required to operate in an electric mode at the current watercraft position, wherein the environment data includes regulatory data regarding locations where various watercraft are required to operate in electric mode.

8. The system of clause 1, wherein the notification is an alert that the watercraft is not permitted to discharge material in the current watercraft position, wherein the environment data includes regulatory data regarding positions where material discharge is not permitted, wherein the status of the watercraft indicates that a command has been made to discharge material from the watercraft.

9. The system of clause 1, wherein the environment data is saved in the memory, wherein receiving the environment data occurs by retrieving the environment data from the memory.

10. The system of clause 9, wherein the environment data saved in the memory is updated periodically.

11. The system of clause 1, wherein the computer program code is configured to, when executed, cause the processor to:

analyze the position data, the environment data, and a proposed action; and
block the proposed action from being performed,
wherein the notification indicates that the proposed action was not performed.

12. The system of clause 1, wherein the computer program code is configured to, when executed, cause the processor to:

receive a user command providing a proposed action;
analyze the user command, the position data, and the environment data to evaluate whether the proposed action is permitted in the current watercraft position; and
block the proposed action from being performed,
wherein the notification indicates that the proposed action was not performed.

13. The system of clause, wherein the computer program code is configured to, when executed, cause the processor to:

receive a user override command; and
execute the proposed action.

14. The system of clause 1, wherein one or more onboard sensors are located on the watercraft that are configured to provide onboard sensor data, wherein the one or more onboard sensors include at least one of a radar, a position sensor, a direction sensor, a sonar transducer element, an air temperature sensor, a water temperature sensor, a current sensor, a light sensor, a wind sensor, a noise sensor, or a speed sensor, wherein the onboard sensor data is analyzed as part of the analysis.

15. A method for presenting environment alerts for a watercraft, the method comprising:

receiving position data for the watercraft including a current watercraft position;
receiving environment data;
determining a status of the watercraft at the current watercraft position;
performing an analysis of the position data, the environment data, and the status of the watercraft;
determining a notification based on the analysis; and
causing presentation of the notification on a display.

16. The method of clause 15, wherein the environment data includes at least one of regulatory data or ecological data.

17. The method of clause 15, further comprising:

receiving a user command providing a proposed action;
analyzing the user command, the position data, and the environment data to evaluate whether the proposed action is permitted in the current watercraft position; and
blocking the proposed action from being performed,
wherein the notification indicates that the proposed action was not performed.

18. A non-transitory computer readable medium having stored thereon software instructions that, when executed by a processor, cause the processor to:

receive position data for a watercraft including a current watercraft position;
receive environment data;
determine a status of the watercraft at the cur-

rent watercraft position;
perform an analysis of the position data, the environment data, and the status of the watercraft;
determine a notification based on the analysis; and
cause presentation of the notification on a display,
wherein the notification is related to the environment data or the status of the watercraft at the current watercraft position.

19. The non-transitory computer readable medium of clause 18, wherein the environment data includes at least one of regulatory data or ecological data.

20. The non-transitory computer readable medium of clause 19, wherein the environment data includes regulatory data in the form of watercraft noise level restrictions at the current watercraft position.

21. A system for presenting environment alerts for a watercraft, the system comprising:

a display;
a processor; and
a memory including computer program code configured to, when executed, cause the processor to:

receive position data for the watercraft including a current watercraft position;
receive environment data;
perform an analysis of the position data and the environment data;
generate a map image based on the position data and the environment data, the map image including:

a watercraft representation;
representations of a surrounding environment around the watercraft; and
at least one environment representation that is emphasized relative to the representations of the surrounding environment; and

cause presentation of the map image in the display.

22. The system of clause 21, wherein the environment data includes regulatory data or ecological data, wherein the at least one environment representation is related to the regulatory data or the ecological data.

23. The system of clause 21, wherein the at least one environment representation emphasizes at least one of a coast line, a closest point of the coast line, a fish sanctuary, an ecological reserve, a low speed zone, a reduced noise area, a prohibited discharge area, a reef area, a shipwreck area, or a shallow water area.

24. The system of clause 21, wherein the at least one environment representation includes a first environment representation, wherein a first distance is a distance from the current watercraft position to an actual position of the first environment representation, wherein the computer program code is configured to, when executed, cause the processor to cause presentation of the first distance in the display.

25. The system of clause 21, wherein the computer program code is configured to, when executed, cause the processor to cause presentation of the at least one environment representation in one or more colors.

26. The system of clause 25, wherein the one or more colors indicate a proximity of an item associated with the at least one environment representation.

27. The system of clause 25, wherein the one or more colors indicate an item type for the item that is being represented by the at least one environment representation in the display.

28. The system of clause 25, wherein the one or more colors indicate an importance level for the item that is being represented by the at least one environment representation in the display.

29. The system of clause 21, wherein the computer program code is configured to, when executed, cause the processor to:

receive a selection of a first environment representation; and
cause presentation of additional information regarding an item represented by the first environment representation.

30. The system of clause 29, wherein the computer program code is configured to, when executed, cause the processor to:

cause presentation of the map image in a first area in the display; and
cause presentation of the additional information in a second area in the display,
wherein the first area is separate from the second area.

31. The system of clause 29, wherein the computer program code is configured to, when executed,

cause the processor to:

cause presentation of the map image in a first area in the display; and
cause presentation of the additional information as a pop-up window within the first area.

32. The system of clause 21, wherein the map image is a two-dimensional image or a three-dimensional image.

33. The system of clause 21, wherein the memory including computer program code is configured to, when executed, cause the processor to:

determine a status of the watercraft at the current watercraft position;
perform the analysis by analyzing the position data, the environment data, and the status of the watercraft;
determine a notification based on the analysis; and
cause presentation of the notification on the display,
wherein the notification is related to the environment data at the current watercraft position.

34. A method for generating and presenting a map image, the method comprising:

receiving position data for the watercraft including a current watercraft position;
receiving environment data;
performing an analysis of the position data and the environment data;
generating a map image based on the analysis, the map image including:

a watercraft representation;
representations of a surrounding environment around the watercraft; and
at least one environment representation that is emphasized relative to the representations of the surrounding environment; and

cause presentation of the map image in a display.

35. The method of clause 34, wherein the environment data includes regulatory data or ecological data, wherein the at least one environment representation is related to the regulatory data or the ecological data.

36. The method of clause 34, wherein the at least one environment representation is presented in one or more colors, wherein the one or more colors indicate:

a proximity of an item associated with the at least one environment representation;
an item type for the item that is being represented by the at least one environment representation in the display; or
an importance level for the item that is being represented by the at least one environment representation in the display.

37. A non-transitory computer readable medium having stored thereon software instructions that, when executed by a processor, cause the processor to:

receive position data for a watercraft including a current watercraft position;
receive environment data;
perform an analysis of the position data and the environment data;
generate a map image based on the analysis, the map image including:

a watercraft representation;
representations of a surrounding environment around the watercraft; and
at least one environment representation that is emphasized relative to the representations of the surrounding environment; and

cause presentation of the map image in a display.

38. The non-transitory computer readable medium of clause 37, wherein the environment data includes regulatory data or ecological data, wherein the at least one environment representation is related to the regulatory data or the ecological data.

39. The non-transitory computer readable medium of clause 37, wherein the software instructions, when executed by a processor, cause the processor to cause presentation of the at least one environment representation in one or more colors.

40. The non-transitory computer readable medium of clause 39, wherein the one or more colors indicate:

a proximity of an item associated with the at least one environment representation;
an item type for the item that is being represented by the at least one environment representation in the display; or
an importance level for the item that is being represented by the at least one environment representation in the display.

Claims

1. A system for presenting environment alerts for a watercraft, the system comprising:

   a display;
   a processor; and
   a memory including computer program code configured to, when executed, cause the processor to:

      receive position data for the watercraft including a current watercraft position;
      receive environment data;
      determine a status of the watercraft at the current watercraft position;
      perform an analysis of the position data, the environment data, and the status of the watercraft;
      determine a notification based on the analysis; and
      cause presentation of the notification on the display,

   wherein the notification is related to the environment data or the status of the watercraft at the current watercraft position.

2. The system of Claim 1, wherein the environment data includes at least one of regulatory data or ecological data.

3. The system of Claim 1, wherein the notification is:

   an alert that discharge is prohibited in the current watercraft position;
   an alert that the watercraft is in a reduced noise area;
   an alert that a watercraft noise level exceeds a permissible level at the current watercraft position;
   an alert indicating the speed limit at the current watercraft position;
   an alert indicating that the watercraft is travelling at a speed that exceeds the speed limit at the current watercraft position; or
   an alert that deployment of a marine device is prohibited at the current watercraft position.

4. The system of Claim 3, wherein the notification is an alert that the watercraft noise level exceeds the permissible level at the current watercraft position, wherein the watercraft noise level is attributable to a motor, a sonar, a sounder, or an onboard speaker on the watercraft.

5. The system of Claim 4, wherein the environment data includes regulatory data in the form of watercraft noise level restrictions at the current watercraft position.

6. The system of Claim 1, wherein the notification is an alert that an animal is located near the watercraft, wherein the environment data includes ecological data regarding a known location of one or more animals.

7. The system of Claim 1, wherein the notification is an alert that the watercraft is required to operate in an electric mode at the current watercraft position, wherein the environment data includes regulatory data regarding locations where various watercraft are required to operate in electric mode.

8. The system of Claim 1, wherein the notification is an alert that the watercraft is not permitted to discharge material in the current watercraft position, wherein the environment data includes regulatory data regarding positions where material discharge is not permitted, wherein the status of the watercraft indicates that a command has been made to discharge material from the watercraft.

9. The system of Claim 1, wherein the environment data is saved in the memory, wherein receiving the environment data occurs by retrieving the environment data from the memory.

10. The system of Claim 9, wherein the environment data saved in the memory is updated periodically.

11. The system of Claim 1, wherein the computer program code is configured to, when executed, cause the processor to:

   analyze the position data, the environment data, and a proposed action; and
   block the proposed action from being performed,
   wherein the notification indicates that the proposed action was not performed.

12. The system of Claim 1, wherein the computer program code is configured to, when executed, cause the processor to:

   receive a user command providing a proposed action;
   analyze the user command, the position data, and the environment data to evaluate whether the proposed action is permitted in the current watercraft position; and
   block the proposed action from being performed,
   wherein the notification indicates that the proposed action was not performed.

13. The system of Claim 12, wherein the computer program code is configured to, when executed, cause the processor to:

receive a user override command; and
execute the proposed action.

14. The system of Claim 1, wherein one or more onboard sensors are located on the watercraft that are configured to provide onboard sensor data, wherein the one or more onboard sensors include at least one of a radar, a position sensor, a direction sensor, a sonar transducer element, an air temperature sensor, a water temperature sensor, a current sensor, a light sensor, a wind sensor, or a speed sensor, wherein the onboard sensor data is analyzed as part of the analysis.

15. A method for presenting environment alerts for a watercraft, the method comprising:

receiving position data for the watercraft including a current watercraft position;
receiving environment data;
determining a status of the watercraft at the current watercraft position;
performing an analysis of the position data, the environment data, and the status of the watercraft;
determining a notification based on the analysis; and
causing presentation of the notification on a display.

16. The method of Claim 15, further comprising:

receiving a user command providing a proposed action;
analyzing the user command, the position data, and the environment data to evaluate whether the proposed action is permitted in the current watercraft position; and
blocking the proposed action from being performed,
wherein the notification indicates that the proposed action was not performed.

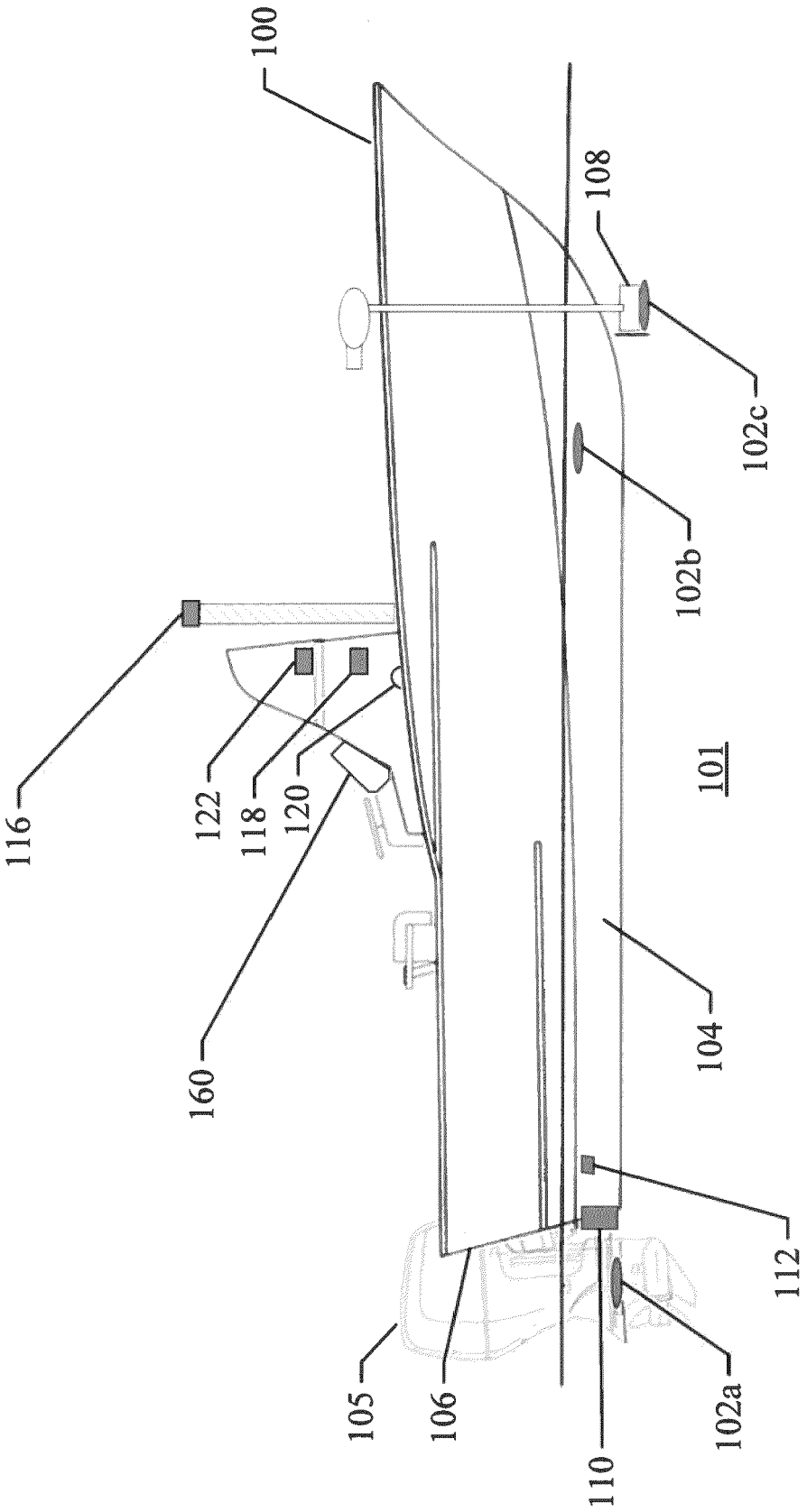
100
108
102c
102b
116
122
118
120
101
160
104
112
105
106
110
102a

FIG. 1

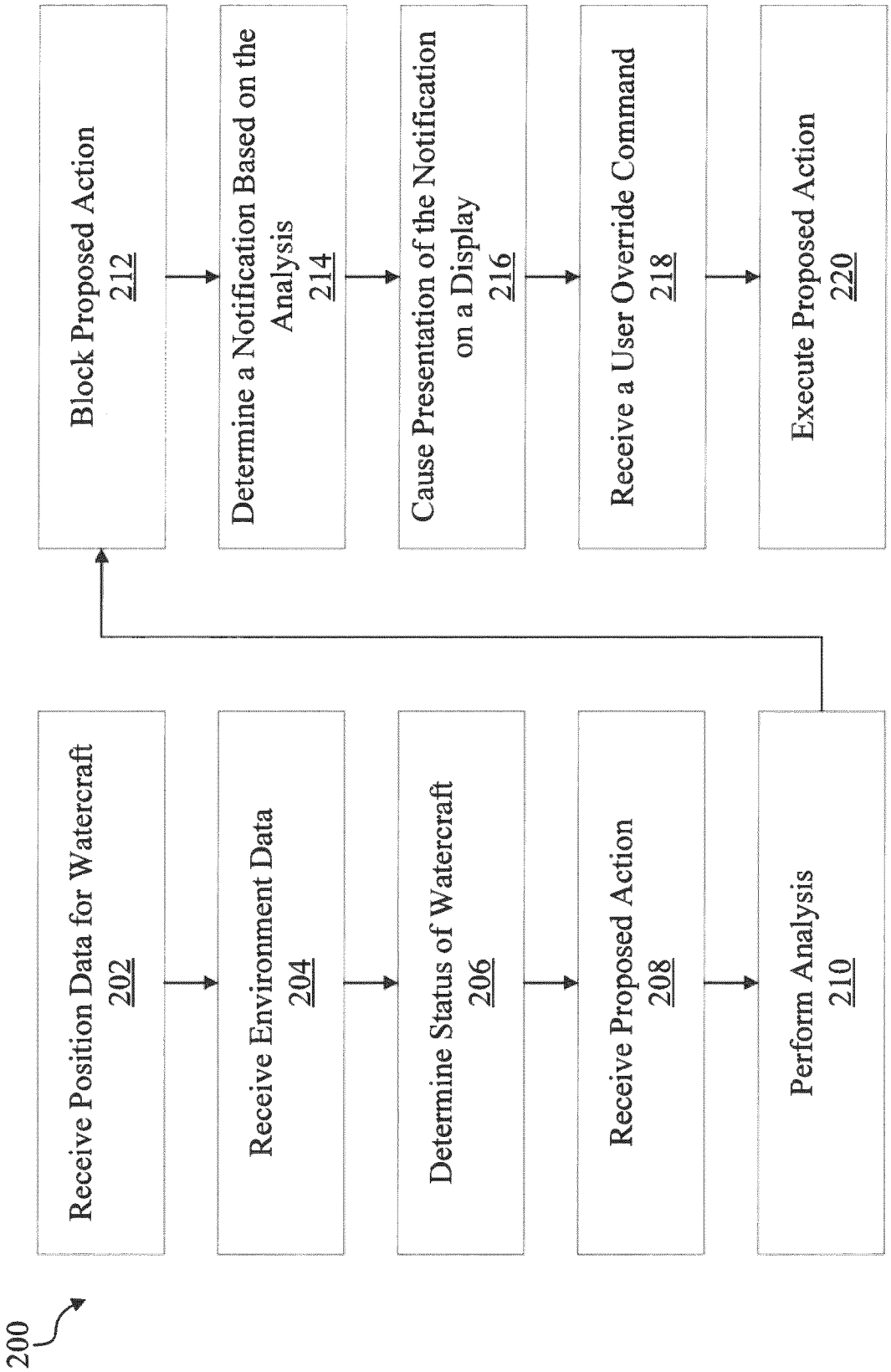
200
Receive Position Data for Watercraft
202
Receive Environment Data
204
Determine Status of Watercraft
206
Receive Proposed Action
208
Perform Analysis
210
Block Proposed Action
212
Determine a Notification Based on the Analysis
214
Cause Presentation of the Notification on a Display
216
Receive a User Override Command
218
Execute Proposed Action
220

FIG. 2

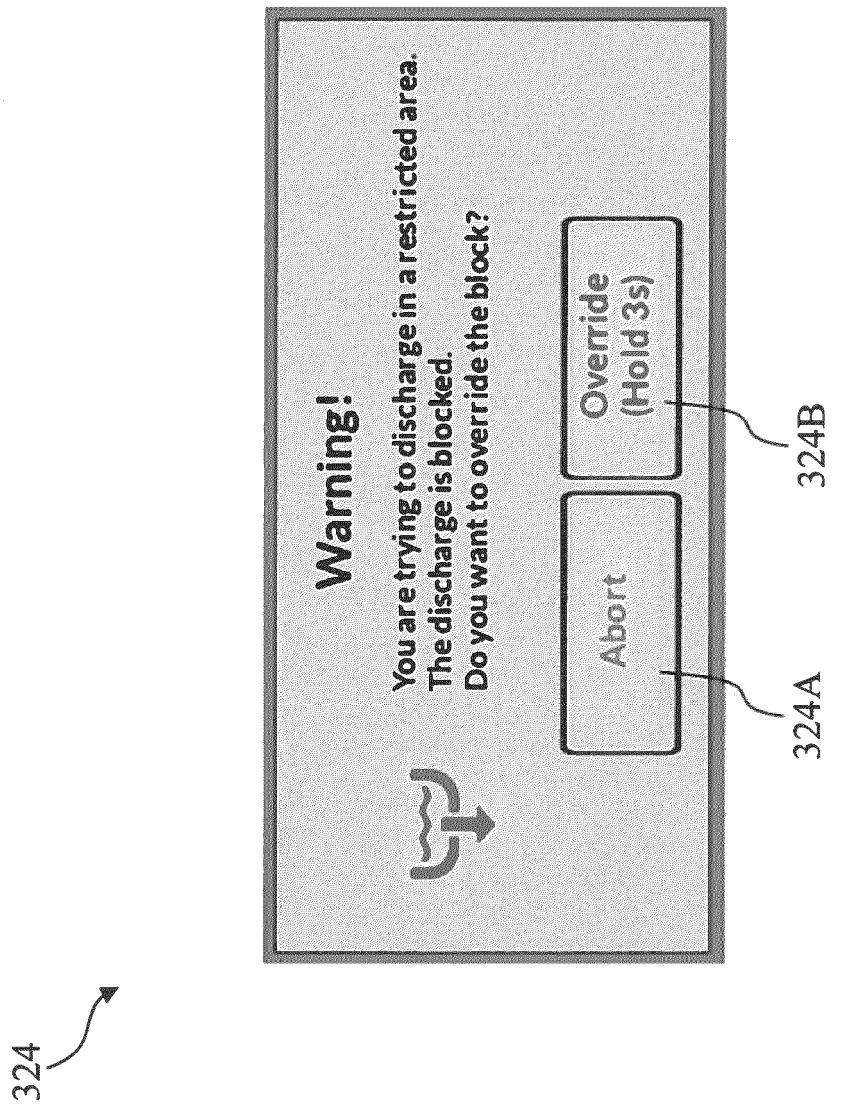
324
Warning!
You are trying to discharge in a restricted area.
The discharge is blocked.
Do you want to override the block?
Abort
Override
(Hold 3s)
324A
324B

FIG. 3A

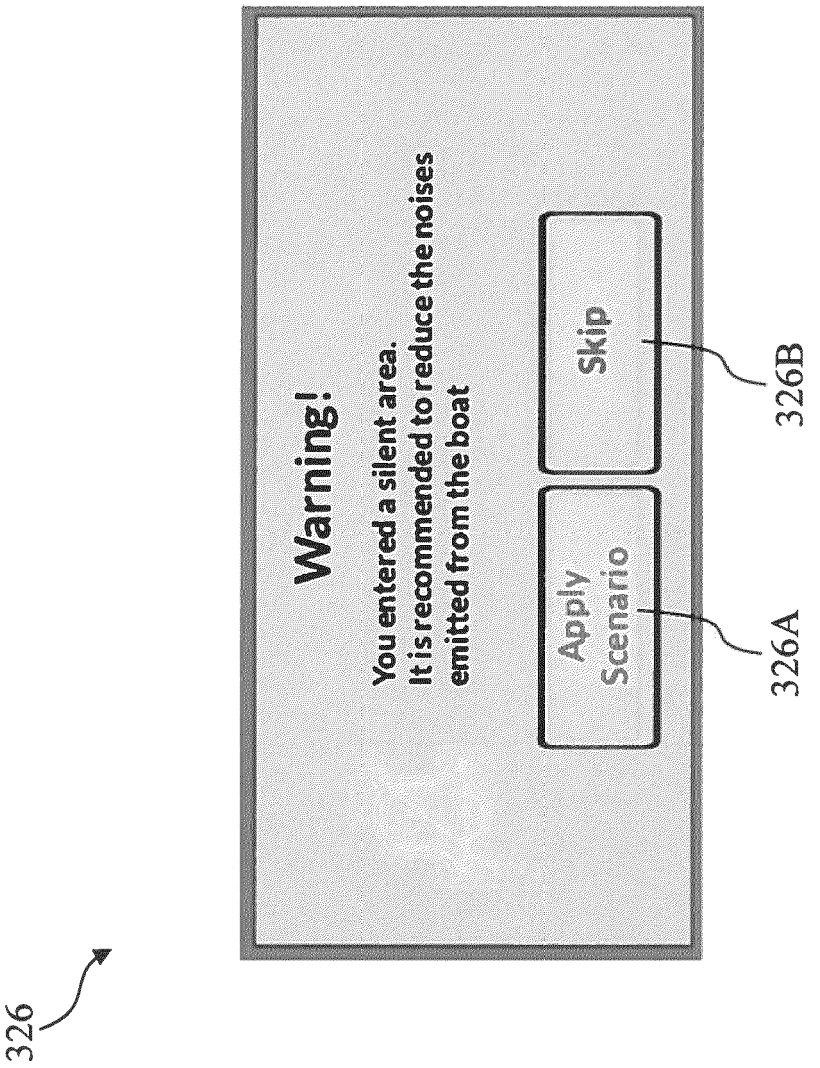
326
Warning!
You entered a silent area.
It is recommended to reduce the noises emitted from the boat
Apply Scenario
Skip
326A
326B

FIG. 3B

FIG. 3C

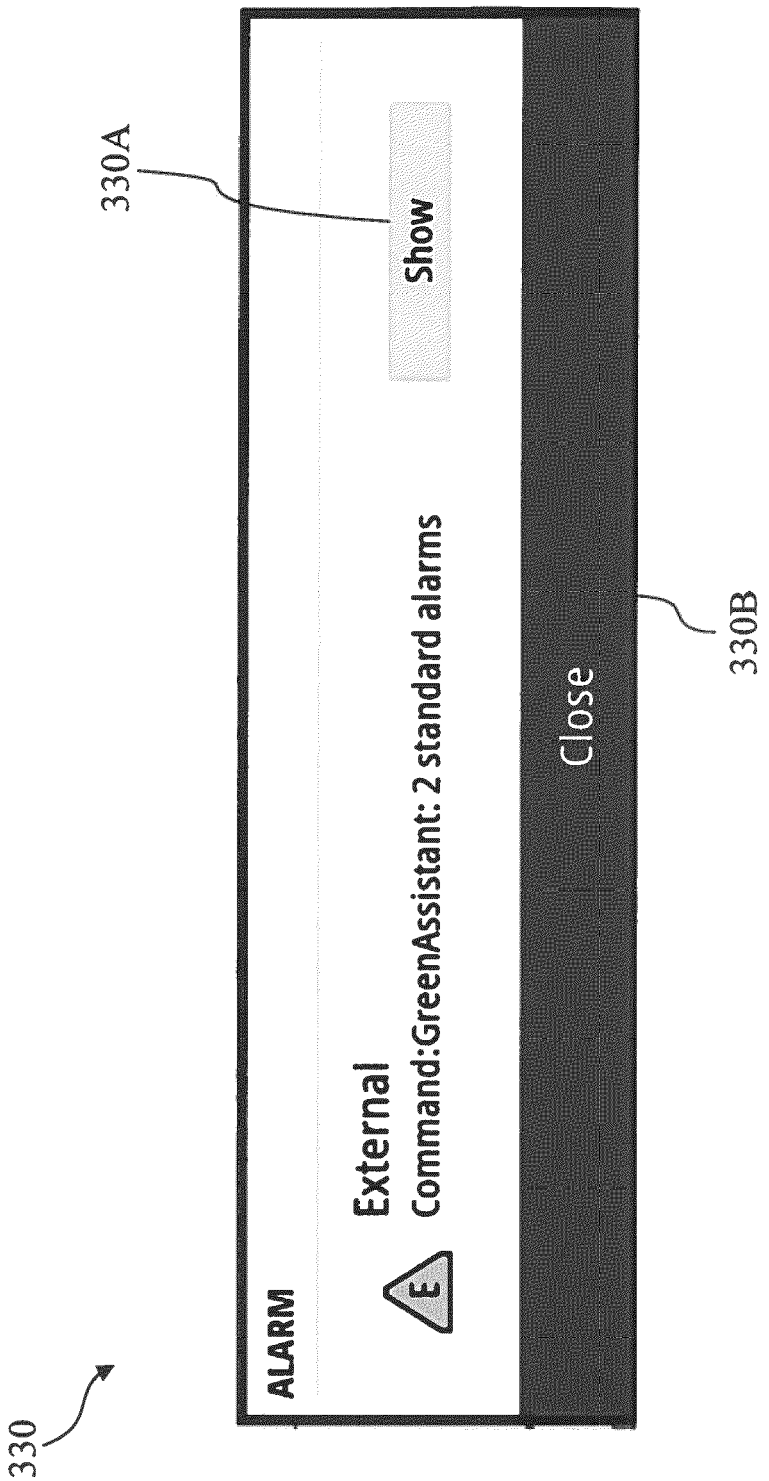
330
330A
330B
ALARM
External
Command:GreenAssistant: 2 standard alarms
Show
Close

FIG. 3D

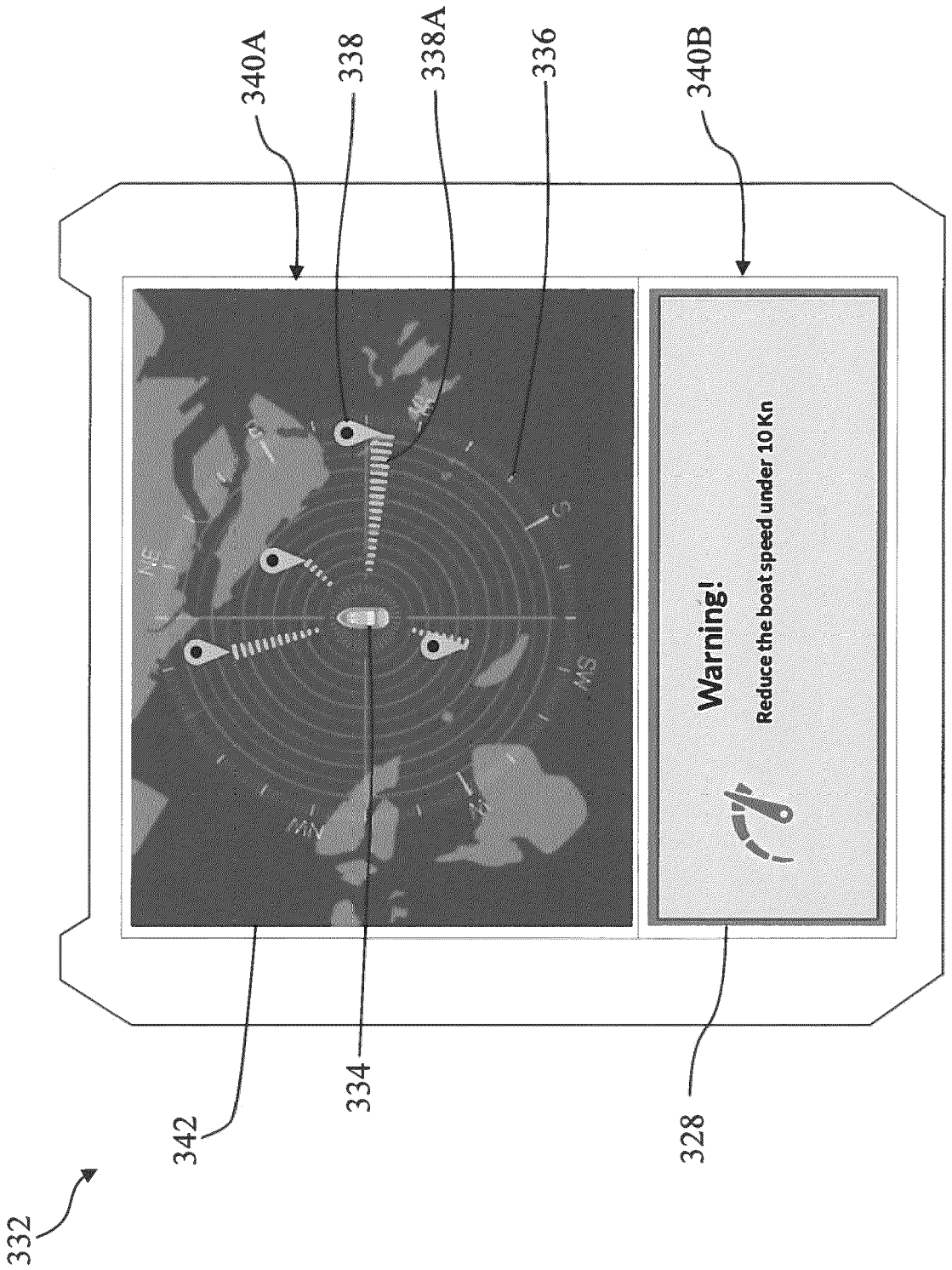
340A
338
338A
336
340B
Warning!
Reduce the boat speed under 10 Kn
342
334
328
332

FIG. 3E

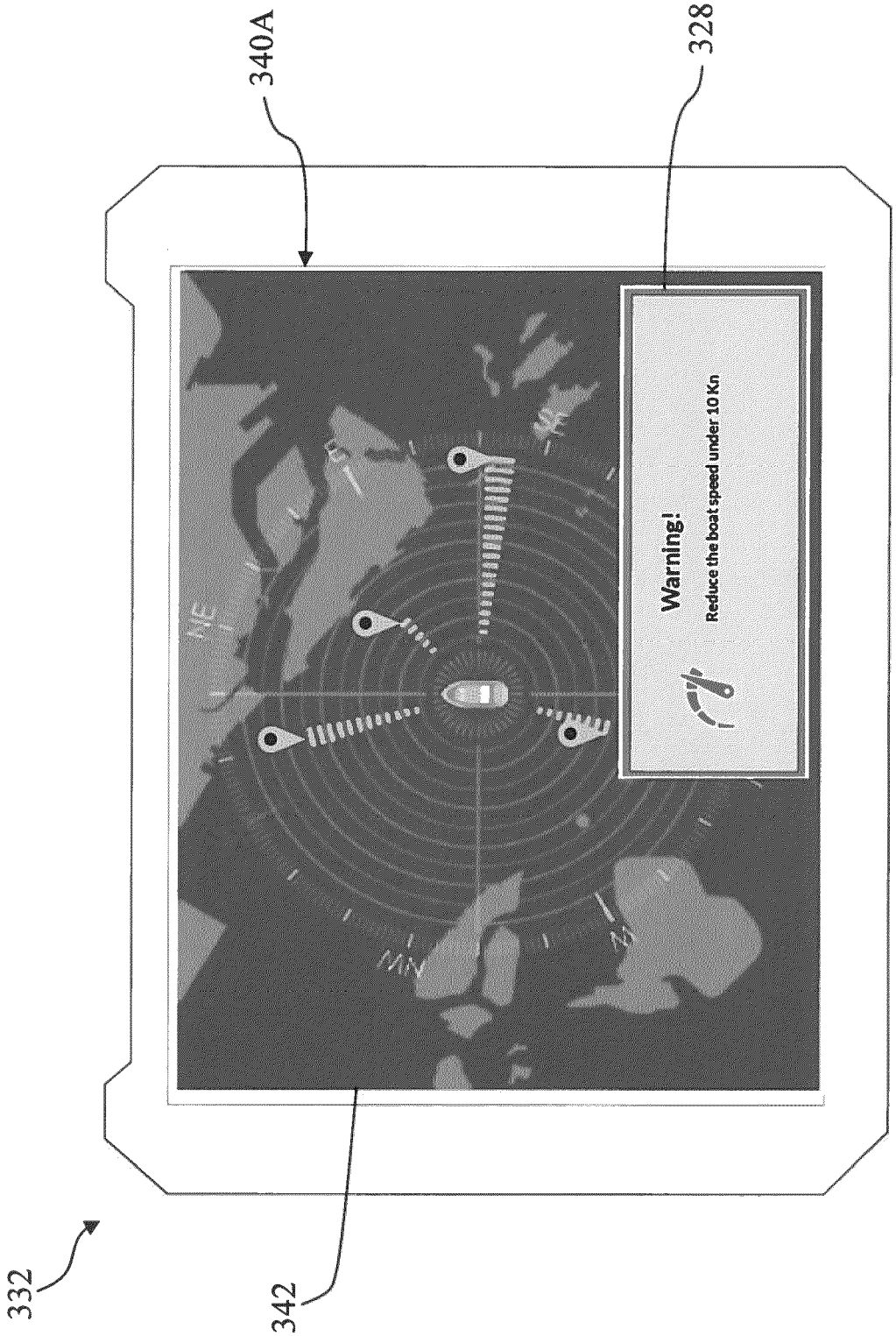

FIG. 3F

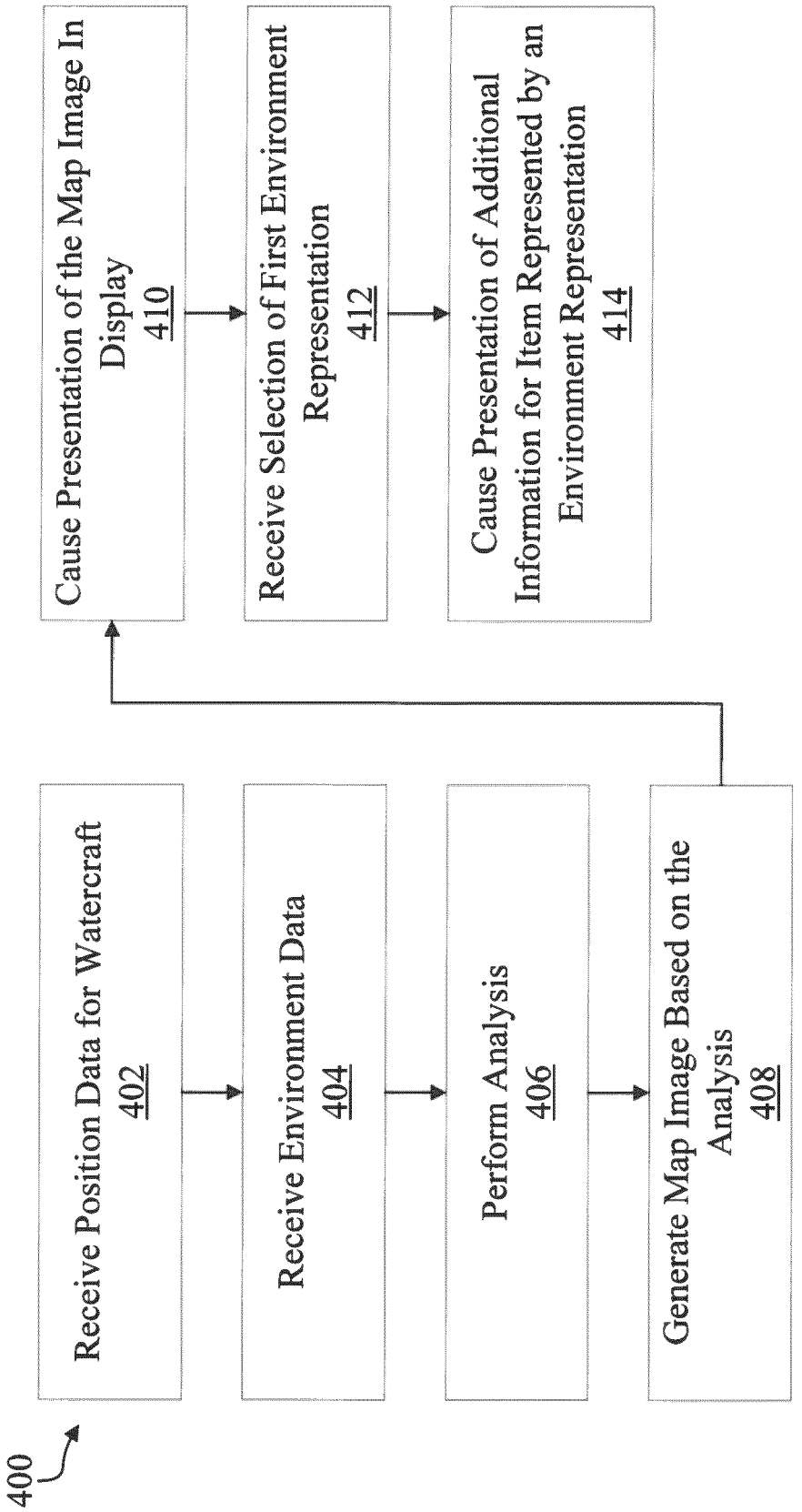
400
Receive Position Data for Watercraft
402
Receive Environment Data
404
Perform Analysis
406
Generate Map Image Based on the Analysis
408
Cause Presentation of the Map Image In Display
410
Receive Selection of First Environment Representation
412
Cause Presentation of Additional Information for Item Represented by an Environment Representation
414

FIG. 4

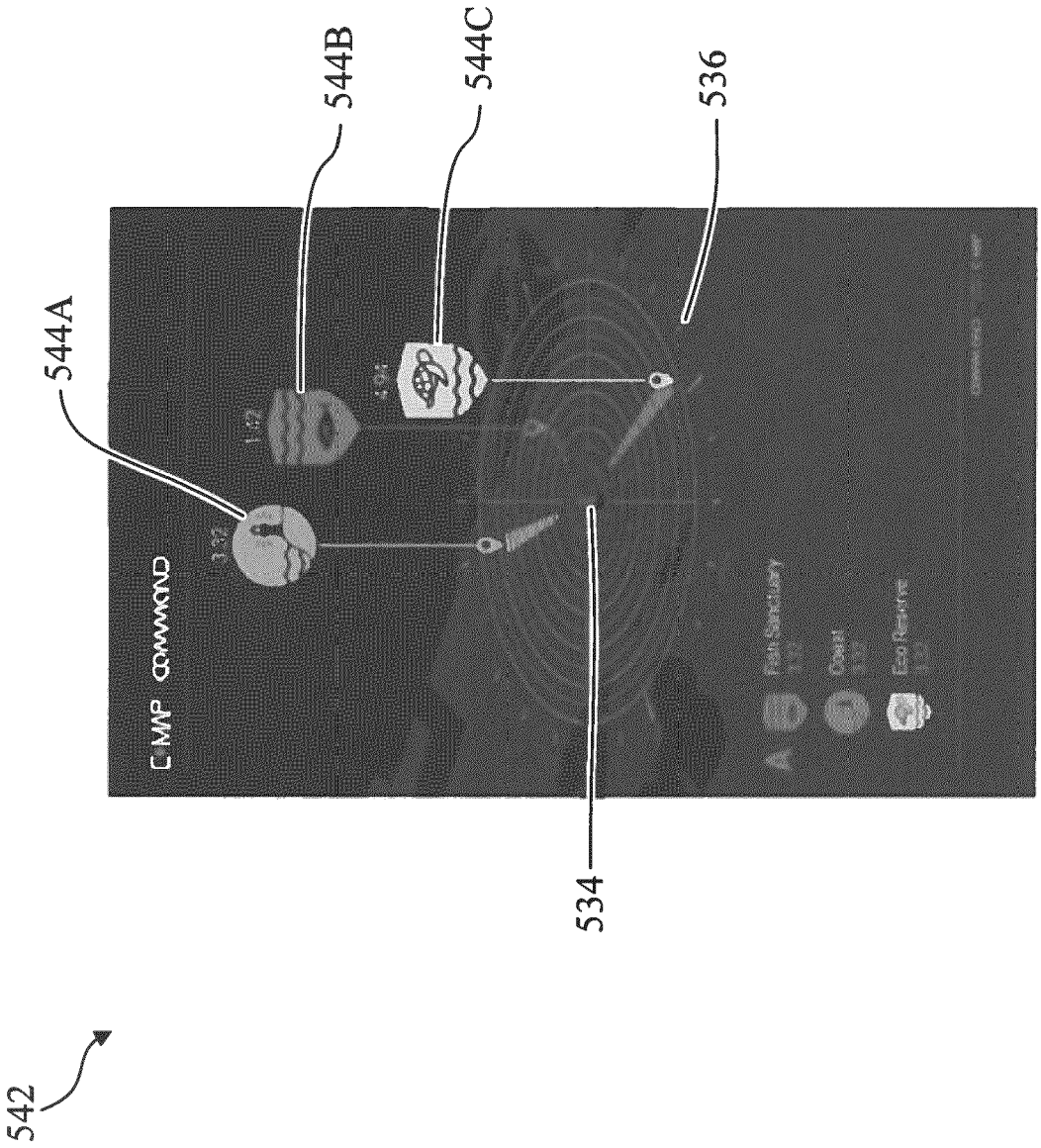

FIG. 5A

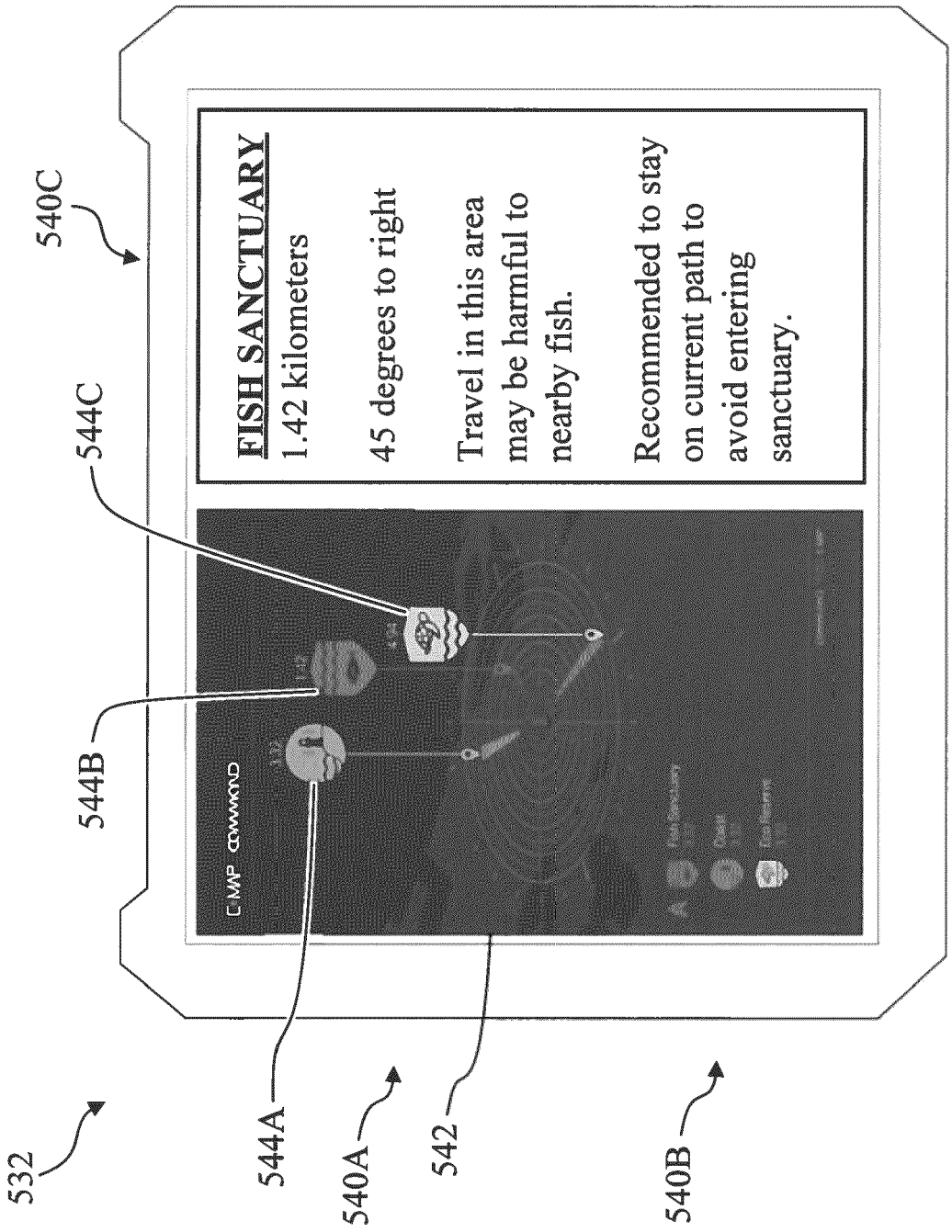
532
544A
540A
542
540B
544B
544C
540C
FISH SANCTUARY
1.42 kilometers
45 degrees to right
Travel in this area may be harmful to nearby fish.
Recommended to stay on current path to avoid entering sanctuary.

FIG. 5B

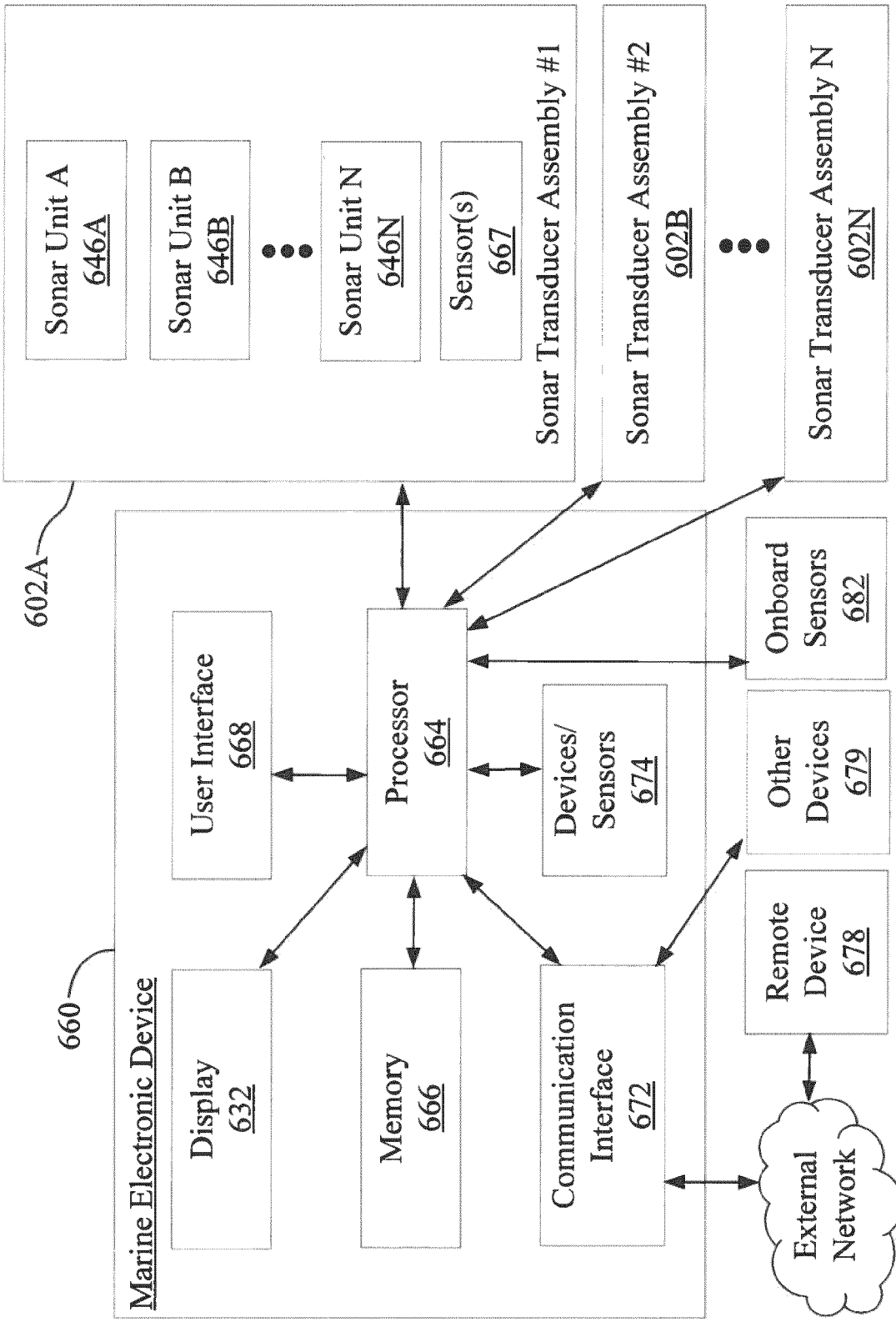
Sonar Unit A
646A
Sonar Unit B
646B
Sonar Unit N
646N
Sensor(s)
667
Sonar Transducer Assembly #1
Sonar Transducer Assembly #2
602B
Sonar Transducer Assembly N
602N
602A
660
Marine Electronic Device
User Interface
668
Processor
664
Devices/
Sensors
674
Onboard
Sensors
682
Other
Devices
679
Remote
Device
678
Display
632
Memory
666
Communication
Interface
672
External
Network
676

FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 22 42 5038

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2019/291832 A1 (HASHIZUME TAKASHI [JP] ET AL) 26 September 2019 (2019-09-26)	1-6, 9-12, 14-16	INV. B63B79/40 B63B79/15 B63J4/00
Y	* figures 3, 4, 6, 7 * * paragraph [0084] *	7,8,13	
X	US 2022/135192 A1 (KHREIBANI JAMES [US] ET AL) 5 May 2022 (2022-05-05)	1-6,8-16	
Y	* figures 3, 4 * * paragraph [0015] *	7,8	
X	KR 2018 0035325 A (HYUN DAI HEAVY IND CO LTD [KR]) 6 April 2018 (2018-04-06)	1-7, 9-12, 14-16	
Y	* paragraphs [0009], [0014], [0043], [0044] *	7,8,13	

TECHNICAL FIELDS SEARCHED (IPC)

B63B
B63J
B63H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 February 2023	Freire Gomez, Jon

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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07-02-2023

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		JP 6427694 B1	21-11-2018
		JP WO2018179443 A1	04-04-2019
		US 2019291832 A1	26-09-2019
		WO 2018179443 A1	04-10-2018
US 2022135192 A1	05-05-2022	NONE	
KR 20180035325 A	06-04-2018	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82