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(12) # EUROPEAN PATENT APPLICATION

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(54) **System for automatic water exploration**

(57) A system is disclosed for automatic water exploation, comprising a watercraft with a floating part (11) and an underwater part (12) linked together by means of a cable (13) that provides at least communication transmission.

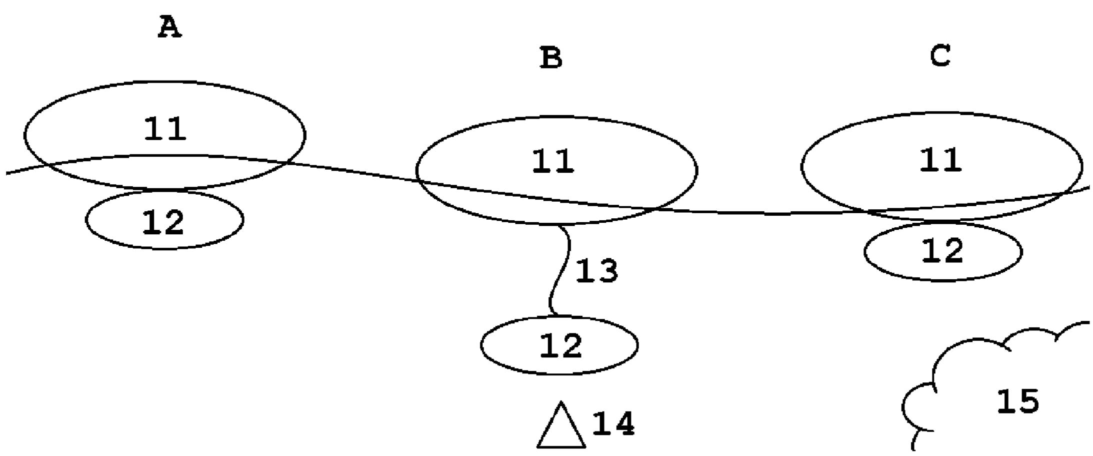

FIGURE 2

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Description

TECHNICAL AREA

[0001] This disclosure is in the area of watercrafts and automatic systems.

ABSTRACT

[0002] A watercraft is disclosed which has the ability to automatically adjust one of its planes in relation to a surface of water to achieve useful goals.

BRIEF DESCRIPTION OF THE FIGURES

[0003]

Figure 1 is an elemental view of the Watercraft Automatic Bi-planar Explorer.

Figure 2 is a representation of the Watercraft Automatic Explorer as it deals with different situations in succession.

DESCRIPTION

[0004] A system that comprises a watercraft can operate in a simple floating mode or have a floating and a submarine mode at the same time, which concur to accomplish a goal.

[0005] Power is necessary for the functioning of the system, and can be provided through different ways: in a simple embodiment of this aspect, the system will integrate batteries; in a more complex embodiment of this aspect, the batteries can be recharged by the system through power generators, which can make use make use of tidal, current and solar energy, for instance.

[0006] Processing means in the system, comprising at least a processor and memory, can interpret sensor data, location data, calculate distance, either in space or time, and apply sets of rules.

[0007] The processor can be any kind of processor that can interpret the sensor data, and actuate the actuators, whilst being able to be programmable, so a general-purpose processor is a standard choice for embodying the current disclosure.

[0008] For instance, the processor may be a CISC processor such as an x86 or x64 processor or a RISC processor such as an ARM processor.

[0009] In small-scale embodiments to this disclosure, the processor may be a reduced-power processor such as an Intel ® Atom ™ processor, on a small form factor motherboard such as ITX (mini, nano, pico, mobile).

[0010] The floating and submarine modes are achieved through corresponding floating and submarine modules, which can be integrated into a single watercraft or can detach from one another, retaining functional integrity through a cable link.

[0011] The floating module comprises wireless communication means so that it can communicate with a remote station or user. The wireless communications means can follow the Bluetooth or Wi-Fi specifications.

[0012] The submarine module comprises at least one sensor of a type, which can be optical, acoustic, magnetic, electric, chemical, and sensitive biological element.

[0013] The submarine module can have a variety of actuators, such as light actuators, image projection means, sound projection means, a claw capable of seizing items, and even a screwdriver.

[0014] The connection between the floating and submarine module is realized through a cable. Depending on embodiment, the cable can carry power or not, but must always carry communication between the floating and communication module.

[0015] The separation of the submarine module from the floating module is of relevance, and can be achieved through alternate means.

[0016] For instance, the submarine cable may be lowered from the floating module by virtue of the relative weight of the submarine module.

[0017] The existence of motors in the submarine module will also impact the connection cable array. The connection cable must be expansible and retractable, which can be embodied by using a system with a reel system coupled to a motor. Such system affords a simple submarine module retrieval function.

[0018] Rich functionality can be achieved through the system, based on sensor detection, actuator means, and an open-ended programmable application to interleave them.

Figure 1 is an elemental view of the Watercraft Automatic Bi-planar Explorer (WABE), in which there are the floating module (11), the deployed submarine module (12) and the connection cable (13).

Figure 2 is a representation of the way the WABE handles a succession of events.

[0019] In moment A, the WABE is floating in a tide, and floating module (11) and submarine module (12) are attached to one another.

[0020] In moment B, in response to the detection of an element of interest (14), the WABE detaches its submarine module (12) from its floating module (11) for close-sensing.

[0021] In moment C, in response to an identified obstacle (15) the WABE attaches its submarine module (12) to its floating module (11).

[0022] In an exemplary embodiment, a leisure ship is at sea and reaches a coral reef.

[0023] The occupants of the leisure ship wish to dive in the coral reef, and are keen to find sea snails of an exotic color.

[0024] They use an application to program the watercraft automatic bi-planar explorer (WABE) to look for the exotic color of the sea snails and set it to a < linear exploration > mode.

[0025] They drop the WABE in the water, and it propels itself forward 1.5 meters, after which it activates an underwater color camera in its submarine module and it runs an application in a memory connected to a processor in the floating module to recognize the exotic sea snail color.

[0026] The WABE moves forward continuously at a slow pace until, 30 meters from the boat, it detects the color in camera image.

[0027] The WABE automatically lowers its submarine module until the blob with the exotic sea snail color has a largest dimension of $1/5^{th}$ of the total image dimension in that axis (either vertical or horizontal) and then uses the camera to take a picture.

[0028] After taking the picture, the WABE transmits the picture through wireless communication to the boat, and raises its submarine module back.

[0029] In the boat, the divers identify a sea snail in the picture as one of interest to them, and dive to meet the WABE and take their own pictures of the snail.

[0030] Alternatively, with a different goal, the divers might have programmed the WABE to simply transmit a slideshow with a picture being taken every so seconds.

[0031] In a further embodiment, the WABE could be used to locate lagan or derelict cargo.

[0032] In another exemplary embodiment, a boy has lost an heirloom pocket knife in a big lake in his family's manor.

[0033] The lake is deep and murky and finding something in the bottom of it presents a challenge.

[0034] The boy gets his portable WABE, which he received at Christmas, and sets a < metal detection > mode, width a width parameter of < 10 meters > and a detection action of < circle at the surface > .

[0035] The boy sets the WABE in the water, and the WABE propels itself 1.5 meters forward, at which point it slowly releases its submarine module into the lake until a pressure sensor in the submarine module detects when it hits bottom, at which time it offsets that relative depth with a parameter of 0.5 meters to define maximum submarine operational depth.

[0036] The WABE enters the < metal detection > mode, whereby a metal sensor in the submarine module periodically senses the depth of the lake for metal.

[0037] The WABE's floating module is equipped with a propeller, which is used in a coordinated manner with the submarine module.

[0038] The floating module moves 0.5 meters forward at a time for a length of 10 meters, and the submarine module senses the bottom of the lake for metal at each stop.

[0039] After moving for 10 meters in a length, the floating module turns 90° degrees, moves forward 0.5 meters again, turns 90° again, and starts to move forward for 10 meters again, 0.5 meters at a time, at the end of which it repeats the procedure but inverting the angles (i.e. -90° or 270°), until it has covered a 10 by 10 meters area.

[0040] At a point in this procedure, the submarine module senses metal at the bottom of the lake, the submarine module is retrieved, and the WABE starts to draw slow sharp circles on the surface of the lake.

[0041] The boy, having been gone for tea, returns to find the WABE slowly drawing circles in the water about 20 meters from the edge.

[0042] Using a remote controller, the boy instructs the WABE to use its magnet to retrieve the metal.

[0043] The WABE receives the magnet instruction, and it powers the electric magnet in its submarine module that it lowers unto the bottom of the lake.

[0044] After the submarine module has reached the bottom of the lake, the submarine module is raised and reintegrated with the floating module, and the WABE returns to the location that it been deployed at by the boy.

[0045] The boy carefully lifts the WABE from the water, and is thrilled to find his pocket knife attached to the bottom of the WABE.

[0046] In a further exemplary embodiment to this disclosure, a fisherman at sea in his boat programs his WABE application to make the WABE roam the surface of the sea until it detects movement under the sea.

[0047] The fisherman programs the application with a < roaming > mode and a detection parameter of < motion > and a detection action of < request manual mode >.

[0048] The fisherman deploys the WABE in the water, the WABE propels itself forward 1.5 meters and then starts to move in an expanding spiral around its point of deployment. As it does so, it uses a Global Positioning System (GPS) module in its floating module to acquire a GPS location for itself, uses Wi-Fi communication means in its floating module to communicate with the WABE application in the boat to acquire a position for the boat, and uses its processing means in the floating module to prevent it being in location within 15 meters of the boat.

[0049] At a certain point in its spiral trajectory, the WABE detects, through processing motion analysis from the video stream from an underwater camera in its submarine element, that there is motion underneath it.

[0050] The WABE wirelessly communicates with the WABE application in the boat, and the application flashes a notice "WAITING ON USER".

[0051] The fisherman sees the flashing notices and uses the interface in the WABE application to control the WABE.

[0052] The fisherman lowers the WABE application in the WABE and uses the camera in the submarine module of the WABE to obtain a video stream of the waters at the WABE's location.

[0053] The fisherman identifies a fish in the video stream as a Marlin, and maneuvers his boat to meet the expected.

[0054] If it has a default location, it uses its GPS to trajectory of the Marlin.

[0055] In the excitement of the moment, the fisherman leaves the WABE in manual mode, and whilst pursuing the Marlin, leads the boat to be outside the communication range of the WABE.

[0056] The WABE, detecting that it has lost communication with the boat, ends the manual mode, and checks for a default location setting in its memory.

[0057] If it finds a default location setting, it uses its GPS to navigate to the default location.

[0058] If it does not find a default location setting, it uses its GPS to navigate to the last location of the boat that it has in its memory.

[0059] In a further exemplary embodiment, a watercraft is in the North-Pacific Ocean collecting long-term thermoaline data from the surfacing point of the great ocean conveyor current.

[0060] It is energetically autonomous, relying on solar cells and tidal absorbers that charge high-capacity accumulators.

[0061] The watercraft continuously adjusts its position in order to maintain itself in the center of the current's surfacing point.

[0062] The watercraft continuously samples the water through sensors in a detachable submarine module which hull is entirely Polycarbonate / Acrylonitrile Butadiene Styrene (PC/ABS) plastic. The plastic composition of the submarine module' hull has the advantage of liberating the sensors from sensing metallic particles from the floating metallic hull.

[0063] The submarine module senses the chemical composition of the current through an array of specific sensors and transmits the chemical composition data to the floating module of the watercraft through a communication cable, which also functions as the anchor cable between the 2 modules when the submarine module is detached.

[0064] The floating module has processing means that analyze the chemical composition for presence of elements and compounds, their relative concentration, and the evolution thereof through time.

[0065] When it detects a high variation in concentration over a period of time, e.g. >50% over a month, for one of the elements or compounds that it is equipped to detect, the floating module automatically uses satellite communication means to transmit a report on the variation to a remote station.

[0066] Equally, the mere presence of a chemical element that has a critical detection attribute may trigger the communication to the remote station.

[0067] Other examples of communication to the remote station are the occurrence of a damaging event such as a hull breach in either of the watercrafts modules, or the loss of sensor functionality.

[0068] Upon reception of communication from the watercraft, the remote station may use a simple remote control console to change the activity of the watercraft, commanding it to collect a water sample, return to dock, or cease use of a certain type of sensor, as examples.

[0069] The foregoing embodiments vie to describe certain aspects of this disclosure in detail.

[0070] Other aspects may be apparent to those skilled in the art that, whilst differing from the foregoing embodiments in detail, do not depart from this disclosure in spirit or scope.

[0071] Intel Atom are trademarks of Intel Corporation in the U.S. and/or other countries.

Claims

1. A system for automatic water exploration, comprised of
a floating part
an underwater part
wherein at least one of the floating part or the underwater part has, separately,
power means
processing means
propulsion means
and wherein
the underwater part can vary its depth from being integrated into the floating part down to a maximum depth range
the floating part and the underwater part are linked by a cable that provides at least communication transmission
the floating part is equipped with wireless communication means the underwater part is equipped with at least one first sensor.

2. The system of claim 1, wherein there is an automatic surveying mode that operates by the underwater part being at a certain depth and taking first sensor readings at regular intervals.

3. The system of claim 1, wherein a first sensor reading over a threshold value triggers a sensor reading by a second sensor.

4. The system of claim 1, wherein a function is to use known locations for automatic navigation.

5. The system of claim 1, wherein the sensor is a chemical sensor.

6. The system of claim 1, wherein the sensor is a metal sensor.

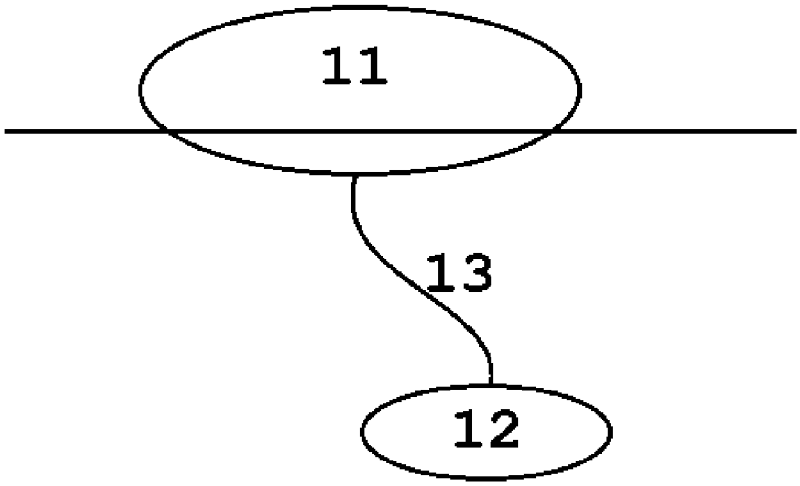

FIGURE 1

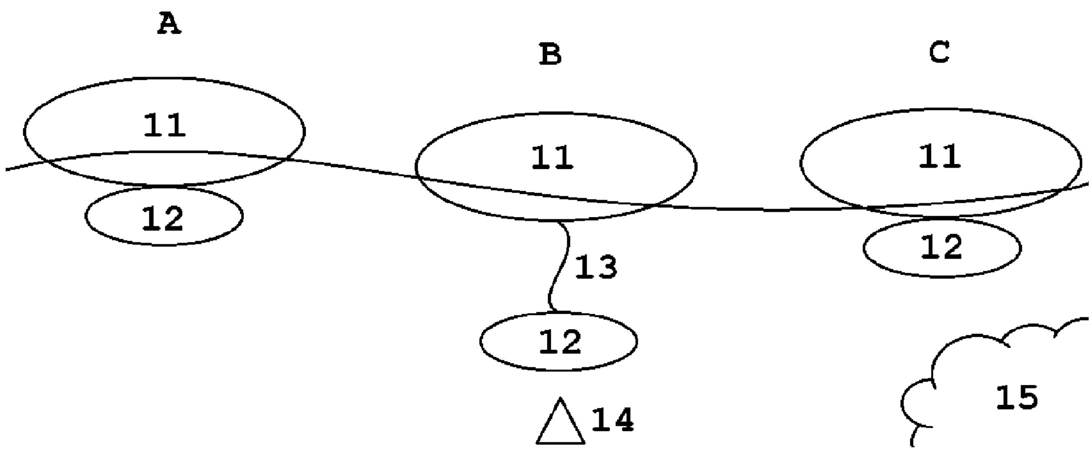

FIGURE 2

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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 4463

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 Y	JP S62 8895 A (KAIKEN KK) 16 January 1987 (1987-01-16) * abstract; figures *	1,3 5	INV. B63C11/48 B63G8/00
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TECHNICAL FIELDS SEARCHED (IPC)

B63G
B63C

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	19 December 2013	Vermeulen, Tom

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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E : earlier patent document, but published on, or after the filing date
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 18 4463

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The members are as contained in the European Patent Office EDP file on
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19-12-2013

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