Observation and image transmission system notably for surface naval drone, and associated naval drone.

The present invention relates to the field of observation and image formation from an inhabited surface craft which is notably intended for maritime applications.

More particularly, the invention relates to the field of surface naval drones remotely controlled by an operator which comprise systems to enable observation and image transmission of water sprays that are obtained when projectiles are fired from a surface vessel.

In practice, in order to be able to study the quality and the accuracy of projectile firings on targets, it is necessary to be able to observe and transmit the images of these firings, and in particular the water sprays that are formed after the impacts on the targets.

In this respect, a remote-controlled surface naval drone is normally used to enable this observation to be carried out without endangering personnel.

The collected images are then analysed in total safety in a centre provided for this purpose which can, for example, be located on the surface vessel, or on land.

Such a surface naval drone conventionally comprises a body, propulsion means, and an observation and image transmission system mounted on the body. The observation and image transmission system normally comprises a camera articulated rotation-wise to perform surveillance over 360° at a predetermined distance from the drone.

This system has the drawback of requiring frequent dismantling of the articulation of the camera which tends to wear relatively rapidly. Consequently, this wear can adversely affect the dependability of the observation and image transmission system, and that of the

drone on which it is mounted. It is therefore necessary to provide for regular maintenance operations.

The aim of the present invention is therefore to remedy these drawbacks.

More particularly, the aim of the invention is to provide an observation and image transmission system, notably for surface naval drone, which is particularly reliable, robust and easy to mount.

According to a first aspect, the subject of the invention is an observation and image transmission system for surface naval drone comprising an observation device provided with a support deck, an optronics assembly which comprises a plurality of cameras mounted on the support deck, and a central management unit for the optronics assembly.

The central management unit is able to control, in a first surveillance mode, all the cameras to obtain a surveillance over 360° at a first distance from the system, and able to control, in a second surveillance mode, a reduced number of cameras to obtain a surveillance over a reduced angular range at a second distance from the system.

With such an observation device provided with a plurality of cameras distributed on the support deck, it is no longer necessary to provide one or more cameras that are mobile rotation-wise, which substantially limits any operating wear.

Furthermore, with such an observation device, it is possible to carry out the observation and image transmission in different angular ranges located at different distances from the drone.

In practice, the optronics assembly is provided for the surveillance of a first area located in a first angular range and at a

first distance from the drone, and a second area located in a second angular range and at a second distance from the drone.

Thus, this device can provide a surveillance according to different modes of operation without it being necessary to provide for cameras to be added or even optical elements of said cameras to be changed.

Advantageously, the cameras are regularly distributed circumferentially on the support deck.

In one embodiment, the cameras are fixed on the support deck.

Advantageously, the observation device comprises a fixing base and a gyrostabilized articulation disposed between the fixing base and the support deck.

Advantageously, the central management unit for the optronics assembly is mounted on the support deck. Thus, the length of the connecting cables linking the cameras to the central management unit is relatively short.

Preferably, the system comprises a transmission unit supporting the observation device and able to allow the system to be mounted on an element external to said system.

Advantageously, the device comprises a bearing sensor, magnetic for example, axially offset relative to the cameras, on the side opposite to the support deck.

The observation device can also be provided with a translucent protective cover mounted on the fixing base. The cover is used to protect the optronics assembly and the central management unit from various external polluting agents that can possibly cause a malfunction.

Advantageously, the observation device comprises at least one navigation image transmission antenna able to be extended.

When the mast is dismantled, the antennas can therefore be stowed along the latter in order to reduce its bulk.

In one embodiment, the system comprises a navigation camera intended to be mounted on a support means of the observation and image transmission system.

According to a second aspect, the subject of the invention is a surface naval drone provided with a body, an observation and image transmission system, and a support means for said observation and image transmission system. The observation and image transmission system comprises an observation device provided with a support deck, an optronics assembly which comprises a plurality of cameras mounted on the support deck, and a central management unit for the optronics assembly, in which the central management unit is able to control, in a first surveillance mode, all the cameras to obtain a surveillance over 360° at a first distance from the system, and able to control, in a second surveillance mode, a reduced number of cameras to obtain a surveillance over a reduced angular range at a second distance from the system.

Advantageously, the support means comprises a mast mounted on the body.

With such a design of the support means, it consequently becomes possible to obtain a surface naval drone that is particularly easy and economical to mount.

In practice, the use of a single mast to provide the support for the observation and image transmission system means that the elements of the drone can be assembled rapidly.

In other words, the provision of a support means consisting of a single element makes it possible to overcome lengthy mounting constraints that can prove particularly costly.

Moreover, the use of a single element for mounting the observation and image transmission system on the body of the drone makes it possible to obtain a support that is less sensitive to the vibrations that can be generated by swell movements. The support means is therefore lighter and less costly.

Advantageously, the drone also comprises means for maintaining the mast in position.

In one embodiment, these position maintaining means comprise ropes and rope tensioning elements.

Thus, the support mast can be maintained in a perfectly vertical position, and this even in relatively difficult navigation conditions.

In practice, the position-maintaining means, and in particular the ropes and the rope tensioning elements, make it possible to constrain the support mast, which significantly limits any risk of bowing caused by strong bursts of wind and/or a rough sea.

Preferably, the mast is mounted removably on the body. Thus, it can be mounted or dismantled, quickly and easily. When the mast has been dismantled, it is therefore possible to use the body of the drone for another application. The result is therefore a boat that can be used to transport people or equipment.

The drone can therefore be transformed to be dedicated to transport. Then, by remounting the mast provided with the observation and transmission system on the body, a drone is once again obtained that can be used to observe and transmit the images of firings. The result is thus a drone that can be converted according to the application for which it is intended, which can be obtained from a semi-rigid boat of the outboard or inboard motor type. For a transport-dedicated application, it is easy to design the body of the drone to be controlled directly on board.

The invention finally relates to an observation and image transmission method, notably from a surface naval drone, in which a plurality of cameras is used, mounted on a support deck, and, in a first surveillance mode, all the cameras are controlled to obtain a surveillance over 360° at a first distance from the system, and, in a second surveillance mode, a reduced number of cameras are controlled to obtain a surveillance over a reduced angular range at a second distance from the system.

The present invention will be better understood from reading the detailed description of an embodiment taken as a by no means limiting example and illustrated by the appended drawings, in which:

- figures 1 and 2 are diagrammatic views that illustrate a surface naval drone according to the invention;

- figure 3 is a perspective view of an observation and image transmission system of the drone of figures 1 and 2.

In figures 1 and 2, a surface naval drone is represented, denoted by the general numeric reference 10.

It is intended to be used to observe and transmit images of firings made from another surface vessel. However, it is possible to design the drone 10 also to be able to be used in other applications.

The surface drone 10 is in particular provided with a body 12, of generally elongated shape, an observation and image transmission system 14 for transmission to a storage and analysis centre (not illustrated) where the quality of the firings will be analysed, propulsion means 15a for moving the drone, and a propulsion control unit 15b. The control unit 15b in particular comprises means of determining the position of the drone 10 and means of controlling the propulsion means 15a.

To enable the observation and image transmission system 14 to be positioned relative to the body 12, the drone 10 also comprises a mast 16, of geometrical axis 18 assumed to be vertical, which is mounted on the body 12.

The mast 16 is mounted on the body 12 so as to extend substantially perpendicularly relative to the latter. In straight cross section, it presents a generally elliptical profile. Naturally, it is also possible to consider providing a mast which presents another type of profile, rectangular or even circular for example.

In order to obtain a mast 16 that exhibits the right rigidity, it is possible to provide a hollow mast 16 and use a lightweight material, such as aluminium. The mast 16 can also advantageously be anodised in order to obtain anti-corrosion protection. The height of the mast 16 can be of the order of a metre, and is normally between 4 and 6 metres. The mast 16 can be of the same type as those used on a sailboat.

To ensure that the mast 16 can be mounted and dismantled easily, said mast is disposed on the body 12 in a removable manner. In this respect, the body 12 of the drone comprises a base (not represented) added to the body 12, and inside which a bottom end of the mast 16 is intended to be housed.

Advantageously, the base is generally U-shaped and comprises two inclined symmetrical grooves, each formed on one of the wings of the U. The grooves are designed to cooperate with trunions (not shown) on the mast 16 to enable said mast to be moved quickly from a horizontal position to a vertical position, and vice versa.

A mast 16 is thus obtained which can easily be mounted or dismantled on the body 12. As a variant, the mast 16 can of course be mounted on the body 12 by any other appropriate means.

To ensure that the mast 16 is maintained in the vertical position, the drone 10 also comprises ropes 20 fitted obliquely between the body 12 and the mast 16. The ropes 20 can advantageously be stays. In this case, there are three of the ropes 20. They are associated with tensioning elements 22, for example graduated turnbuckles linked to the body 12, so as to vary the tension of the ropes 20. Advantageously, it is possible to provide on one of the ropes 20, a hoist (not represented) to assist in immobilizing the mast 16 in the vertical position.

In other words, the single mast 16 constitutes a support means for the observation and transmission system 14, the ropes 20 and the tensioning elements 22 forming means of maintaining said mast in the vertical position.

The observation and transmission system 14 mainly comprises an observation device 24 mounted at a top end of the mast 16 and comprising in particular means 26 for transmitting the images observed by the device 24.

As illustrated more visibly in figure 3, the observation device 24 comprises a fixing base 28 centred on the axis 18 and an optronics assembly 32 mounted on the fixing base 28 in order to observe and analyse the firings made.

The fixing base 28 is made of aluminium. Here, it takes the general form of a disc and is axially delimited by bottom and top surfaces 28a and 28b. The bottom surface 28a is used to secure the observation device 24 to the top end of the mast 16. The top surface 28b is used to support the optronics assembly 32.

The optronics assembly 32 can be used to observe several areas to be viewed which can be located in different angular ranges and at different distances from the drone 10.

The optronics assembly 32 mainly comprises a plurality of cameras 34, a support deck 35 for the cameras, and a stabilized gyroscopic articulation 36 (here represented diagrammatically) which is disposed between the top surface 28b of the base 28 and a bottom surface of the deck 35.

The cameras 34 are here distributed regularly around the circumference of a top surface of the support deck 35. Here, there are seven cameras 34. Obviously, it is also possible to consider providing more or fewer cameras. The articulation 36, known per se, makes it possible to maintain a good centring of the deck 35 during swell movements. The gyroscopic articulation 36 can, for example, comprise two axes and be used to compensate for amplitudes ranging up to 25° in roll or pitch.

The observation device 24 also comprises a central unit (not represented). The central unit is here mounted on the top side of the support deck 35 near the cameras 34. The central unit comprises all the hardware and software means for controlling the operation of the cameras 34 of the optronics assembly 32.

So as to enable the position of the surveillance system 14 to be determined, said system also comprises a bearing sensor 40, magnetic for example, here mounted on a top side of an additional higher deck 38. The higher deck 38 is fixed to the support deck 35 via spacers (not referenced). It is axially located above the cameras 34. The sensor 40 is therefore added onto the support deck 35, via the higher deck 38. It is thus axially distanced from the gyroscopic articulation 36, which can comprise sources of electromagnetic fields.

The optronics assembly 32 can be used to observe a first area at a distance that is relatively close to the drone 10 and over 360°, and

at least one second area more distant from the drone in a reduced angular segment.

In practice, in a first surveillance mode, the central unit controls all the cameras 34. There is therefore obtained a surveillance over 360°. In a second mode, the central unit controls only one of the cameras 34, which makes it possible for example to survey a reduced angular range, of the order of 60°. Obviously, the number of cameras 34 used in the second mode of operation can vary according to the angular range to be observed. The central management unit can also control the cameras 34 so as to allow for a surveillance according to other modes of operation, that is, over different angular ranges and at different distances from the drone 10.

To enable an observation of the areas located at different distances from the drone 10, the optics of the cameras 34 are chosen according to the area to be observed which is most distant from the drone 10 and are then controlled by the control unit according to the distance at which the area to be surveyed is located. In this respect, the cameras 34 are all controlled when the surveillance must be carried out over 360°, and only one or a restricted number of cameras 34 are controlled for the surveillance of a reduced angular range.

With such an observation device 24, it is easy to conceive that it is possible to observe different angular ranges independently, without it being necessary to provide for additional camera mounting operations.

Thus, the observation device 24 can provide a surveillance according to different operating modes without it being necessary to provide additional cameras, or even change optics of the cameras 34.

To limit the risk of the intrusion of external polluting agents on the cameras 34 and the central unit, the observation device 24 also

comprises a protective cover 42. It is made of transparent or translucent material, and is advantageously obtained by moulding a synthetic material, for example polymethyl methacrylate (PMMA) or even polycarbonate (PC). The protective cover 42 has a generally rounded shape, in the form of a dome. It is added to the fixing base 28.

To refer again to figures 1 and 2, the transmission means 26 of the system 14 are mainly provided with a transmission unit 50, inside which there are a radio-modem and an antenna 54 for the transmission of the images obtained by the optronics assembly 32 to a processing centre provided for this purpose to analyse them. This processing centre can, for example, be located on the surface vessel from which the projectile firings originate, or even on land.

The transmission unit 50 is fixed to the top end of the mast 16, by an appropriate means, and can also be used to mount the observation device 24. In practice, the fixing base 28 is added onto the top end of the transmission unit 50. In other words, said transmission unit is inserted between the top end of the mast 16 and the bottom surface 28a of the fixing base 28 of the observation device 24. With the transmission unit supporting the observation device 24, an autonomous assembly is thus obtained, requiring only a voltage source to be able to operate. Furthermore, this assembly can easily be dismantled from the mast 16 to be used on another naval vessel, or on a sea-borne floating support, fixed or otherwise, or even on land.

The antenna 54 is located at the top end of the protective cover 42, for example being screwed onto the latter.

As can easily be conceived, the observation device 24 can be considered independently of the mast 16. Consequently, in other embodiments of the drone 10, it is possible to provide other types of

means to support the observation and image transmission system 14, and, more particularly, the observation device 24.

In order to be able to allow for remote operation of the drone 10, the drone also comprises antennas 52 and 56, a navigation camera 60 fixed to the mast 16 and a transmission radio-modem 62 mounted on said mast 16 between the transmission antennas 52 and 56.

The antennas 52 and 56 are disposed on the mast 16 via articulations 52a and 56a mounted to rotate on the latter. The antennas 52 and 56 are mounted to rotate at the free end of the articulations 52a and 56a. The antennas 52 and 56 are disposed in one and the same radial plane, from the viewpoint of the axis 18 of the mast 16. The antenna 56 is used to receive remote commands from an operator intended for the control unit 15b which manages the movements of the drone. The antenna 52 is used to remotely return the images from the navigation camera 60.

The articulations 52a and 56a of the antennas 52 and 56 are here arranged to allow for a transition from an extended position, as is illustrated in figure 1, in which they are extended mainly perpendicularly relative to the mast 16, to a folded position, as is illustrated in figure 2.

In the folded position, the articulations 52a and 56a of the antennas 52 and 56 of the observation device 24 extend along the mast 16, so as to obtain a mast of little bulk.

The navigation camera 60 is oriented downward in order for the prow of the drone 10 and the horizon to be in its field of vision. It can be mounted on the mast 16 by any appropriate means.

The transmission radio-modem 62 can be used to transmit to the processing centre images from the camera 60 in order to provide for a servo-control of the drone 10 based on the view of these images,

and by an action on the propulsion means 15a, via the control unit 15b. As a variant, the control unit can also allow for automatic control of the path of the drone 10.

With the invention, a surface naval drone 10 is obtained which comprises a single removable mast 16 to support the observation and image transmission system 14, which in particular provides for an inexpensive drone.

Moreover, the drone 10 can be obtained from a lightweight craft of Zodiac® type. In practice, it is possible, from such a craft, to add the mast 16 equipped with the observation and image transmission system 14, and so obtain a drone for sea trials. Then, by dismantling the mast 16, the craft is once again able to be used to transport people or equipment.

CLAIMS

1-Observation and image transmission system, notably for a surface naval drone, the system comprising an observation device (24) provided with a support deck (35), an optronics assembly (32) which comprises a plurality of cameras (34) mounted on the support deck (35), and a central management unit for the optronics assembly (32), characterized in that the central management unit is able to control, in a first surveillance mode, all the cameras (34) to obtain a surveillance over 360° at a first distance from the system, and able to control, in a second surveillance mode, a reduced number of cameras (34) to obtain a surveillance over a reduced angular range at a second distance from the system.

2-System according to Claim 1, in which the cameras (34) are regularly distributed circumferentially on the support deck (35).

3-System according to Claim 1 or 2, in which the cameras (34) are fixed on the support deck (35).

4-System according to any one of the preceding claims, in which the observation device (24) comprises a fixing base (28) and a gyrostabilized articulation (36) disposed between the fixing base and the support deck (35).

5-System according to Claim 4, in which the observation device (24) is also provided with a translucent protective cover (42) mounted on the fixing base (28).

6-System according to any one of the preceding claims, in which the central management unit for the optronics assembly (32) is mounted on the support deck (35).

7-System according to any one of the preceding claims, comprising a transmission unit (50) supporting the observation device

(24) and able to allow the system to be mounted on an external element.

8-System according to any one of the preceding claims, in which the observation device (24) comprises a magnetic bearing sensor (40) axially offset relative to the cameras (34), on the side opposite to the support deck (35).

9-System according to any one of the preceding claims, comprising a navigation camera (60) intended to be mounted on a support means of the observation and image transmission system.

10-Surface naval drone provided with:

- a body (12),
- an observation and image transmission system (14), and
- a support means for said observation and image transmission system,

characterized in that the observation and image transmission system (14) comprises an observation device (24) provided with a support deck (35), an optronics assembly (32) which comprises a plurality of cameras (34) mounted on the support deck (35), and a central management unit for the optronics assembly (32), in which the central management unit is able to control, in a first surveillance mode, all the cameras (34) to obtain a surveillance over 360° at a first distance from the system, and able to control, in a second surveillance mode, a reduced number of cameras (34) to obtain a surveillance over a reduced angular range at a second distance from the system.

11- Drone according to Claim 10, in which the support means comprises a mast (16) mounted on the body (12).

12-Observation and image transmission method, notably from a surface naval drone, in which a plurality of cameras is used, mounted on a support deck, characterized in that, in a first surveillance mode, all the cameras are controlled to obtain a surveillance over 360° at a

first distance from the system, and in that, in a second surveillance mode, a reduced number of cameras are controlled to obtain a surveillance over a reduced angular range at a second distance from the system.