

DESCRIPTION

5 **Title of the Invention:** NAVIGATION SUPPORT SYSTEM FOR A SHIP

Technical Field

10 **[0001]** The present invention relates to a navigation support system for a ship, and more particularly to a navigation support system for a ship favorable for use when docking or undocking the ship (hereinafter simply referred to as "docking/undocking") and the like.

Background Art

15 **[0002]** When docking/undocking a ship, docking/undocking work is carried out. For example, for a large vessel, side thrusters may be used, the hull may be moved by a tugboat, or the hull may be pulled toward the quay side using mooring lines.

20 **[0003]** An image system has been proposed in which cameras are provided on the ship, and during such docking/undocking work, a ship operator is able to look at an image indicating the positional relationship between the ship and the quay.

Prior Art Document

25 **Patent Document**

[0004] Patent Document 1: Japanese Patent Laid-Open No. 2010-4130

Summary of the Invention

Problems to be solved by the Invention

30 **[0005]** According to the image system, when docking/undocking and the like, the ship operator is able to operate the ship's propulsion device, steering gear, and side thrusters while looking at the image, while in

addition, the ship operator is able to give instructions (such as the direction and force to push or pull the ship, for example) to a tugboat operator on the tugboat side to additionally move the ship appropriately.

- 5 **[0006]** Also, on the quay side, work is performed to secure mooring lines to mooring equipment such as bitts. This work is performed while the ship operator and operations support personnel on the quay side communicate with each other to decide procedures such as which bitts
10 are to be used to secure the mooring lines and in what order. In addition, the work of bringing (the ship operator's) ship alongside a separate, associated vessel (such as a tugboat or a ship to come alongside, for example) or an associated floating facility (such as an
15 offshore oil platform, an offshore wind farm, or other floating structure, for example) is also performed while the ship operator and a worker on the associated vessel or the associated floating facility communicate with each other.
- 20 **[0007]** Furthermore, at onshore ship operations support facilities that operate associated vessels for supporting ship operations, run onshore facilities, and provide safety supervision of ships, records of ship docking/undocking in particular have not been stored in a suitable form.
- 25 **[0008]** As described above, according to the image system of Patent Document 1, the ship operator is able to easily grasp the surrounding conditions, including one's own ship, while looking at an image from the image system, but because the instructions given by the ship operator are
30 generally issued through voice transmission such as with a transceiver, there have been problems. For example, it may be time-consuming for the tugboat operator, the driving support personnel on the quay side, or the worker on the

associated vessel or associated floating facility to accurately grasp the conditions on both the starboard and port sides of the ship, for example.

[0009] Also, in onshore ship operations support

5 facilities, there is a desire to store appropriate data for analyzing factors such as the attitude of a ship in various situations when docking/undocking.

[0010] Accordingly, an object of the present invention is to provide a navigation support system for a ship that

10 is favorable for use on a ship and is capable of addressing the above problems.

Means for Solving the Problems

[0011] In order to achieve the above object, an aspect of the present invention is a navigation support system for

15 a ship comprising: a plurality of cameras arranged on a side part of a hull of the ship at intervals from each other in a longitudinal direction of the hull of the ship, each camera imaging surroundings of the hull and outputting an image signal; a processor, provided in the ship, that
20 has a function of creating an integrated composite image including the hull and the surroundings of the hull on a basis of the image signals from the plurality of cameras, and outputting a signal expressing the composite image; a first display unit, provided in the ship, that receives the
25 output from the processor and displays an image including the composite image; and a second display unit, provided in an associated vessel separate from the ship or an associated floating facility, that receives the output from the processor and displays an image including the composite
30 image.

[0012] According to the navigation support system for a ship of an aspect of the present invention, the integrated composite image including the hull and the surroundings of

the hull, which is created by the processor on the basis of image signals from the plurality of cameras, is displayed on both the first display unit provided on the ship and the second display unit provided on the associated vessel

5 separate from the ship(such as a tugboat or a ship to come alongside, for example) or an associated floating facility (such as an offshore oil platform, an offshore wind farm, a floating pier, or other floating structure, for example).

Consequently, the ship operator is able to appropriately

10 operate the ship's propulsion device, steering gear, side thrusters, and the like while looking at the image

displayed on the first display unit, while in addition, a worker on the associated vessel separate from the ship or the associated floating facility can easily grasp the

15 conditions around the ship by looking at the image

displayed on the second display unit. For this reason,

when performing the work of docking/undocking the ship with respect to a quay or coming alongside the associated

floating facility and the like, information about the

20 conditions around the ship can be shared, thereby

significantly improving communication between the ship

operator and the worker on the associated vessel or the

associated floating facility, and thus improving the safety and efficiency of the docking/undocking work or the

25 alongside work.

[0013] Also, the navigation support system for a ship according to an aspect of the present invention may further comprise a course detection unit, provided in the ship,

that detects a forward direction of the ship, wherein the

30 processor receives the output from the course detection

unit and outputs a signal expressing the composite image

together with an image indicating the forward direction of the ship.

[0014] According to such a configuration, the first display unit and the second display unit can display an image that includes the composite image together with the forward direction of the ship.

5 **[0015]** Furthermore, the navigation support system for a ship according to an aspect of the present invention may further comprise a speed detection unit, provided in the ship, that detects and outputs a speed of the ship, wherein the processor receives the output from the speed detection
10 unit and outputs a signal expressing the composite image together with an image indicating the speed of the ship.

[0016] According to such a configuration, the first display unit and the second display unit can display an image that includes the composite image together with the
15 speed of the ship.

[0017] Still furthermore, the navigation support system for a ship according to an aspect of the present invention may further comprise a course detection unit, provided in the ship, that detects and outputs a forward direction of
20 the ship, and a speed detection unit, provided in the ship, that detects and outputs a speed of the ship, wherein the processor receives the output from the course detection unit and the speed detection unit, and outputs a signal expressing the composite image together with an image
25 indicating the forward direction and the speed of the ship.

[0018] According to such a configuration, the first display unit and the second display unit can display an image that includes the composite image together with the forward direction as well as the speed of the ship, thereby
30 enabling the operator of the ship and the worker on the associated vessel or the associated floating facility to accurately grasp the forward direction, the speed, or the forward direction as well as the speed of the ship.

[0019] Also, the navigation support system for a ship according to an aspect of the present invention may be configured such that the processor outputs a signal expressing an image of an arrow indicating the forward direction and the speed of the ship overlaid onto the composite image.

[0020] According to such a configuration, because an image of an arrow indicating the forward direction and speed of the ship is overlaid onto the image including the hull of the ship and the surroundings of the hull and displayed on the first display unit and the second display unit, the ship operator and the worker on the associated vessel or the associated floating facility can easily and visually grasp the relationship between the forward direction and speed of the ship and the ship itself.

[0021] Furthermore, the navigation support system for a ship according to an aspect of the present invention may further comprise a wind direction and wind speed detection unit, provided in the ship, that detects and outputs a wind direction and a wind speed around the ship, wherein the processor receives the output from the wind direction and wind speed detection unit, and outputs a signal expressing the composite image together with an image indicating the wind direction and the wind speed.

[0022] According to such a configuration, because an image including the wind direction and wind speed around the ship is displayed together with the image including the hull of the ship and the surroundings of the hull on the first display unit and the second display unit, the ship operator and the worker on the associated vessel or the associated floating facility can accurately grasp the wind direction and wind speed around the ship.

[0023] Also, the navigation support system for a ship

according to an aspect of the present invention may be configured such that the processor outputs a signal expressing an image of an arrow indicating the wind direction and the wind speed overlaid onto the composite
5 image.

[0024] According to such a configuration, because an image of an arrow indicating the wind direction and wind speed around the ship is overlaid onto the image including the hull of the ship and the surroundings of the hull and
10 displayed on the first display unit and the second display unit, the relationship between the wind direction and wind speed around the ship and the ship itself can easily and visually grasped.

[0025] Still furthermore, the navigation support system
15 for a ship according to an aspect of the present invention may further comprise a driving status detection unit, provided in the ship, that detects and outputs a driving status of a driving mechanism of the ship, wherein the processor receives the output from the driving status
20 detection unit and outputs a signal expressing the composite image together with an image indicating the driving status.

[0026] According to such a configuration, the first display unit and the second display unit can be configured
25 to display an image that includes the composite image together with the driving status. With this arrangement, the ship operator and the worker on the associated vessel or the associated floating facility can accurately grasp the image including the hull of the ship and the
30 surroundings of the hull together with the driving status of the driving mechanism of the ship.

[0027] Also, the navigation support system for a ship according to an aspect of the present invention may be

configured such that the first display unit and the second display unit have a function of communicating with the processor, including issuing instructions to the processor, and if the second display unit receives the output from the processor and displays the image including the composite image, the processor causes an indication of the reception to be displayed on the first display unit or on a display device provided nearby.

[0028] According to such a configuration, the ship operator is able to know that the second display unit provided on the associated vessel or the associated floating facility has received the output from the processor and is displaying the image including the composite image, and the ship operator can communicate with the worker on the associated vessel or the associated floating facility on the presumption of such knowledge.

[0029] Also, the navigation support system for a ship according to an aspect of the present invention may be configured such that the processor additionally has a function of outputting information related to a navigation and an engine of the ship when the imaging is performed by the plurality of cameras as numerical data associated with the output composite image, and the navigation support system for a ship may further comprise a memory unit, provided in the ship, that receives the information related to the navigation and the engine of the ship output by the processor, and stores a continuous time series of the received information together with the composite image.

[0030] According to such a configuration, by analyzing information related to the driving and the environment of the ship stored together with the composite image in the memory unit, an improvement in operation methods can be attained. For example, an improvement in economical

operation methods or operation methods that increase safety can be attained.

[0031] Also, a navigation support system for a ship according to another aspect of the present invention comprises: a plurality of cameras arranged on a side part of a hull of the ship at intervals from each other in a longitudinal direction of the hull of the ship, each camera imaging surroundings of the hull and outputting an image signal; a processor, provided in the ship, that has a function of creating an integrated composite image including the hull and the surroundings of the hull on a basis of the image signals from the plurality of cameras, and outputting a signal expressing the composite image; a first display unit, provided in the ship, that receives the output from the processor and displays an image including the composite image; and a second display unit, disposed on a quay side where the ship is docked, that receives the output from the processor and displays an image including the composite image.

[0032] According to the navigation support system for a ship, the integrated composite image including the hull and the surroundings of the hull, which is created by the processor on the basis of image signals from the plurality of cameras, is displayed on both the first display unit provided on the ship and the second display unit provided on the quay side where the ship is docked/undocked. Consequently, the ship operator is able to appropriately operate the ship's propulsion device, steering gear, side thrusters, and the like while looking at the image displayed on the first display unit, while in addition, a worker on the quay side can easily grasp the conditions around the ship by looking at the image displayed on the second display unit. For this reason, when performing the

work of docking/undocking the ship with respect to the quay and the like, information about the conditions around the ship can be shared, thereby significantly improving communication between the ship operator and the worker on the quay side, and thus improving the safety and efficiency of the docking/undocking work.

[0033] Also, a navigation support system for a ship according to yet another aspect of the present invention comprises: a plurality of cameras arranged on a side part of a hull of the ship at intervals from each other in a longitudinal direction of the hull of the ship, each camera imaging surroundings of the hull and outputting an image signal; a processor, provided in the ship, that has a function of creating an integrated composite image including the hull and the surroundings of the hull on a basis of the image signals from the plurality of cameras, and outputting a signal expressing the composite image; a first display unit, provided in the ship, that receives the output from the processor and displays an image including the composite image; and a second display unit, disposed in an onshore ship operations support facility, that receives the output from the processor and displays an image including the composite image.

[0034] According to the navigation support system for a ship, the composite image including the hull and the surroundings of the hull, which is created by the processor on the basis of image signals from the plurality of cameras, is displayed on both the first display unit provided on the ship and the second display unit disposed in the onshore ship operations support facility. Consequently, in the onshore ship operations support facility, the docking status of ships can be grasped accurately, and by analyzing the docking status of each ship together with the composite

image, the navigation support system for a ship is useful for attaining an improvement in operation methods. For example, an improvement in economical operation methods or operation methods that increase safety can be attained.

5 **[0035]** Also, the navigation support system for a ship may be configured such that the processor additionally has a function of outputting information related to a navigation and an engine of the ship when the imaging is performed by the plurality of cameras as numerical data
10 associated with the output composite image, and the navigation support system for a ship further comprises a memory unit, disposed in the ship operations support facility, that receives the information related to the navigation and the engine of the ship output by the
15 processor, and stores a continuous time series of the received information together with the composite image.

[0036] According to such a configuration, in the onshore ship operations support facility, the docking/undocking status of the ship can be grasped accurately, and
20 furthermore, by analyzing information related to the driving and the environment of the ship stored together with the composite image in the memory unit, an improvement in operation methods can be attained. For example, an improvement in economical operation methods or operation
25 methods that increase safety can be attained.

Advantageous Effects of the Invention

[0037] According to the navigation support system for a ship of an aspect of the present invention, the ship operator is able to appropriately operate the ship's
30 propulsion device, steering gear, side thrusters, and the like while looking at the image displayed on the first display unit, while in addition, a worker on the associated vessel separate from the ship or the associated floating

facility can easily grasp the conditions around the ship by looking at the image displayed on the second display unit. For this reason, information about the conditions around the ship can be shared, thereby significantly improving communication between the ship operator and the worker on the associated vessel or the associated floating facility, and also improving the safety and efficiency of the docking/undocking work or the alongside work.

[0038] Also, according to a navigation support system for a ship of another aspect of the present invention, the ship operator is able to appropriately operate the ship's propulsion device, steering gear, side thrusters, and the like while looking at the image displayed on the first display unit, while in addition, a worker on an associated facility on the quay side can easily grasp the conditions around the ship by looking at the image displayed on the second display unit. For this reason, information about the conditions around the ship can be shared, thereby significantly improving communication between the ship operator and the worker on the associated facility on the quay side, and thus improving the safety and efficiency of the docking/undocking work.

[0039] According to a navigation support system for a ship of yet another aspect of the present invention, in the onshore ship operations support facility, the docking/undocking status of ships can be grasped accurately, and by analyzing the docking/undocking status of each ship, an improvement in operation methods can be attained. For example, an improvement in economical operation methods or operation methods that increase safety can be attained.

Brief Description of the Drawings

[0040]

FIG. 1 is a side view of a ship according to an

embodiment of the present invention.

FIG. 2 is a plan view of the ship 2 illustrated in FIG. 1.

FIG. 3 is a block diagram illustrating a flow of
5 signals in the embodiment.

FIG. 4 is an explanatory diagram illustrating an example of a display device in the embodiment.

FIG. 5 is a flowchart illustrating image processing in the embodiment.

10 FIG. 6 is a general view including a ship according to another embodiment of the present invention.

Mode for Carrying out the Invention

[0041] Hereinafter, an embodiment of the present invention will be described on the basis of the drawings.

15 **[0042]** FIGS. 1 to 5 illustrate an embodiment of the present invention. In FIG. 1, a ship 2 is a large cargo vessel having a hull 4 and a bridge 6 provided on a rear part of the hull where ship operators such as a pilot of the ship 2 and a captain in command of maneuvering are
20 stationed.

[0043] As illustrated in FIGS. 1 and 2, on the left side of the hull 4, four cameras C1 to C4 are provided at intervals from each other along the longitudinal direction of the hull, and on the right side of the hull 4, four
25 cameras C5 to C8 are provided at intervals from each other along the longitudinal direction. Also, a camera C9 is provided on the front end of the hull 4, and a camera C10 is provided on the rear end. These cameras C1 to C10 are all pointed downward and are configured to take an image of
30 the conditions around the hull 4, that is, a water surface W including a portion of the hull 4, and output respective image signals. For this reason, the cameras C1 to C10 are provided sticking outward on the exterior of the hull 4.

Note that, as illustrated in FIG. 3, respective imaging regions R1 to R10 of the cameras C1 to C10 cover the entirety of the region enclosed by the hull thick-frame, and are also set such that neighboring imaging regions of the cameras partially overlap each other.

[0044] Also, a draft detection unit 10 is provided on the upper edge on the left side in the approximate longitudinal center of the hull 4. The draft detection unit 10 includes a Doppler radar that detects the distance from the draft detection unit 10 to the water surface W and outputs a signal. Note that the draft detection unit 10 may also be a pressure-type detection unit that measures the pressure acting on the outer surface of the hull 4, and computes the draft of the hull on the basis of the measured pressure. Furthermore, the draft detection unit 10 may also be a detection unit that computes a draft value of the hull on the basis of the weight of the cargo loaded in the hull 4 and the amount of ballast water inside the ballast tanks of the hull 4.

[0045] As illustrated in FIG. 3, the cameras C1 to C10 are connected to a PoE hub 12 via LAN cables. Also connected to the PoE hub 12 is a processor 14 that has a function of compositing an integrated overhead view image including the hull 4 and the surroundings of the hull 4 on the basis of the image signals from the cameras C1 to C10, and outputting a signal expressing the overhead view image. In addition, nautical instruments 16, such as a GPS, a compass, a depth indicator, and a wind direction/speed gauge for example, as well as an engine information detection unit 18 that detects engine information such as the rudder angle, the rotation rate of the thrust shaft, and the rotation rate of stern thrusters/bow thrusters are connected to the PoE hub 12 via a communication converter

20. Note that the GPS of the nautical instruments 16 is capable of detecting the course and speed of the ship 2. An access point A1 and an access point A2 are also connected to the PoE hub 12. A display terminal D1 that
5 acts as a display device disposed in the bridge 6 can wirelessly connect to the access point A1, while a display terminal D2 that acts as a display device disposed outside can wirelessly connect to the access point A2. The access points A1 and A2 are provided in plural as necessary.

10 Furthermore, the draft detection unit 10 is connected to the PoE hub 12. Note that an uninterruptible power supply 22 supplies power to the PoE hub 12, the processor 14, and the communication converter 20.

[0046] Also, as illustrated in FIG. 3, the first display
15 unit D1 is provided in the bridge 6 of the ship 2, while the second display unit D2 is provided in the wheelhouse of a tugboat T. Herein, the tugboat T corresponds to the associated vessel in the present invention.

[0047] FIG. 4 illustrates an example of the first
20 display unit D1 or the second display unit D2. In the substantially left half of a display 24 of the first display unit D1 or the second display unit D2, an integrated overhead view image 26 including the hull 4 and the surroundings of the hull 4 is displayed. The overhead
25 view image 26 is composited by the processor 14 on the basis of the image signals from the plurality of cameras C1 to C10. Note that the overhead view image 26 includes the tugboat T that assists with the movement of the ship 2, and a quay B where the ship 2 is to be docked. In addition, in
30 the remaining part of the display 24, the processor 14 displays the current latitude and longitude, course, speed, water depth, draft value, rudder angle, rotation rate of the thrust shaft, and rotation rate of the stern

thrusters/bow thrusters of the ship 2 on the basis of the signals from the nautical instruments 16 and the engine information detection unit 18 described above. Note that the processor 14 displays an arrow 28 corresponding to the course and an arrow 30 corresponding to the wind direction overlaid onto the center of gravity of the hull 4 in the overhead view image 26. The lengths of the arrow 28 and the arrow 30 can be made to correspond to the ship speed and the wind speed, respectively.

[0048] Next, an image compositing process executed by the processor 14 will be described according to FIG. 5. The processor 14 includes components such as an input/output device, a memory device, a central processing unit, and a timer for executing the image compositing process described above. The memory device stores a command for executing the image compositing process.

[0049] First, the processor 14 acquires an image signal from each of the cameras C1 to C10 (step S1). Next, on the basis of the image signals from the cameras C1 to C10 acquired in step S1, the processor 14 composites a single overhead view image including the hull 4 according to a known method (step S2). The compositing of the overhead view image by the processor 14 in step S2 can use any known method, and for example, the method indicated in Patent Document 1 can be used.

[0050] Additionally, the processor 14 acquires output signals from the nautical instruments 16 and the engine information detection unit 18 (step S3), and creates a composite image including the overhead view image composited in step S2 overlaid with the current latitude and longitude, course, speed, water depth, draft value, rudder angle, rotation rate of the thrust shaft, and rotation rate of the stern thrusters/bow thrusters of the

ship 2 as described with reference to FIG. 4 (step S4). Subsequently, a composite image signal is output to the first and second display units D1 and D2 through the access points A1 and A2 (step S5). As a result, a composite image
5 like the one illustrated in FIG. 4 for example is displayed on each display 24 of the first and second display units D1 and D2 on the basis of the output signal.

[0051] Also, in this embodiment, the first display unit D1 and the second display unit D2 have a function of
10 communicating with the processor 14, including issuing instructions to the processor 14. For this reason, each display 24 of the first and second display units D1 and D2 has a touch panel function enabling a person to transmit a signal to the processor 14 by touching the screen.

[0052] On the other hand, a camera C11 is provided in a
15 central portion on the front end of the bridge 6 or at a position higher than the bridge 6, and is pointed at a deck D of the hull 4 to monitor cargo handling work on the deck D. The camera C11 is connected to the PoE hub 12 via a LAN
20 cable. An operation button 32 is displayed on the display 24, and when an operator touches the operation button 32, the status on the deck D of the hull 4 taken by the camera C11 is displayed on the entirety of the display 24.

[0053] Furthermore, the first and second display units
25 D1 and D2 have a function by which, when an operator uses a finger or the like to touch an arbitrary position in a peripheral region of the hull 4 on the screen of each display 24, the portion of the overhead view image including the position is enlarged and displayed on the
30 screen. This function may be provided in either or both of the display units D1 and D2. A configuration is also possible in which, instead of displaying an enlarged portion of the overhead view image, the taken image from

one of the cameras C1 to C10 closest to the arbitrary position in the peripheral region is enlarged directly and displayed on the screen of each display 24. With this arrangement, the operator or worker is able to display an enlarged image of a specific portion on the screen, and see details of the specific portion more easily. Note that a configuration is also possible in which fine lines corresponding to the respective imaging regions of the cameras C1 to C10 are displayed in the peripheral region of the ship 2 on the screen of the display 24 to make it easier for the operator or the worker to specify the image region to enlarge.

[0054] Also, when the second display unit D2 receives the output from the processor 14 and displays an image including the composite image, the processor 14 is configured to present a display indicating the functioning of the second display unit D2 on the first display unit D1. Specifically, a display area 34 on the display 24 of the first display unit D1 lights up. Note that instead of the above, the display area 34 may also be provided externally near the first display unit D1.

[0055] According to the navigation support system for a ship of this embodiment as described above, the composite image including the hull 4 and the surroundings of the hull, which is created by the processor 14 on the basis of image signals from the plurality of cameras C1 to C11, is displayed on both the first display unit D1 provided on the ship 2 and the second display unit D2 provided on the tugboat T. Consequently, the ship operator of the ship 2 is able to appropriately operate the propulsion device, steering gear, side thrusters, and the like of the ship 2 and also appropriately give instructions to the tugboat operator on the tugboat T side while looking at the image

displayed on the first display unit D1. Meanwhile, the tugboat operator is able to understand the content and context of instructions from the ship operator more accurately while looking at the image displayed on the second display unit D2. Herein, the tugboat operator corresponds to the worker on the associated vessel of the present invention. In other words, because the image displayed on the second display unit D2 includes the hull 4 of the ship 2 and the surroundings of the hull, the tugboat operator is able to sufficiently grasp the conditions on the opposite side of the ship 2 from the tugboat T and the conditions around the tugboat itself, including the heading of the tugboat T with respect to the ship, and thereby understand the content and context of the instructions from the ship operator more accurately.

[0056] In the navigation support system for a ship of this embodiment, because the processor 14 outputs a signal expressing the composite image together with the forward direction and the speed of the ship 2, and the first display unit D1 and the second display unit D2 display an image that includes the composite image including the hull 4 and the surroundings of the hull together with the forward direction and the speed of the ship 2, the tugboat operator is able to grasp the current forward direction and the speed of the ship 2.

[0057] Also, because the processor 14 displays an image in which the arrow 28 indicating the forward direction and the speed of the ship 2 is overlaid onto the composite image, the ship operator and the tugboat operator can easily and visually grasp the relationship between the forward direction and the speed of the ship 2 and the heading of the ship.

[0058] Furthermore, in the navigation support system for

a ship of this embodiment, the processor 14 outputs a signal expressing the composite image together with the wind direction and wind speed around the ship 2, and the first display unit D1 and the second display unit D2

5 display an image that includes the composite image together with the wind direction and wind speed of the ship 2, the ship operator and the tugboat operator are able to grasp the current wind direction and wind speed.

[0059] Also, because the processor 14 displays an image
10 in which an arrow indicating the wind direction and wind speed around the ship 2 is overlaid onto the composite image, the ship operator and the tugboat operator can easily and visually grasp the relationship between the wind direction and wind speed around the ship 2 and the heading
15 of the ship.

[0060] Furthermore, because the navigation support system for a ship of this embodiment is equipped with the driving status detection unit 18, provided in the ship 2, that detects and outputs the driving status of the driving
20 mechanism of the ship 2, the processor 14 receives the output from the driving status detection unit 18 and outputs a signal expressing the composite image together with the driving status, and the first display unit D1 and the second display unit D2 display an image expressing the
25 composite image together with the driving status, the tugboat operator is able to grasp the driving status of the driving mechanism of the ship 2.

[0061] Also, in the navigation support system of this embodiment, the first display unit D1 and the second
30 display unit D2 have a function of communicating with the processor 14, including issuing instructions to the processor 14, and when the second display unit D2 receives the output from the image processing unit 14 and displays

an image that includes the composite image, the processor 14 is configured to display an indication of the reception in a display area 34 provided on or near the first display unit D1.

5 **[0062]** Consequently, the ship operator is able to know that the second display unit D2 of the tugboat T has received the output from the processor 14 and is displaying the image that includes the composite image, and the ship operator can give instructions to the tugboat operator on
10 the presumption of such knowledge.

[0063] Note that a memory unit M1 is provided in the bridge 6 of the ship 2. The processor 14 is configured to output navigation information from instruments such as a GPS, a compass, a depth indicator, and a wind
15 direction/speed gauge obtained from the nautical instruments 16 as well as engine information such as the rudder angle, the rotation rate of the thrust shaft, and the rotation rate of stern thrusters/bow thrusters obtained from the engine information detection unit 18 to the memory
20 unit M1 as numerical information associated with the signal of the composite screen. The memory unit M1 can store a continuous time series of the received navigation information and engine information in association with the composite image together.

25 **[0064]** Consequently, in the ship 2, by utilizing information related to the driving and the environment of the ship 2 stored together with the composite image in association with the composite image in the memory unit M1 to analyze images of docking/undocking in similar
30 conditions (such as weather and load) from the past, it is possible to prepare for docking/undocking, and an improvement in operation methods relating to docking/undocking can be attained. For example, an

improvement in economical operation methods or operation methods that increase safety can be attained.

[0065] In the navigation support system for a ship according to the embodiment described above, a single
5 tugboat T assists the ship 2 with docking/undocking, but it is also possible for two or more tugboats to assist the ship 2 with docking/undocking. In this case, a third display unit D3 is installed in the second and subsequent tugboats in addition to the first and second display units
10 D1 and D2, and the third display unit D3 is connected to the processor 14 through the access point A2. The third display unit D3 has the same functions as the second display unit D2. A second display area in addition to the display area 34 is additionally provided on or near the
15 display 24 of the first display unit D1, and when the third display unit D3 receives the output from the image processing unit 14 and displays an image that includes the composite image, the processor 14 is configured to display an indication of the reception in the second display area
20 34 provided on or near the first display unit D1.

[0066] Consequently, the ship operator is able to know that the second and third display units D2 and D3 of the tugboat T and the second tugboat(s) have received the output from the processor 14 and are displaying the image
25 that includes the composite image, and the ship operator can give instructions to the tugboat operators on the presumption of such knowledge.

[0067] In the embodiment described above, the second display unit D2 is installed in the tugboat T, but although
30 not illustrated in the diagrams, the second display unit D2 instead may be disposed in an associated floating facility that the ship 2 comes alongside, such as an offshore oil platform, an offshore wind farm, a floating pier, or other

floating structure, for example. When the ship 2 comes alongside the associated floating facility, a worker on the associated floating facility is able to look at the second display unit D2.

5 **[0068]** According to such a configuration, because the worker on the associated floating facility can easily grasp the conditions around the ship by looking at the image displayed on the second display unit, information about the conditions around the ship can be shared during work such
10 as bringing the ship alongside the associated floating facility, thereby significantly improving communication between the ship operator and the worker on the associated floating facility, and thus improving the safety and efficiency of the alongside work.

15 **[0069]** Furthermore, in the case where the ship 2 comes alongside another associated vessel, it is possible to dispose the second display unit D2 in the other associated vessel that the ship 2 comes alongside instead of the tugboat T. For example, in the case where the ship 2 is an
20 oiler, it is necessary for the oiler to come alongside an associated vessel, but because the worker on the associated vessel can easily grasp the conditions around the oiler by looking at the image displayed on the second display unit, the safety and efficiency of the alongside work can be
25 improved.

[0070] In the embodiment described above, the second display unit D2 is installed in the tugboat T, but a configuration is also possible in which the display unit D2 is disposed instead on the quay B side where the ship 2 is
30 docked/undocked, and a worker on the quay B side is able to look at the second display unit D2.

[0071] With this arrangement, the worker on the quay B side is able to understand the content and context of

instructions from the ship operator more accurately while looking at the image displayed on the second display unit D2. In other words, because the image displayed on the second display unit D2 includes the hull 4 of the ship 2 and the surroundings of the hull 4, the worker on the quay B side is able to sufficiently grasp the conditions on the opposite side of the ship 2 from the quay B and the conditions around the ship 2, and thereby understand the content and context of the instructions from the ship operator more accurately.

[0072] Furthermore, if necessary, a configuration is also possible in which a display unit having the same functions as the second display unit D2 is disposed in both the tugboat T and the quay B, and as a result the tugboat operator and the worker on the quay side are able to look at an image that is substantially the same as that of the first display unit D1. In this case, it is possible to dispose the necessary number of display units according to the number of tugboats T and the number of workers on the quay B.

[0073] FIG. 6 illustrates a different embodiment. The processor 14 is configured to be capable of outputting navigation information from instruments such as a GPS, a compass, a depth indicator, and a wind direction/speed gauge obtained from the nautical instruments 16 as well as engine information such as the rudder angle, the rotation rate of the thrust shaft, and the rotation rate of stern thrusters/bow thrusters obtained from the engine information detection unit 18 from the access point A2 as numerical information associated with the signal of the composite screen. Meanwhile, the second display unit D2 and a memory unit M2 are provided in an onshore ship operations support facility S. The second display unit D2

is capable of receiving the signal of the composite screen together with the navigation information or the engine information as numerical data from the access point A2.

The memory unit M2 can store a continuous time series of the received information together with the composite image.

[0074] According to the different embodiment, the composite image including the hull 4 and the surroundings of the hull 4, which is created by the processor 14 on the basis of image signals from the plurality of cameras C1 to C10, is displayed on both the first display unit D1 provided on the ship 2 and the second display unit D2 disposed in the onshore ship operations support facility S. Consequently, in the onshore ship operations support facility S, the docking status of the ship 2 can be grasped accurately. Furthermore, in the onshore ship operations support facility S, by analyzing information related to the driving and the environment of the ship 2 stored together with the composite image in association with the composite image in the memory unit M2, an improvement in operation methods can be attained. For example, an improvement in economical operation methods or operation methods that increase safety can be attained.

Explanation of Reference Signs

[0075]

25	2	ship
	4	hull
	6	bridge
	10	draft measurement unit
	14	image processing unit
30	24	display
	32	input unit
	A1, A2	access point
	C1 to C11	camera

D1, D2 display terminal
M1, M2 memory device
S ship operations support facility

CLAIMS

1. A navigation support system for a ship comprising:
a plurality of cameras arranged on a side part of a
hull of the ship at intervals from each other in a
5 longitudinal direction of the hull of the ship, each camera
imaging surroundings of the hull and outputting an image
signal;

a processor, provided in the ship, that has a function
of creating an integrated composite image including the
10 hull and the surroundings of the hull on a basis of the
image signals from the plurality of cameras, and outputting
a signal expressing the composite image;

a first display unit, provided in the ship, that
receives the output from the processor and displays an
15 image including the composite image; and

a second display unit, provided in an associated
vessel separate from the ship or an associated floating
facility, that receives the output from the processor and
displays an image including the composite image.

20 2. The navigation support system for a ship according
to claim 1, further comprising:

a course detection unit, provided in the ship, that
detects a forward direction of the ship, wherein

the processor receives the output from the course
25 detection unit and outputs a signal expressing the
composite image together with an image indicating the
forward direction of the ship.

3. The navigation support system for a ship according
to claim 1, further comprising:

30 a speed detection unit, provided in the ship, that
detects and outputs a speed of the ship, wherein

the processor receives the output from the speed
detection unit and outputs a signal expressing the

composite image together with an image indicating the speed of the ship.

4. The navigation support system for a ship according to claim 1, further comprising:

5 a course detection unit, provided in the ship, that detects and outputs a forward direction of the ship; and
 a speed detection unit, provided in the ship, that detects and outputs a speed of the ship, wherein
 the processor receives the output from the course
10 detection unit and the speed detection unit, and outputs a signal expressing the composite image together with an image indicating the forward direction and the speed of the ship.

5. The navigation support system for a ship according
15 to claim 4, wherein

 the processor outputs a signal expressing an image of an arrow indicating the forward direction and the speed of the ship overlaid onto the composite image.

6. The navigation support system for a ship according
20 to claim 1, further comprising:

 a wind direction and wind speed detection unit, provided in the ship, that detects and outputs a wind direction and a wind speed around the ship, wherein
 the processor receives the output from the wind
25 direction and wind speed detection unit, and outputs a signal expressing the composite image together with an image indicating the wind direction and the wind speed.

7. The navigation support system for a ship according to claim 6, wherein

30 the processor outputs a signal expressing an image of an arrow indicating the wind direction and the wind speed overlaid onto the composite image.

8. The navigation support system for a ship according

to claim 1, further comprising:

a driving status detection unit, provided in the ship, that detects and outputs a driving status of a driving mechanism of the ship, wherein

5 the processor receives the output from the driving status detection unit and outputs a signal expressing the composite image together with an image indicating the driving status.

10 9. The navigation support system for a ship according to claim 1, wherein

the first display unit and the second display unit have a function of communicating with the processor, including issuing instructions to the processor, and

15 if the second display unit receives the output from the processor and displays the image including the composite image, the processor causes an indication of the reception to be displayed on the first display unit or on a display device provided nearby.

20 10. The navigation support system for a ship according to claim 1, wherein

the processor additionally has a function of outputting information related to a navigation and an engine of the ship when the imaging is performed by the plurality of cameras as numerical data associated with the output composite image, and

25 the navigation support system for a ship further comprises a memory unit, provided in the ship, that receives the information related to the navigation and the engine of the ship output by the processor, and stores the received information together with the composite image.

30 11. A navigation support system for a ship comprising:

a plurality of cameras arranged on a side part of a

hull of the ship at intervals from each other in a longitudinal direction of the hull of the ship, each camera imaging surroundings of the hull and outputting an image signal;

5 a processor, provided in the ship, that has a function of creating an integrated composite image including the hull and the surroundings of the hull on a basis of the image signals from the plurality of cameras, and outputting a signal expressing the composite image;

10 a first display unit, provided in the ship, that receives the output from the processor and displays an image including the composite image; and

 a second display unit, disposed on a quay side where the ship is docked or undocked, that receives the output
15 from the processor and displays an image including the composite image.

12. A navigation support system for a ship comprising:

 a plurality of cameras arranged on a side part of a
20 hull of the ship at intervals from each other in a longitudinal direction of the hull of the ship, each camera imaging surroundings of the hull and outputting an image signal;

 a processor, provided in the ship, that has a function
25 of creating an integrated composite image including the hull and the surroundings of the hull on a basis of the image signals from the plurality of cameras, and outputting a signal expressing the composite image;

 a first display unit, provided in the ship, that
30 receives the output from the processor and displays an image including the composite image; and

 a second display unit, disposed in an onshore ship operations support facility, that receives the output from

the processor and displays an image including the composite image.

13. The navigation support system for a ship according to claim 12, wherein

5 the processor additionally has a function of outputting information related to a navigation and an engine of the ship when the imaging is performed by the plurality of cameras as numerical data associated with the output composite image, and

10 the navigation support system for a ship further comprises a memory unit, disposed in the ship operations support facility, that receives the information related to the navigation and the engine of the ship output by the processor, and stores the received information together
15 with the composite image.