

# SHIP NAVIGATION SUPPORT SYSTEM, SHIP NAVIGATION SUPPORT METHOD, SHIP NAVIGATION SUPPORT DEVICE AND PROGRAM

## TECHNICAL FIELD

- 5 [0001] The present disclosure relates to a ship navigation support system, a ship navigation support method, a ship navigation support device, and a program.

## BACKGROUND ART

- 10 [0002] Patent Document 1 describes calculating, for each of a plurality of grids through which a trail of a specific ship passes, an angle of entry and an angle of exit of the trail, and based on a determination condition set for each of the plurality of grids, extracting a grid for which the angle of entry and the angle of exit suit the determination condition, and then, based on a relative distance with  
15 another ship corresponding to the position of the specific ship on the trail in the extracted grid, determining whether the specific ship performed an evasive action.

[Reference Document of Conventional Art]

[Patent Document]

- 20 [0003]

[Patent Document 1] JP2017-182729A

## DESCRIPTION OF THE DISCLOSURE

[Problem to be Solved by the Disclosure]

- 25 [0004] Meanwhile, in the field of ships, even if an instruction is issued from

the control to a ship, it is difficult from other ships to grasp whether the ship follows the instruction of the control.

[0005] The present disclosure is made in view of the problem described above, and the main purpose thereof is to provide a ship navigation support system, a  
5 ship navigation support method, a ship navigation support device, and a program, capable of easily grasping a movement of a ship.

[Means for Solving the Problem]

[0006] In order to solve the problem, a ship navigation support system according to one aspect of the present disclosure includes a recommended route  
10 providing device that transmits recommended route data for a first ship, a first ship navigation support device that is mounted on the first ship and transmits acknowledgment data indicating that a recommended route based on the recommended route data for the first ship has been approved, and a second ship  
navigation support device that is mounted on a second ship and includes a  
15 recommended route acquiring module that acquires the recommended route data for the first ship, an acknowledgment acquiring module that acquires the acknowledgment data, and a display unit that displays the recommended route based on the recommended route data for the first ship so as to be discriminable before and after the acquisition of the acknowledgment data.

20 [0007] Further, a ship navigation support method according to another aspect of the present disclosure, includes the steps of transmitting, from a recommended route providing device, recommended route data for a first ship, and transmitting, from a first ship navigation support device mounted on the first ship, acknowledgment data indicating that a recommended route based on  
25 the recommended route data for the first ship has been approved. The method

includes the steps of, from a second ship navigation support device mounted on a second ship, acquiring the recommended route data for the first ship, acquiring the acknowledgment data, and displaying the recommended route based on the recommended route data for the first ship so as to be discriminable before and  
5 after the acquisition of the acknowledgment data.

[0008] Further, a ship navigation support device according to another aspect of the present disclosure includes a recommended route acquiring module that acquires recommended route data for another ship, an acknowledgment acquiring module that acquires acknowledgment data indicating that a  
10 recommended route based on the recommended route data for the another ship has been approved, and a display unit that displays the recommended route based on the recommended route data for the another ship so as to be discriminable before and after the acquisition of the acknowledgment data.

[0009] Further, a program according to another aspect of the present disclosure  
15 causes a computer to function as a recommended route acquiring module that acquires recommended route data for another ship, an acknowledgment acquiring module that acquires acknowledgment data indicating that a recommended route based on the recommended route data for the another ship has been approved, and a display controlling module that displays the  
20 recommended route based on the recommended route data for the another ship so as to be discriminable before and after the acquisition of the acknowledgment data.

[Effect of the Disclosure]

[0010] According to the present disclosure, grasping a movement of a ship  
25 becomes easy.

## BRIEF DESCRIPTION OF DRAWINGS

[0011]

Fig. 1 is a view illustrating one example of a ship navigation support  
5 system according to one embodiment.

Fig. 2 is a view illustrating one example of a recommended route  
providing device according to this embodiment.

Fig. 3 is a view illustrating one example of a ship ICT system mounted  
on a ship.

10 Fig. 4 is a view illustrating one example of a ship navigation support  
device according to this embodiment.

Fig. 5 is a view illustrating one example of a ship navigation support  
method according to this embodiment.

Fig. 6 is a view illustrating one example of a screen indication.

15 Fig. 7 is a view illustrating one example of the screen indication.

Fig. 8 is a view illustrating one example of the screen indication.

Fig. 9 is a view illustrating one example of the screen indication.

## MODE FOR CARRYING OUT THE DISCLOSURE

20 [0012] Hereinafter, one embodiment of the present disclosure is described with  
reference to the drawings.

[0013] Fig. 1 is a view illustrating one example of a ship navigation support  
system 100. This drawing illustrates a control C on land, and a plurality of  
ships S which travel in a control area A. The control C is a seaborne traffic  
25 center or a port radio station, for example.

[0014] The ship navigation support system 100 includes a recommended route providing device 1 (hereinafter, referred to as "the providing device 1") provided to the control C, and a plurality of ship navigation support devices 2 (hereinafter, referred to as "the support device(s) 2") provided to the plurality of ships S, respectively.

[0015] Fig. 2 is a block diagram illustrating one example of a configuration of the providing device 1. The providing device 1 includes a controller 10 and a communication apparatus 19. The controller 10 is a computer, such as a server computer, for example.

[0016] In detail, the controller 10 is a computer including a CPU, a RAM, a ROM, a nonvolatile memory, and an input/output interface. The CPU of the controller 10 performs information processing according to a program loaded to the RAM from the ROM or the nonvolatile memory.

[0017] For example, the program may be supplied via an information storage medium, such as an optical disc or a memory card, or may be supplied via a communication network, such as the Internet or a LAN.

[0018] The controller 10 includes a navigational data acquiring module 11 and a recommended route generating module 12. These functional parts are realized by the CPU of the controller 10 performing the information processing according to the program.

[0019] The navigational data acquiring module 11 acquires ship navigational data from each ship S via the communication apparatus 19. The ship navigational data is AIS data transmitted from the ship S, for example.

[0020] The recommended route generating module 12 generates recommended route data for each ship S based on the ship navigational data acquired from the

ship S.

[0021] The communication apparatus 19 includes various radio equipment which realized communications with the ships S, such as radio equipment for the ultrashort-wave band, the intermediate-wave band, and the shortwave band,  
5 for example.

[0022] The recommended route data generated by the recommended route generating module 12 is provided to the ship S via the communication apparatus 19. The recommended route data is contained in the AIS data transmitted from the control C, for example.

10 [0023] Fig. 3 is a block diagram illustrating one example of a configuration of a ship ICT system 200 mounted on the ship S. The support device 2 is included in the ship ICT system 200.

[0024] The ship ICT system 200 includes, in addition to the support device 2, a radar 3, a GNSS receiver 4, a gyrocompass 5, an ECDIS 6, and an AIS 7, for  
15 example. These apparatuses are connected to a network N, such as a LAN (Local Area Network), for example, and network communications are possible therebetween.

[0025] The radar 3 detects a target which exists around the ship, and generates target tracking data (TT data) indicative of a position and a velocity vector of  
20 the target.

[0026] The GNSS receiver 4 detects the position of the ship based on a radio wave received from a GNSS (Global Navigation Satellite System), and generates positional data indicative of the position of the ship.

[0027] The gyrocompass 5 detects the heading of the ship, and generates  
25 directional data indicative of the heading. It is not limited to the gyrocompass,

but may be a GPS compass or a magnetic compass.

[0028] The ECDIS (Electronic Chart Display and Information System) 6 acquires the positional data of the ship from the GNSS receiver 4, and displays the position of the ship on an electronic nautical chart. Further, the ECDIS 6  
5 also displays a schedule route which is set so as to sequentially follow a plurality of waypoints on the electronic nautical chart. Instead of the ECDIS 6, a GNSS plotter having a similar function may be used.

[0029] In this example, although the support device 2 and the ECDIS 6 are provided as discrete devices, they are not limited to this configuration, and the  
10 support device 2 and the ECDIS 6 may be provided as an integrated device. That is, the function of the support device 2 may be incorporated into the ECDIS 6.

[0030] The AIS (Automatic Identification System) 7 transmits AIS data to the surrounding ships S and the control C on land, and receives AIS data from the  
15 surrounding ships S and the control C on land. It is not limited to this configuration, but a VDES (VHF Data Exchange System) may be used.

[0031] The AIS data transmitted from the ship S contains data, such as an identification signal, the ship's name, the position, the course, the travelling speed, and the destination, for example. The AIS data transmitted from the  
20 control C contains data, such as control information.

[0032] Fig. 4 is a block diagram illustrating one example of a configuration of the support device 2. The support device 2 includes a controller 20, a user interface 28, and a display unit 29.

[0033] The controller 20 is a computer similar to the controller 10 of the  
25 providing device 1 described above. The controller 20 includes a

recommended route acquiring module 21, an acknowledgment acquiring module 22, and a display controlling module 23. These functional parts are realized by the CPU of the controller 20 performing information processing according to a program.

5 [0034] The user interface 28 is a pointing device, such as a touch panel or a trackball, for example. The display unit 29 is a display device, such as a liquid crystal display or an organic electroluminescence display, for example.

[0035] The recommended route acquiring module 21 acquires recommended route data from the control C via the AIS 7. The recommended route acquiring  
10 module 21 acquires not only recommended route data for the ship, but also recommended route data for other ships.

[0036] The acknowledgment acquiring module 22 acquires acknowledgment data (a so-called "ACK data") transmitted from another ship. The acknowledgment data is data indicating that a recommended route based on the  
15 recommended route data for another ship is approved by a crew of the another ship.

[0037] The display controlling module 23 displays the recommended route based on the recommended route data acquired from the control C on the electronic nautical chart displayed on the display unit 29.

20 [0038] In detail, the display controlling module 23 displays not only the recommended route for the ship, but also the recommended routes for other ships. Further, the display controlling module 23 displays the recommended route for another ship discriminably whether it is before the acquisition of the acknowledgment data or after the acquisition of the acknowledgment data  
25 (described later in detail).

[0039] Below, concrete operations of the providing device 1 provided to the control C and the support devices 2 provided to the plurality of ships S are described. Fig. 5 is a flowchart illustrating one example of a procedure of a ship navigation support method according to this embodiment, which is realized  
5 by the providing device 1 and the plurality of support devices 2.

[0040] The providing device 1 of the control C performs processing of S11-S14 illustrated in this drawing. The support device 2 of the ship S performs processing of S21-S26 or processing of S31-S34 illustrated in this drawing.

[0041] First, the support device 2 of the ship S transmits the AIS data (S21),  
10 and the providing device 1 of the control C receives the AIS data transmitted from the ship S (S11; processing as the navigational data acquiring module 11).

[0042] Next, the providing device 1 of the control C generates the recommended route data based on the AIS data transmitted from the ship S (S12; processing as the recommended route generating module 12). In detail, the  
15 providing device 1 of the control C acquires the AIS data from all the ships S which are located in and around the control area A, and calculates the recommended route for each ship S.

[0043] For example, the providing device 1 identifies the schedule route of each ship S based on the AIS data. Then, as for the schedule route without any  
20 possibility of a collision, it is adopted as the recommended route as it is, and as for the schedule route with the possibility of a collision, a recommended route including an evasive action is calculated. The computational algorithm of the recommended route is not limited in particular.

[0044] The schedule route of the ship S is estimated based on the data contained  
25 in the AIS data, such as the position, the course, the travelling speed, and the

destination, for example. Alternatively, data of the schedule route displayed on the ECDIS 6 (see Fig. 3) may be included in the AIS data, and this data may be used.

[0045] The recommended route data also includes data of a recommended travelling speed associated with the recommended route. The data of the recommended travelling speed may be a numerical value of a concrete travelling speed, or may indicate a relative travelling speed, such as acceleration or deceleration, for example. Further, the recommended route data also includes data for identifying the ship S which is a target of the recommended route.

10 [0046] Next, the providing device 1 of the control C transmits the generated recommended route data (S13). The recommended route data is included in the AIS data and is transmitted. Therefore, the recommended route data is received by all the ships S which are located in and around the control area A. That is, the recommended route data is received not only by the ship S that is a target of the recommended route (hereinafter, referred to as "the first ship"), but also by other ships S (hereinafter, referred to as "the second ship(s)").

[0047] When the support device 2 of the first ship receives the recommended route data for this ship from the control C (S22; processing as the recommended route acquiring module 21), it displays the recommended route for this ship based on the received recommended route data (S23; processing as the display controlling module 23). As illustrated in Fig. 6, on the electronic nautical chart displayed on the display unit 29 of the first ship, the recommended route for this ship is displayed. The recommended route is associated with the recommended travelling speed, such as acceleration or deceleration, for every section.

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[0048] Further, the support device 2 of the first ship displays a dialog box DL for asking a crew of this ship about whether the displayed recommended route for this ship is to be approved (S24), and in response to a button BT for accepting the approval, it accepts the approval of the recommended route by the crew of  
5 this ship (S25). The crew is a navigation officer, an engineer, or a radio officer, for example.

[0049] When accepted the approval of the recommended route, the support device 2 of the first ship transmits the acknowledgment data indicating that the crew of this ship has approved the recommended route for this ship (S26). The  
10 acknowledgment data is included in the AIS data and is transmitted. Therefore, the acknowledgment data is received not only by the control C, but also by the second ships which are located around this ship.

[0050] When the support device 2 of the second ship receives the recommended route data for the first ship from the control C (S31; processing  
15 as the recommended route acquiring module 21), it displays the recommended route for the first ship based on the received recommended route data in a mode indicating that the recommended route has not been approved (that is, before the acquisition of the acknowledgment data) (S32; processing as the display controlling module 23).

[0051] Then, when the support device 2 of the second ship S receives the acknowledgment data from the first ship (S33; processing as the  
20 acknowledgment acquiring module 22), it changes the display mode so that it indicates that the recommended route for the first ship has been approved (that is, after the acquisition of the acknowledgment data) and displays it (S34;  
25 processing as the display controlling module 23).

[0052] In detail, as illustrated in Fig. 7, on the electronic nautical chart displayed on the display unit 29 of the second ship, the recommended route for other ships (first ship) are displayed, together with the recommended route for this ship (second ship).

- 5 [0053] The recommended route for another ship is displayed discriminably in mutually different modes before the acquisition of the acknowledgment data (negative ACK) and after the acquisition the acknowledgment data (positive ACK). In the example of the drawing, "before the acquisition of the acknowledgment data (negative ACK)" is displayed by a one-dot chain line, and  
10 "after the acquisition of the acknowledgment data (positive ACK)" is displayed by a solid line.

[0054] Further, when the recommended route for this ship and the recommended route for another ship intersect with each other, an ETA (Estimated Time of Arrival) for this ship arriving at the intersecting position  
15 may be displayed. The ETA is calculated by the providing device 1 and is included in the recommended route data.

[0055] Further, the recommended routes for this ship and for other ships may be associated with the acceleration, the deceleration, or the recommended travelling speed for maintaining the travelling speed and displayed. Moreover,  
20 the recommended routes for this ship and for other ships may be differentiated in color according to the recommended travelling speed and displayed.

[0056] According to the embodiment described above, since the recommended route of other ships are displayed so as to be discriminable before and after the acquisition of the acknowledgment data, it becomes easier to grasp the  
25 movement of other ships. That is, since each ship S which enters into the

control area A is capable of grasping the movements of other ships as common understandings, it becomes easier to suppress the occurrence of a collision.

[0057] Particularly, in the case of ships, not all the ships have similar equipment, and it is difficult to determine whether other ships located around a ship follow instructions of the control. However, by sharing the recommended route data and the acknowledgment data like this embodiment, it becomes easier to distinguish between ships following the instructions of the control and ships not following.

[0058] Note that, as illustrated in Fig. 8, the recommended routes for other ships after the acquisition of the acknowledgment data (positive ACK) may be displayed, together with subordinate information regarding the approval ("AD" in this drawing). The subordinate information regarding the approval is a time point, the crew, the position, etc. at/by which the recommended route is approved, for example, and the information is included in the acknowledgment data when it is transmitted.

[0059] Further, as illustrated in Fig. 9, the reference character (symbol) "MK" indicating that the recommended route for another ship has been approved may be displayed at the position where this recommended route is approved. Further, the symbol MK may include subordinate information regarding the time point, the crew, etc. at/by which the recommended route is approved, for example.

[0060] Although the embodiment of the present disclosures is described, the present disclosure is not limited to the above embodiment, and it is needless to say that various modifications are possible for the person skilled in the art.

[0061] Although in the above embodiment the providing device 1 is provided

to the control C on land, it is not limited to this configuration, but the providing device 1 may be provided to a patrol ship which cruises in the control area A, for example.

[0062] Further, by distributing the recommended route data and the  
5 acknowledgment data through the Internet etc., it may be configured so that a small ship without the AIS can grasp the movement of a large ship.

[0063] Further, it may be configured to notify a logistics system on land when a significant delay occurs as a result of travelling on the recommended route including the evasive action.

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#### DESCRIPTION OF REFERENCE CHARACTERS

[0064]

- |    |    |                                     |
|----|----|-------------------------------------|
|    | 1  | Recommended Route Providing Device  |
|    | 10 | Controller                          |
| 15 | 11 | Navigational Data Acquiring Module  |
|    | 12 | Recommended Route Generating Module |
|    | 19 | Communication Apparatus             |
|    | 2  | Ship Navigation Support Device      |
|    | 20 | Controller                          |
| 20 | 21 | Recommended Route Acquiring Module  |
|    | 22 | Acknowledgment Acquiring Module     |
|    | 23 | Display Controlling Module          |
|    | 28 | User Interface                      |
|    | 29 | Display Unit                        |
| 25 | 3  | Radar                               |

|   |     |                                |
|---|-----|--------------------------------|
|   | 4   | GNSS Receiver                  |
|   | 5   | Gyrocompass                    |
|   | 6   | ECDIS                          |
|   | 7   | AIS                            |
| 5 | 100 | Ship Navigation Support System |
|   | 200 | Ship ICT System                |
|   | C   | Control                        |
|   | S   | Ship                           |
|   | A   | Control Area                   |

## CLAIMS

1. A ship navigation support system, comprising:
  - a recommended route providing device that transmits recommended
  - 5 route data for a first ship;
  - a first ship navigation support device that is mounted on the first ship and transmits acknowledgment data indicating that a recommended route based on the recommended route data for the first ship has been approved; and
  - a second ship navigation support device that is mounted on a second
  - 10 ship and includes:
    - a recommended route acquiring module that acquires the recommended route data for the first ship;
    - an acknowledgment acquiring module that acquires the acknowledgment data; and
    - 15 a display unit that displays the recommended route based on the recommended route data for the first ship so as to be discriminable before and after the acquisition of the acknowledgment data.
2. The ship navigation support system of claim 1, wherein the
- 20 recommended route data for the first ship includes data of a recommended travelling speed associated with the recommended route, and
- wherein the display unit displays the recommended route based on the recommended route data for the first ship, together with the recommended travelling speed.

3. The ship navigation support system of claim 1 or 2, wherein the acknowledgment data includes data of a time point at which the recommended route is approved, and

wherein the display unit displays the time point at which the recommended route is approved.

4. The ship navigation support system of any one of claims 1 to 3, wherein the acknowledgment data includes data of a person who approves the recommended route, and

wherein the display unit displays the person who approves the recommended route.

5. The ship navigation support system of any one of claims 1 to 4, wherein the acknowledgment data includes data of a position at which the recommended route is approved, and

wherein the display unit displays the position at which the recommended route is approved.

6. The ship navigation support system of any one of claims 1 to 5, wherein the acknowledgment data includes data of a position at which the recommended route is approved, and

wherein the display unit displays a symbol indicating that the recommended route has been approved so as to be associated with the position at which the recommended route is approved.

7. The ship navigation support system of any one of claims 1 to 6, wherein the recommended route providing device further includes:

a navigational data acquiring module that acquires ship navigational data from the first ship; and

5 a recommended route generating module that generates the recommended route data for the first ship based on the ship navigational data.

8. The ship navigation support system of any one of claims 1 to 7, wherein the recommended route acquiring module further acquires  
10 recommended route data for the second ship, and

wherein the display unit further displays recommended route based on the recommended route data for the second ship.

9. The ship navigation support system of claim 8, wherein the  
15 display unit displays a time until the ships reach a position where the recommended route based on the recommended route data for the first ship and the recommended route based on the recommended route data for the second ship intersect with each other.

20 10. A ship navigation support method, comprising the steps of:  
transmitting, from a recommended route providing device, recommended route data for a first ship;

transmitting, from a first ship navigation support device mounted on the first ship, acknowledgment data indicating that a recommended route based on  
25 the recommended route data for the first ship has been approved;

from a second ship navigation support device mounted on a second ship,  
acquiring the recommended route data for the first ship;  
acquiring the acknowledgment data; and  
displaying the recommended route based on the recommended route  
5 data for the first ship so as to be discriminable before and after the acquisition  
of the acknowledgment data.

11. A ship navigation support device, comprising:  
a recommended route acquiring module that acquires recommended  
10 route data for another ship;  
an acknowledgment acquiring module that acquires acknowledgment  
data indicating that a recommended route based on the recommended route data  
for the another ship has been approved; and  
a display unit that displays the recommended route based on the  
15 recommended route data for the another ship so as to be discriminable before  
and after the acquisition of the acknowledgment data.

12. A program for causing a computer to function as:  
a recommended route acquiring module that acquires recommended  
20 route data for another ship;  
an acknowledgment acquiring module that acquires acknowledgment  
data indicating that a recommended route based on the recommended route data  
for the another ship has been approved; and  
a display controlling module that displays the recommended route  
25 based on the recommended route data for the another ship so as to be

discriminable before and after the acquisition of the acknowledgment data.