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MOBILE OBJECT CONTROL SYSTEM

Abstract

The processor of the mobile object control system calculates the target speed of the mobile object on the basis of the first operation amount for each individual operation terminal, calculates the target turning angular speed of the mobile object on the basis of the second operation amount for each individual operation terminal, combines the target speed calculated for each individual operation terminal at the first ratio to calculate the final target speed, combines the target turning angular speed calculated for each individual operation terminal at a second ratio different from the first ratio to calculate the final target turning angular speed, and controls one or a plurality of actuators related to the traveling of the mobile object on the basis of the final target speed and the final target turning angular speed.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Japanese Patent Application No. 2024-018125 filed on Feb. 8, 2024, incorporated herein by reference in its entirety.

BACKGROUND

1. Technical Field

[0002] The present disclosure relates to a technology for controlling traveling of a mobile object using a plurality of operation terminals operated by a plurality of operators.

2. Description of Related Art

[0003] Japanese Unexamined Patent Application Publication No. 2019-077528 (JP 2019-077528 A) discloses a technology for remotely operating an industrial vehicle using a remote operation device that is an operation terminal having a communication function. More specifically, JP 2019-077528 A discloses only an example of remote operation using one operation terminal.

[0004] Japanese Unexamined Patent Application Publication No. 2021-026558 (JP 2021-026558 A) discloses a driving takeover control device capable of suppressing interference between a driving operation of a first driver and a driving operation of a second driver.

SUMMARY

[0005] A configuration is conceivable in which traveling of a mobile object is controlled by cooperation between a plurality of operators who operates a plurality of operation terminals, respectively. This configuration is desirably devised to facilitate sharing of pleasure of operating the mobile object in cooperation among a plurality of operators.

[0006] The present disclosure has been made in view of the above issue, and an object of the present disclosure is to provide a mobile object control system capable of facilitating sharing of pleasure of operating a mobile object in cooperation among a plurality of operators.

[0007] A mobile object control system according to a first aspect of the present disclosure is configured to control traveling of a mobile object based on operation amount information of a plurality of operation terminals operated by a plurality of operators, respectively. The mobile object control system includes one or more processors.

[0008] The operation amount information includes a first operation amount and a second operation amount as operation amounts of each of the operation terminals.

[0009] The one or more processors are configured to: [0010] calculate, for the individual operation terminals, target speeds that are target values of a speed in a traveling direction of the mobile object based on the first operation amount; [0011] calculate, for the individual operation terminals, target turning angular velocities that are target values of a turning angular velocity of the mobile object based on the second operation amount; [0012] calculate a final target speed by combining the target speeds calculated for the individual operation terminals at a first ratio; [0013] calculate a final target turning angular velocity by combining the target turning angular velocities calculated for the individual operation terminals at a second ratio different from the first ratio; and [0014] control one or more actuators related to the traveling of the mobile object based on the final target speed and the final target turning angular velocity.

[0015] A mobile object control system according to a second aspect of the present disclosure is configured to control traveling of a mobile object based on operation amount information of a plurality of operation terminals operated by a plurality of operators, respectively. The mobile object control system includes one or more processors.

[0016] The operation amount information includes a first operation amount and a second operation amount as operation amounts of each of the operation terminals.
[0017] The one or more processors are configured to: [0018] calculate a first combined operation amount by combining the first operation amounts of the individual operation terminals at a first ratio; [0019] calculate a second combined operation amount by combining the second operation amounts of the individual operation terminals at a second ratio different from the first ratio; calculate a final target speed that is a target value of a speed in a traveling direction of the mobile object based on the first combined operation amount; [0020] calculate a final target turning angular velocity that is a target value of a turning angular velocity of the mobile object based on the second combined operation amount; and control one or more actuators related to the traveling of the mobile object based on the final target speed and the final target turning angular velocity.
[0021] According to the first and second aspects of the present disclosure, the different first and second ratios are used in the calculation of the final target speed and the final target turning angular velocity that are two target values for the traveling control on the mobile object. As a result, the ratios that reflect the first and second operation amounts of the individual operation terminals are different between the final target speed and the final target turning angular velocity. Thus, different roles are given to the individual operators in units of control amounts of the mobile object, that is, the speed and the turning angular velocity. This leads to easy sharing of the pleasure of operating the mobile object in cooperation among the operators.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0022] Features, advantages, and technical and industrial significance of exemplary embodiments of the disclosure will be described below with reference to the accompanying drawings, in which like signs denote like elements, and wherein:
[0023] FIG. **1** is a block diagram illustrating a configuration example of a mobile object control system according to an embodiment;
[0024] FIG. **2**A is a schematic diagram illustrating a specific example of a configuration of the mobile object shown in FIG. **1**;
[0025] FIG. **2**B is a schematic diagram illustrating a specific configuration of the mobile object shown in FIG. **1**;
[0026] FIG. **3** is a diagram for describing an example of the operation amount information I;
[0027] FIG. **4**A is a diagram illustrating an example of functional blocks related to travel control of a moving object;
[0028] FIG. **4**B is a diagram illustrating an example of setting a first ratio and a second ratio;
[0029] FIG. **5** is a diagram illustrating another exemplary functional block related to travel control of a moving object; and
[0030] FIG. **6** is a diagram illustrating still another example of a functional block related to travel control of a moving object.
DETAILED DESCRIPTION OF EMBODIMENTS
[0031] Embodiments of the present disclosure will be described with reference to the accompanying drawings. In the drawings, the same reference numerals are assigned to the same elements, and redundant descriptions are omitted or simplified.
1. Mobile Object Control System
[0032] FIG. **1** is a block diagram illustrating a configuration example of a mobile object control system **100** according to an embodiment. The mobile object control system **100** includes two operation terminals (or simply terminals) **10** and **20** and a mobile object (mobility) **30**. Note that the number of the “plurality of mobile terminals” included in the “mobile object control system”

according to the present disclosure may be three or more.

[0033] Each of the terminals **10** and **20** is operated by two operators **1** and **2** (see FIGS. **2**A and **2**B) for driving (running control) the mobile object **30**. For example, each of the terminals **10** and **20** is a mobile terminal such as a smartphone or a tablet terminal.

[0034] Specifically, the terminal **10** includes, for example, a touch panel **11**, a communication device **12**, a processor **13**, a storage device **14**, and sensors **15**. The touch panel **11** is formed on one plate surface of the first terminal **10** and includes a display screen and a touch sensor. The touch sensor is configured to be able to detect a touch of an operator on a display screen. The communication device **12** performs wireless communication with the mobile object **30**. Although the shape of the terminal **10** is not particularly limited, for example, the terminal **10** is formed in a plate shape (for example, a rectangular plate shape) in which one side is a short side direction and the other side is a longitudinal direction (see FIG. **3**).

[0035] The processor (processing circuit) **13** executes various processes for controlling the travel of the mobile object **30**. The storage device **14** stores various kinds of information necessary for processing by the processor **13**. More specifically, the processor **13** executes various processes by using various programs related to travel control of the mobile object **30**. The various programs may be stored in the storage device **14** or may be recorded in a computer-readable recording medium. The sensors **15** include, for example, an inclination angle sensor and a position sensor. The inclination angle sensor detects an inclination direction and an inclination angle (posture) of the first terminal **10**. The inclination angle sensor includes, for example, a six-axis gyro sensor. The tilt angle of the terminal **10** is used for the travel control of the mobile object **30** using the "tilt operation O" described later. The position sensor includes a GNSS (Global Navigation Satellite System) receiver and detects a position and an orientation of the first terminal **10**.

[0036] Like the terminal **10**, the terminal **20** includes a touch panel **21**, a communication device **22**, a processor **23**, a storage device **24**, and sensors **25**.

[0037] FIGS. **2**A and **2**B are schematic diagrams illustrating a specific exemplary configuration of the mobile object **30** illustrated in FIG. **1**. FIG. **2**A is a perspective view of a mobile object **30**, and FIG. **2**B is a view of the mobile object **30** looking down on a chassis **32** from above.

[0038] The mobile object **30** is an open type small mobility capable of being ridden by two persons. The mobile object **30** includes a vehicle body **31** and a chassis **32**. The vehicle body **31** has a seating **31***a* for two passengers. As shown in FIG. **2**A, one of the passengers is the operator **1** holding the terminal **10**, and the other of the passengers is the operator **2** holding the terminal **20**.

[0039] The chassis **32** includes a circular frame **33**. Two drive wheels (left and right front wheels) **34**R, a **34**L, and one driven wheel (rear wheel) **35** are attached to the frame **33**. The drive wheels **34**R and **34**L are arranged opposite each other and are respectively rotationally driven by the electric motors **36**R and **36**L. The driven wheel **35** is an omni-wheel (for example, an omni-wheel (registered trademark)).

[0040] The mobile object **30** further includes a communication device **37**, an electronic control unit (ECU) **38**, and sensors **39**. The communication device **37** performs wireless communication with the first and second terminals **10** and **20**.

[0041] ECU **38** controls the traveling of the mobile object **30**. ECU **38** includes a processor **40** and a storage device **41**. The processor **40** executes various processes related to travel control of the mobile object **30**. The storage device **41** stores various kinds of information necessary for processing by the processor **40**. More specifically, the processor **40** executes various processes using various programs related to travel control of the mobile object **30**. The various programs may be stored in the storage device **41** or may be recorded in a computer-readable recording medium.

[0042] The sensors **39** include, for example, a recognition sensor, a moving object state sensor, and a position sensor. The recognition sensor recognizes a situation around the mobile object **30**. Examples of recognition sensors include cameras, LIDAR (Laser Imaging Detection and Ranging), radars, and the like. The mobile object state sensor detects a state of the mobile object **30**. The moving body state sensor includes, for example, a speed sensor that detects the speed V and a turning angular speed sensor that detects the turning angular speed ω. The position sensor detects the position and the azimuth of the mobile object **30**. For example, the position sensor includes a GNSS receiver.

[0043] As shown in FIG. **2**B, the speed V is a speed in the traveling direction of the mobile object **30**, and more specifically, is a speed in the center position P**1** of the two drive wheels **34**R and **34**L. The velocities V.sub.R and V.sub.L are the velocities at the grounding points of the drive wheels **34**R and **34**L, respectively. Assuming that the distance between the drive wheel **34**R and the drive wheel **34**L is W and the turning angular velocity ω at the time of the left turning is positive, the velocities V.sub.R and V.sub.L can be expressed by the following Equations (1) and (2) using the speed V, the turning angular velocity @, and the distance W, respectively.

[00001] $V_L = V - \omega \times W / 2 \quad (1) \quad V_R = V + \omega \times W / 2 \quad (2)$

[0044] As can be seen from the relations of equations (1) and (2), ECU **38** can cause the mobile object **30** to travel straight along the traveling direction by controlling the two electric motors **36**R and **36**L such that the velocity V.sub.R and the velocity V.sub.L are equal. ECU **38** can then accelerate and decelerate the mobile object **30** by controlling the two electric motors **36**R and **36**L. In addition, ECU **38** can turn the mobile object **30** to the left and right by controlling the two electric motors **36**R and **36**L to provide a difference between the velocity V.sub.R and the velocity V.sub.L.

[0045] In addition, the “plurality of operation terminals” according to the present disclosure is not limited to a portable terminal such as a smartphone, and may be a terminal using another operation method such as a joystick. In addition, the “mobile object” according to the present disclosure is not limited to the mobile object **30** shown in FIG. **2**A, and may be various moving bodies such as a four-wheeled vehicle. In the example of the mobile object **30**, the operators **1** and **2** ride on the mobile object **30** and operate the terminals **10** and **20**. However, in an example in which a plurality of operation terminals capable of wirelessly communicating with a mobile object are used, the “plurality of operators” according to the present disclosure may remotely operate the mobile object from outside the mobile object. In the example of the mobile object operated by the plurality of operators on board, the plurality of operation terminals may be wired to the mobile object.

2. Travel Control of Mobile Object

[0046] The mobile object control system **100** is configured to control the traveling of the mobile object **30** based on the operation amount information I of the plurality of operation terminals (terminals **10** and **20**). More specifically, the mobile object control system **100** controls the speed V and the turning angular speed ω of the mobile object **30** based on the operation amount information I. That is, the speed V and the turning angular velocity ω correspond to a control amount for controlling the travel of the mobile object **30**.

[0047] The mobile object control system **100** uses the operation amount information I when the tilt operation O of each of the terminals **10** and **20** is performed in order to control each of the speed V and the turning angular velocity ω. The tilt operation O is an operation of tilting the terminals **10** and **20** by the operators **1** and **2**.

[0048] FIG. **3** is a diagram for explaining an example of the operation amount information I. The operation amount information I includes an tilt angle A as an example of the “first operation amount” of each of the terminals **10** and **20** and an tilt angle B as an example of the “second operation amount”. Hereinafter, the tilt angles A and B of the terminal **10** are referred to as tilt angles A.sub.1 and B.sub.1, and the tilt angles A and B of the terminal **20** are referred to as tilt angles A.sub.2 and B.sub.2. In FIG. **3**, the tilt angle A.sub.1 and the B.sub.1 of the terminal **10** are represented, but the tilt angle A.sub.2 and the B.sub.2 of the terminal **20** are also represented in the same manner.

[0049] In the exemplary embodiment illustrated in FIG. **3**, the tilt angle A.sub.1 is a rotation angle of the terminal **10** about a rotation axis that is parallel to the center line L.sub.A. The center line L.sub.A extends through the center P**2** of the terminal **10** and along the lateral direction of the terminal **10**. Similarly, the tilt angle B.sub.1 is a rotation angle about a rotation axis that is parallel to the center line L.sub.B. The center line L.sub.B extends through the center P**2** of the terminal **10** and along the length of the terminal **10**. The center lines L.sub.A and L.sub.B are orthogonal to each other.

[0050] Here, it is assumed that the tilt angle A.sub.1 is zero when a predetermined reference state (for example, a state in which the center line L.sub.B is horizontal) is satisfied. Then, the tilt angle A.sub.1 becomes positive when the operator **1** tilts the terminal **10** so that the end **10*e*1** of the terminal **10** farther from the operator **1** with respect to the reference condition is lowered. It is assumed that the tilt angle A.sub.1 is negative when the operator **1** tilts the terminal **10** so that the end **10*e*1** increases with respect to the reference condition. This also applies to the tilt angle A.sub.2 of the terminal **20**.

[0051] Further, it is assumed that the tilt angle B.sub.1 is zero when a predetermined reference state (for example, a state in which the center line L.sub.A is horizontal) is satisfied. Then, it is assumed that the tilt angle B.sub.1 is positive when the operator **1** tilts the terminal **10** so that the left end **10*e*2** of the operator **1** is lowered with respect to the reference state, and is negative when the operator **1** tilts the terminal **10** so that the end **10*e*2** is raised with respect to the reference state. This also applies to the tilt angle B.sub.2 of the terminal **20**.

[0052] FIG. **4**A is a diagram illustrating an example of functional blocks related to travel control of a mobile object **30**. The terminal **10** includes an operation amount acquisition unit **51** and a control amount calculation unit **52** as functional blocks related to travel control of the mobile object **30**. Similarly, the terminal **20** includes an operation amount acquisition unit **61** and a control amount calculation unit **62**. ECU **38** of the mobile object **30** includes a control amount arbitration unit **71** and a motor control unit **72**. These functional blocks are realized by software when the program related to the travel control is executed by the processor **13**, **23**, or **40**.

[0053] The operation amount acquisition unit **51** of the terminal **10** acquires the tilt angle A.sub.1 and the B.sub.1 detected by the tilt angle sensor included in the sensors **15**. Similarly, the operation amount acquisition unit **61** of the terminal **20** acquires the tilt angle A.sub.2 and the B.sub.2 detected by the tilt angle sensor included in the sensors **25**. The tilt angle A.sub.1, B.sub.1, A.sub.2, and B.sub.2 may, for example, be between −180° and 180°.

[0054] The control amount calculation unit **52** of the terminal **10** calculates a target velocity V.sub.1 (target control amount). Specifically, the storage device **14** of the terminal **10** stores a of map MV.sub.1 that defines the relation between the tilt angle A.sub.1 and the target velocity V.sub.1. The map MV.sub.1 is set such that, for example, when the tilt angle A.sub.1 is zero, the target velocity V.sub.1 also becomes zero, and the target velocity V.sub.1 becomes higher as the positive tilt angle A.sub.1 becomes larger. The control amount calculation unit **52** calculates a target velocity V.sub.1 corresponding to the acquired tilt angle A.sub.1 from the map MV.sub.1. In addition, the storage device **24** of the terminal **20** stores a map MV.sub.2 that determines the relation between the tilt angle A.sub.2 and the target velocity V.sub.2 based on the same concept as the map MV.sub.1. The control amount calculation unit **62** calculates the target velocity V.sub.2 corresponding to the acquired tilt angle A.sub.2 from the map MV.sub.2.

[0055] The control amount calculation unit **52** of the terminal **10** calculates the target turning angular velocity ω.sub.1 (target control amount). Specifically, the storage device **14** also stores a map Mω.sub.1 that defines the relation between the tilt angle B.sub.1 and the target turning angular velocity ω.sub.1. The map Mω.sub.1 is set such that the target turning angular velocity ω.sub.1 is also zero when the tilt angle B.sub.1 is zero, for example. The map Mω.sub.1 is set such that, for example, the positive target turning angular velocity ω.sub.1 increases as the positive tilt angle B.sub.1 increases, and the negative target turning angular velocity ω.sub.1 increases as the negative tilt angle B.sub.1 increases. The control amount calculation unit **52** calculates a of the target turning angular velocity ω.sub.1 corresponding to the obtained tilt angle B.sub.1 from the map Mω.sub.1. In the storage device **24** of the terminal **20**, a map Mω.sub.2 in which the relation between the tilt angle B.sub.2 and the target turning angular velocity ω.sub.2 is determined based on the same concept as the map Mω.sub.1 is stored. The control amount calculation unit **62** calculates 2 of the target turning angular velocity ω.sub.2 corresponding to the obtained tilt angle B.sub.2 from the map Mω.sub.2.

[0056] The target velocity V.sub.1 and V.sub.2 and the target turning angular velocity ω.sub.1 and ω.sub.2 calculated in the terminals **10** and **20** as described above are transmitted to the mobile object **30**.

[0057] The control amount arbitration unit **71** of the mobile object **30** arbitrates the target velocities V.sub.1 and V.sub.2 received from the terminals **10** and **20**, respectively. Specifically, the control amount arbitration unit **71** combines the target velocities V.sub.1 and V.sub.2 calculated for each of the terminals **10** and **20** at the “first ratio” to calculate the final target velocity V.sub.t. The final target velocity V.sub.t is expressed, for example, by Equation (3). The first ratio is specified by the coefficients C.sub.1 and C.sub.2. That is, the C.sub.1 is a factor indicating the first ratio of the target velocity V.sub.1 and is multiplied by the target velocity V.sub.1. The C.sub.2 is a factor indicating the first ratio of the target velocity V.sub.2 and is multiplied by the target velocity V.sub.2. The final target velocity V.sub.t corresponds to the product of the coefficient C.sub.1 and the target velocity V.sub.1and the product of the coefficient C.sub.2 and the target velocity V.sub.2. In an example in which three or more operation terminals are used, three or more target speeds V.sub.i corresponding to three or more first operation amounts are synthesized by the first ratio.

[00002] $V_t = C_1 \times V_1 + C_2 \times V_2 \quad (3)$

[0058] The control amount arbitration unit **71** arbitrates the target turning angular velocities ω.sub.1 and ω.sub.2 received from the terminals **10** and **20**, respectively. Specifically, the control amount arbitration unit **71** combines the target turning angular velocities ω.sub.1 and ω.sub.2calculated for each of the terminals **10** and **20** at the “second ratio” to calculate the final target turning angular velocity ω.sub.t. The second ratio differs from the first ratio as illustrated in FIG. **4**B. The final target turning angular velocity ω.sub.t is expressed, for example, by Equation (4). The second ratio is specified by the coefficients D.sub.1 and D.sub.2. That is, the D.sub.1 is a factor indicating the second ratio of the target turning angular velocity ω.sub.1 and is multiplied by the target turning angular velocity ω.sub.1. The D.sub.2 is a factor indicating the second ratio of the target turning angular velocity ω.sub.2 and is multiplied by the target turning angular velocity ω.sub.2. The final target turning angular velocity ω.sub.t corresponds to the sum of the product of the coefficient C.sub.1 and the target turning angular velocity ω.sub.1 and the product of the coefficient C.sub.2 and the target turning angular velocity ω.sub.2. In an example in which three or more operation terminals are used, three or more target turning angular velocities ω.sub.i corresponding to three or more second operation amounts are combined by a second ratio.

[00003] $\omega_t = D_1 \times \omega_1 + D_2 \times \omega_2 \quad (4)$

[0059] The first and second ratios can be set by the operator **1** operating the touch panel **11** of the terminal **10**. More specifically, for example, the terminal **10** may be able to set only the coefficients C.sub.1 and D.sub.1 associated with the operation of the terminal **10**, or may be able to set the coefficients C.sub.2 and D.sub.2 associated with the operation of the other terminal **20**. This also applies to the terminal **20**.

[0060] The first and second ratios may be arbitrarily set on condition that they are different from each other. In addition, FIG. **4**B shows an exemplary setting of the first and second ratios.

[0061] In the embodiment shown in FIG. **4**B, the first ratio for the final target velocity V.sub.t is set such that the coefficient C.sub.1 of the terminal **10** is greater than the coefficient C.sub.2 of the terminal **20**. More specifically, for example, the coefficient C.sub.1 is set to 1, and the coefficient C.sub.2 is set to 0. According to this configuration, only the operator **1** of the terminal **10** can perform an operation of changing the final target velocity Vt. In other words, the final target velocity Vt is determined only by operating the terminal **10**.

[0062] On the other hand, the second ratio with respect to the final target turning angular velocity ωt is set such that the coefficient D.sub.1 of the terminal **10** is equal to the coefficient D.sub.2 of the terminal **20**. More specifically, for example, the coefficient D.sub.1 is set to 0.5, and the coefficient D.sub.2 is set to 0.5. According to this setting example, in order to control the turning angular velocity ω, the two operators **1** and **2** are required to operate the terminals **10** and **20** together with the rhythm.

[0063] In addition, in each of the first and second ratios, the sum of the two coefficients (e.g., C.sub.1+C.sub.2, D.sub.1+D.sub.2) is basically 1 as shown in the example in FIG. **4**B. However, the total value may be greater than 1 or less than 1. This also applies to an example in which three or more operation terminals are used and thus three or more coefficients are used.

[0064] The motor control unit **72** controls the two electric motors **36**L and **36**R so that the calculated final target velocity Vt and final target turning angular speed ωt are realized. More specifically, the motor control unit **72** substitutes the final target velocity Vt and the final target turning angular speed ωt into the speed V and the turning angular speed ω in Equations (1) and (2), respectively, to calculate the target velocities V.sub.Lt and V.sub.Rt of the two drive wheels **34**L and **34**R, respectively. The motor control unit **72** controls the electric motor **36**L and **36**R so that the target velocities V.sub.Lt and V.sub.Rt are realized. Note that the electric motor **36**L and **36**R correspond to an exemplary "one or more actuators related to traveling of a moving object" according to the present disclosure.

[0065] According to the mobile object control system **100** according to the present embodiment described above, the first and second ratios that differ from each other are used in the calculation of the final target velocity Vt and the final target turning angular speed ωt, which are two target values for the travel control of the mobile object **30**. Consequently, the ratio in which the first and second manipulated variables of the individual operation terminals **10** and **20** are reflected differs between the final target velocity Vt and the final target turning angular velocity ωt (see Equations (3) and (4)). This means that the degree of involvement of the two operators **1**, **2** with respect to the travel control of the mobile object **30** differs between the final target velocity Vt and the final target turning angular speed ωt. In other words, this allows the two operators **1** and **2** to have different roles in units of the control amount of the mobile object **30**, namely, the speed V and the turning angular velocity ω. This leads to the fact that the pleasure of operating the mobile object **30** in cooperation can be easily shared between the two operators **1** and **2**.

[0066] In addition, the mobile object **30** shown in FIG. **2**A is a mobile object suitably used in an entertainment facility such as a theme park or an amusement park, or a sightseeing place. According to the mobile object control system **100** according to the present embodiment, excellent entertainment using the mobile object **30** can be provided to the operators **1** and **2**.

[0067] Further, as illustrated in FIG. **4**B, the first ratio regarding the final target velocity Vt may be set such that the coefficient C.sub.1 of the terminal **10** is larger than the coefficient C.sub.2 of the terminal **20**. The second ratio with respect to the final target turning angular velocity ωt may be set such that the coefficient D.sub.1 of the terminal **10** is equal to the coefficient D.sub.2 of the terminal **20**. Here, it can be said that the control of the speed V related to the progress and the stop of the mobile object **30** is required to have higher safety than the control of the turning angular speed ω of the mobile object **30**. According to the configuration example of the first and second ratios, the terminal **10** is dominant in controlling the speed V. Therefore, the operator **1** and the operator **2** can enjoy the cooperative operation while the one operator **1** operating the terminal **10** safely manages the speed V. More specifically, by setting the coefficient C.sub.1 to 1 and setting the coefficient C.sub.2 to 0, the operator **1** can more reliably stop the mobile object **30** in the unlikely event. With respect to the turning angular velocity ω in which the operations of the operators **1** and **2** are uniformly reflected, the operators **1** and **2** can sufficiently share the enjoyment of the operation of the mobile object **30** by operating the terminals **10** and **20** together with the rhythm.

[0068] In addition, according to the above setting example of the first and second ratios, when the mobile object **30** is boarded by the parent and the child, the parent operates the terminal **10** and the child operates the terminal **20**. As a result, the child can enjoy the operation related to the turning of the mobile object **30** together with the parent while the parent safely manages the speed V.

3. Another Configuration Example of Mobile Object Control System

[0069] The mobile object control system according to the present disclosure may include the configuration shown in FIG. **5** or FIG. **6** instead of the configuration shown in FIG. **4**A and FIG. **4**B.

[0070] FIG. **5** is a diagram illustrating another example of a functional block related to travel control of the mobile object **30**. The mobile object control system **200** illustrated in FIG. **5** is different from the mobile object control system **100** described above in the following points. That is, in the mobile object control system **200**, the terminal **10** includes only the operation amount acquisition unit **51**, and the terminal **20** includes only the operation amount acquisition unit **61**. ECU **38** of the mobile object **30** includes control amount calculation units **73** and **74** in addition to the control amount arbitration unit **71** and the motor control unit **72**.

[0071] In the example illustrated in FIG. **5**, the control amount calculation unit **73** of the mobile object **30** calculates the target velocity V.sub.1 corresponding to the tilt angle A.sub.1 received from the terminal **10** from the map MV.sub.1, and calculates the target turning angular speed @.sub.1 corresponding to the tilt angle B.sub.1 received from the terminal **10** from the map Mω.sub.1. Similarly, the control amount calculation unit **74** calculates the target velocity V.sub.2corresponding to the tilt angle A.sub.2 received from the terminal **20** from the map MV.sub.2, and calculates the target turning angular speed ω.sub.2 corresponding to the tilt angle B.sub.2 received from the terminal **20** from the map Mω.sub.2. The map MV.sub.1, MV.sub.2, the Mω.sub.1, and the Mω.sub.2 are stored in the storage device **34** of ECU **38**. The calculated target velocity V.sub.1 and V.sub.2 and the target turning angular velocity ω.sub.1 and ω.sub.2 are inputted to the control amount arbitration unit **71**.

[0072] The mobile object control system **200** described above also provides effects similar to those described above for the mobile object control system **100**.

[0073] FIG. **6** is a diagram illustrating still another example of a functional block related to the travel control of the mobile object **30**. The mobile object control system **300** shown in FIG. **6** is different from the mobile object control system **100** described above in the following points. That is, in the mobile object control system **300**, as in the example of the mobile object control system **200**, the terminal **10** includes only the operation amount acquisition unit **51**, and the terminal **20** includes only the operation amount acquisition unit **61**. ECU **38** of the mobile object **30** includes an operation amount arbitration unit **75** and a final control amount calculation unit **76** together with the motor control unit **72**.

[0074] In the embodiment illustrated in FIG. **6**, the operation amount arbitration unit **75** of the mobile object **30** arbitrates the tilt angle A.sub.1 and A.sub.2 received from the terminals **10** and **20**, respectively. Specifically, the operation amount arbitration unit **75** combines the tilt angle A.sub.1 and A.sub.2 at the “first ratio” to calculate the post-arbitration operation amount (first combination operation amount) A.sub.x. The post-arbitration operation amount A.sub.x is expressed, for example, by Equation (5). That is, the post-arbitration operation amount A.sub.x corresponds to the product of the coefficient C.sub.1 and the tilt angle A.sub.1 and the product of the coefficient C.sub.2 and the tilt angle A.sub.2. In an example in which three or more operation terminals are used, three or more first operation amounts are synthesized according to a first ratio.

[00004] $A_x = C_1 \times A_1 + C_2 \times A_2$ (5)

[0075] The operation amount arbitration unit **75** of the mobile object **30** arbitrates the tilt angle

B.sub.1 and B.sub.2 received from the terminals **10** and **20**, respectively. Specifically, the operation amount arbitration unit **75** combines the tilt angle B.sub.1 and B.sub.2 at the “second ratio” to calculate the post-arbitration operation amount (second combination operation amount) B.sub.x. The post-arbitration operation amount B.sub.x is expressed, for example, by Equation (6). That is, the post-arbitration operation amount B.sub.x corresponds to the product of the coefficient D.sub.1 and the tilt angle B.sub.1 and the product of the coefficient D.sub.2 and the tilt angle B.sub.2. In an example in which three or more operation terminals are used, three or more second operation amounts are combined by a second ratio.

[00005] $B_x = D_1 \times B_1 + D_2 \times B_2 \quad (6)$

[0076] In addition, even in the example shown in FIG. **6**, the first and second ratio coefficient C.sub.1, C.sub.2, D.sub.1, and D.sub.2 is set as shown in FIG. **4**B as an example.

[0077] The final control amount calculation unit **76** calculates the final target velocity V.sub.t corresponding to the post-arbitration operation amount A.sub.x inputted from the operation amount arbitration unit **75** from the map MV.sub.t. The map MV.sub.t defines the relation between the post-arbitration operation amount A.sub.x and the final target velocity V.sub.t based on the same concept as the above-described map MV.sub.1, and is stored in the storage device **34**. Further, the final control amount calculation unit **76** calculates the final target turning angular velocity ω.sub.t corresponding to the post-arbitration operation amount B.sub.x input from the operation amount arbitration unit **75** from the map Mω.sub.t. The map Mω.sub.t defines the relation between the post-arbitration operation amount B.sub.x and the final target turning angular velocity ω.sub.t based on the same concept as the map Mω.sub.1 described above, and is stored in the storage device **34**. The calculated final target velocity V.sub.t and the final target turning angular speed ω.sub.t are input to the motor control unit **72**.

[0078] The mobile object control system **300** described above also provides effects similar to those described above for the mobile object control system **100**.

[0079] In addition, the configuration shown in FIG. **6** is applicable to a case where the following nonlinear processing is not included in the control amount calculation. On the other hand, the configurations shown in FIG. **4**A and FIG. **5** can be applied regardless of whether the nonlinear process is included. Here, the nonlinear processing can be performed by the control amount calculation units **52**, **62**, **73**, and **74**. Here, the nonlinear processing will be described by taking the control amount calculation unit **52** as an example. That is, the nonlinear processing in the control amount calculation unit **52** is such that, when the tilt operation O of the terminal **10** is performed while the operator **1** is touching the touch panel **11**, the change amount of the tilt angle A.sub.1 or B.sub.1 by the tilt operation O is used as the first or second operation amount for the control amount calculation.

Claims

1. A mobile object control system configured to control traveling of a mobile object based on operation amount information of a plurality of operation terminals operated by a plurality of operators, respectively, the mobile object control system comprising one or more processors, wherein the operation amount information includes a first operation amount and a second operation amount as operation amounts of each of the operation terminals, and the one or more processors are configured to: calculate, for the individual operation terminals, target speeds that are target values of a speed in a traveling direction of the mobile object based on the first operation amount; calculate, for the individual operation terminals, target turning angular velocities that are target values of a turning angular velocity of the mobile object based on the second operation amount; calculate a final target speed by combining the target speeds calculated for the individual operation terminals at a first ratio; calculate a final target turning angular velocity by combining the target turning angular velocities calculated for the individual operation terminals at a second ratio different from the first ratio; and control one or more actuators related to the traveling of the mobile object based on the final target speed and the final target turning angular velocity.

2. The mobile object control system according to claim 1, wherein: the operation terminals include a first operation terminal and a second operation terminal; a coefficient of the first ratio for multiplication of the target speed based on the first operation amount of the first operation terminal is larger than a coefficient of the first ratio for multiplication of the target speed based on the first operation amount of the second operation terminal; and a coefficient of the second ratio for multiplication of the target turning angular velocity based on the second operation amount of the first operation terminal is equal to a coefficient of the second ratio for multiplication of the target turning angular velocity based on the second operation amount of the second operation terminal.

3. The mobile object control system according to claim 2, wherein: the coefficient of the first ratio for multiplication of the target speed based on the first operation amount of the first operation terminal is **1**; and the coefficient of the first ratio for multiplication of the target speed based on the first operation amount of the second operation terminal is **0**.

4. A mobile object control system configured to control traveling of a mobile object based on operation amount information of a plurality of operation terminals operated by a plurality of operators, respectively, the mobile object control system comprising one or more processors, wherein the operation amount information includes a first operation amount and a second operation amount as operation amounts of each of the operation terminals, and the one or more processors are configured to: calculate a first combined operation amount by combining the first operation amounts of the individual operation terminals at a first ratio; calculate a second combined operation amount by combining the second operation amounts of the individual operation terminals at a second ratio different from the first ratio; calculate a final target speed that is a target value of a speed in a traveling direction of the mobile object based on the first combined operation amount; calculate a final target turning angular velocity that is a target value of a turning angular velocity of the mobile object based on the second combined operation amount; and control one or more actuators related to the traveling of the mobile object based on the final target speed and the final target turning angular velocity.

5. The mobile object control system according to claim 4, wherein: the operation terminals include a first operation terminal and a second operation terminal; a coefficient of the first ratio for multiplication of the first operation amount of the first operation terminal is larger than a coefficient of the first ratio for multiplication of the first operation amount of the second operation terminal; and a coefficient of the second ratio for multiplication of the second operation amount of the first operation terminal is equal to a coefficient of the second ratio for multiplication of the second operation amount of the second operation terminal.