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(54) **AIRCRAFT MANAGEMENT SYSTEM AND AIRCRAFT MANAGEMENT METHOD**

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(57) **ABSTRACT**

An aircraft management system includes: a nearby available-for-landing port search unit configured to search for a nearby available-for-landing port located within a determination threshold distance from a route of the aircraft and able to accept a landing within a predetermined time after a route passing timing; and an alternative candidate port determination unit configured to, if the nearby available-for-landing port is extracted by the nearby available-for-landing port search unit, designate the extracted nearby available-for-landing port as an alternative candidate port for accommodating an emergency landing, or to, if the nearby available-for-landing port is not extracted, change the route of the aircraft to the destination point to a route in which a nearby available-for-landing port is extracted, and then designate the nearby available-for-landing port extracted for the changed route as the alternative candidate port.

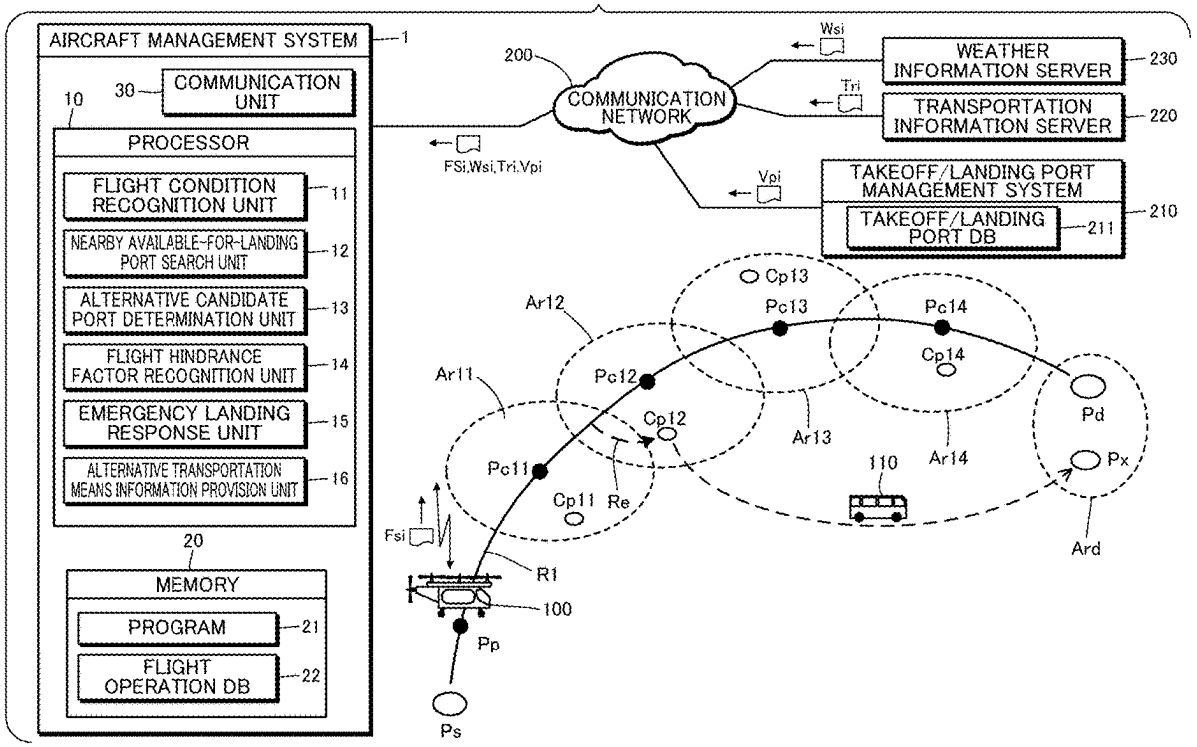


FIG. 1

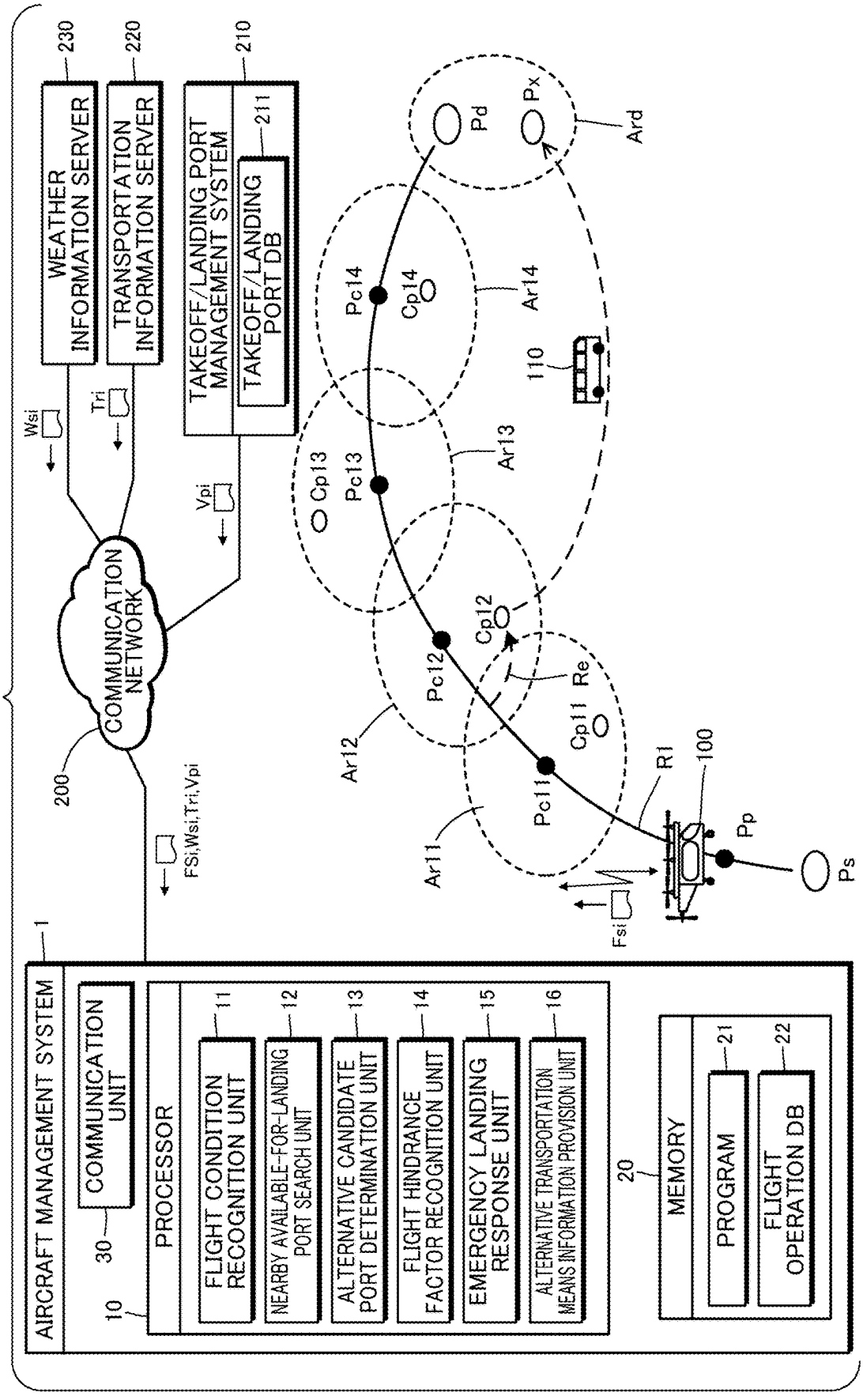

AIRCRAFT MANAGEMENT SYSTEM
1
COMMUNICATION UNIT
30
10
PROCESSOR
FLIGHT CONDITION RECOGNITION UNIT
11
NEARBY AVAILABLE-FOR-LANDING PORT SEARCH UNIT
12
ALTERNATIVE CANDIDATE PORT DETERMINATION UNIT
13
FLIGHT HINDRANCE FACTOR RECOGNITION UNIT
14
EMERGENCY LANDING RESPONSE UNIT
15
ALTERNATIVE TRANSPORTATION MEANS INFORMATION PROVISION UNIT
16
20
MEMORY
PROGRAM
21
FLIGHT OPERATION DB
22
200
COMMUNICATION NETWORK
WEATHER INFORMATION SERVER
230
TRANSPORTATION INFORMATION SERVER
220
TAKEOFF/LANDING PORT MANAGEMENT SYSTEM
210
TAKEOFF/LANDING PORT DB
211
Wsi
Tri
Vpi
FSi,Wsi,Tri,Vpi
Fsi
Ps
Pp
Pc11
Pc12
Pc13
Pc14
Pd
Px
Cp11
Cp12
Cp13
Cp14
Re
R1
Ar11
Ar12
Ar13
Ar14
Ard
110
100

FIG.2

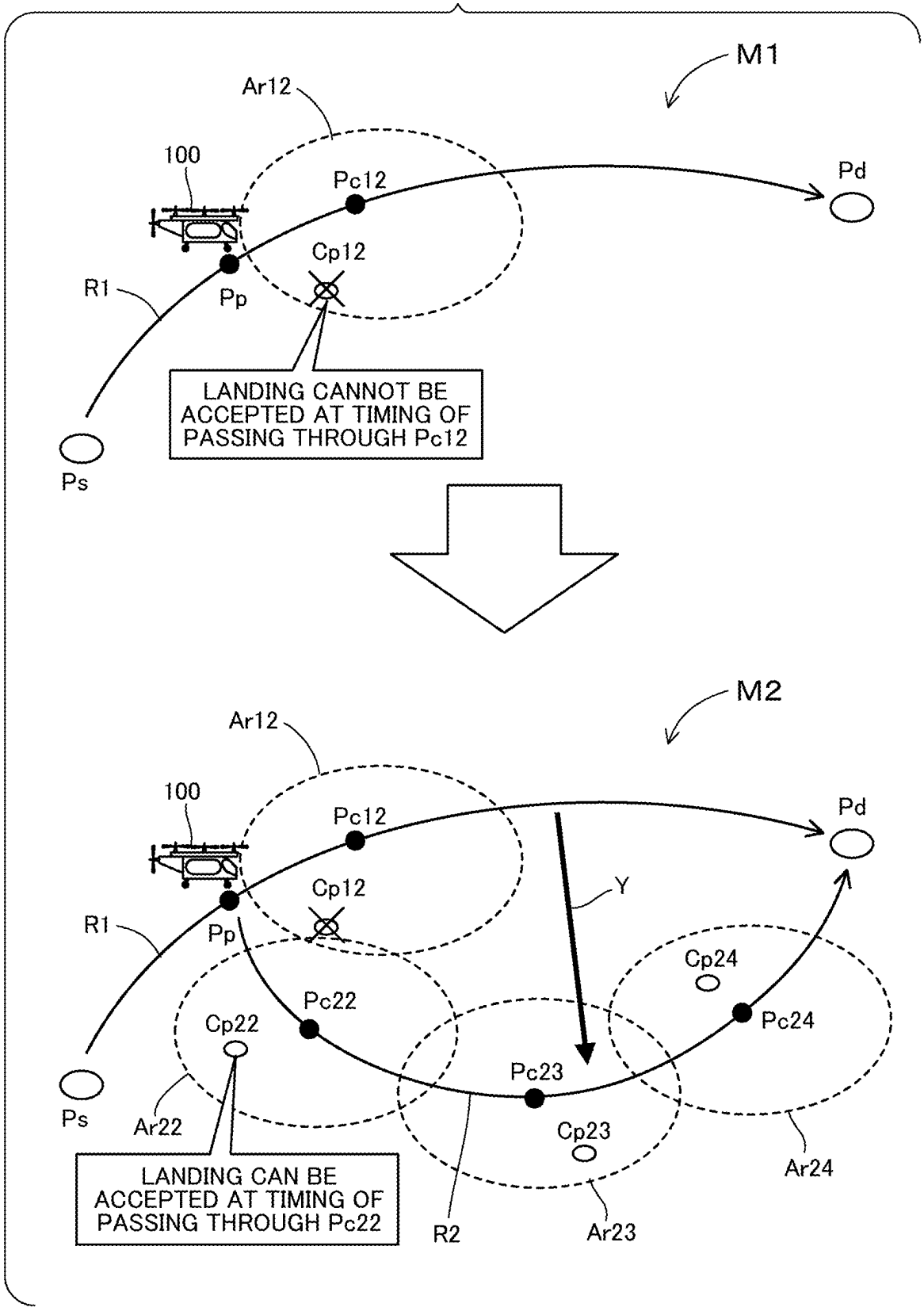
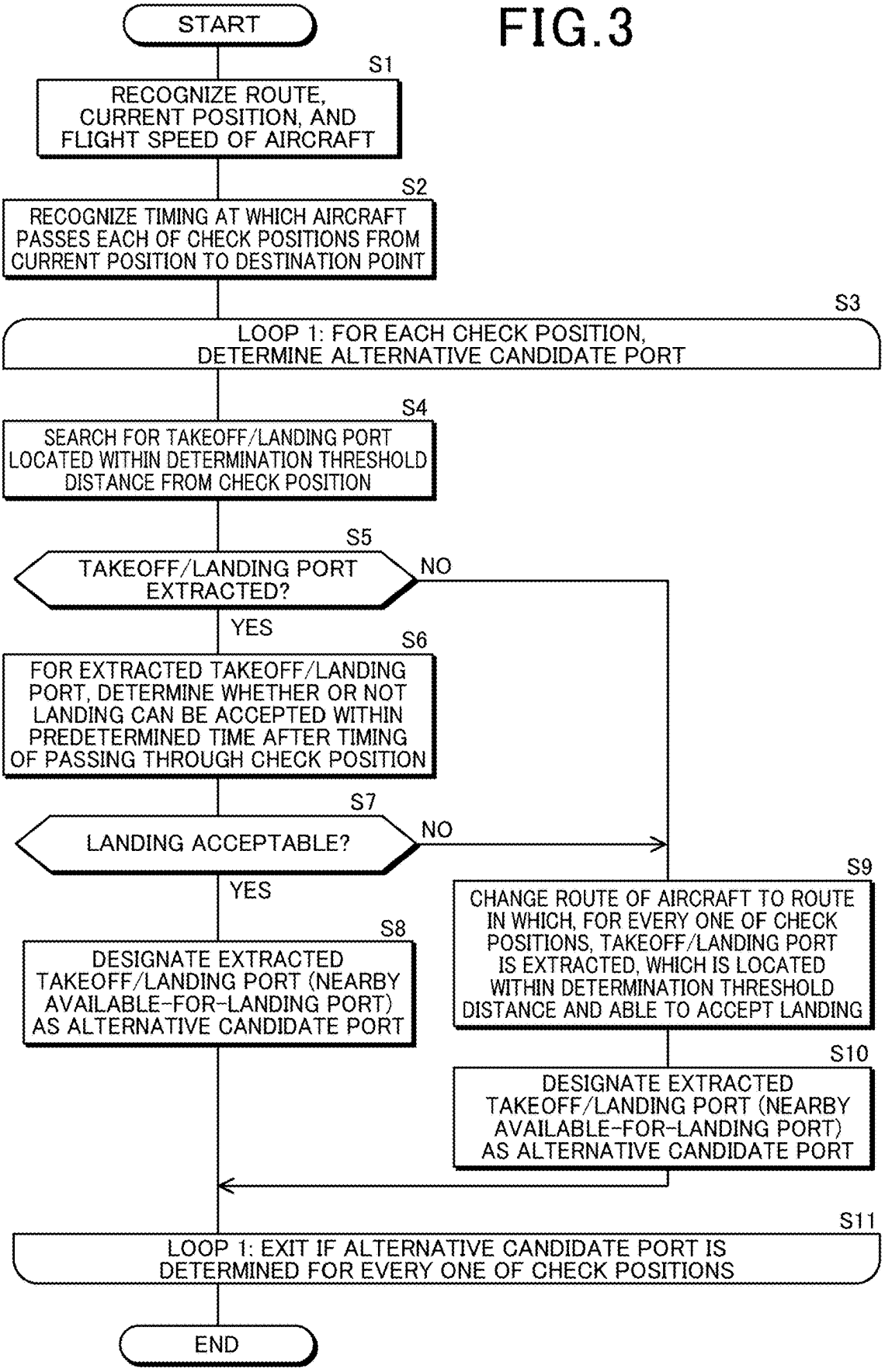

M1
Ar12
100
Pc12
Pd
Cp12
R1
Pp
LANDING CANNOT BE ACCEPTED AT TIMING OF PASSING THROUGH Pc12
Ps
M2
Ar12
100
Pc12
Pd
Y
Cp12
R1
Pp
Cp24
Pc22
Pc24
Cp22
Pc23
Ps
Ar22
Cp23
LANDING CAN BE ACCEPTED AT TIMING OF PASSING THROUGH Pc22
Ar24
R2
Ar23

FIG.3


START
S1
RECOGNIZE ROUTE, CURRENT POSITION, AND FLIGHT SPEED OF AIRCRAFT
S2
RECOGNIZE TIMING AT WHICH AIRCRAFT PASSES EACH OF CHECK POSITIONS FROM CURRENT POSITION TO DESTINATION POINT
S3
LOOP 1: FOR EACH CHECK POSITION, DETERMINE ALTERNATIVE CANDIDATE PORT
S4
SEARCH FOR TAKEOFF/LANDING PORT LOCATED WITHIN DETERMINATION THRESHOLD DISTANCE FROM CHECK POSITION
S5
TAKEOFF/LANDING PORT EXTRACTED?
NO
YES
S6
FOR EXTRACTED TAKEOFF/LANDING PORT, DETERMINE WHETHER OR NOT LANDING CAN BE ACCEPTED WITHIN PREDETERMINED TIME AFTER TIMING OF PASSING THROUGH CHECK POSITION
S7
LANDING ACCEPTABLE?
NO
YES
S8
DESIGNATE EXTRACTED TAKEOFF/LANDING PORT (NEARBY AVAILABLE-FOR-LANDING PORT) AS ALTERNATIVE CANDIDATE PORT
S9
CHANGE ROUTE OF AIRCRAFT TO ROUTE IN WHICH, FOR EVERY ONE OF CHECK POSITIONS, TAKEOFF/LANDING PORT IS EXTRACTED, WHICH IS LOCATED WITHIN DETERMINATION THRESHOLD DISTANCE AND ABLE TO ACCEPT LANDING
S10
DESIGNATE EXTRACTED TAKEOFF/LANDING PORT (NEARBY AVAILABLE-FOR-LANDING PORT) AS ALTERNATIVE CANDIDATE PORT
S11
LOOP 1: EXIT IF ALTERNATIVE CANDIDATE PORT IS DETERMINED FOR EVERY ONE OF CHECK POSITIONS
END

AIRCRAFT MANAGEMENT SYSTEM AND AIRCRAFT MANAGEMENT METHOD

INCORPORATION BY REFERENCE

[0001] The present application claims priority under 35 U.S.C. § 119 to Japanese Patent Application No. 2024-019933 filed on Feb. 14, 2024. The content of the application is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to an aircraft management system and an aircraft management method.

Description of the Related Art

[0003] A technique has been disclosed, which, as a precaution for a malfunction of an aircraft in flight, predetermines an alternative landing site to the original destination point and an alternative flight route, and thereby allows the malfunctioning aircraft to land at the alternative landing site (see, for example, U.S. Patent Application Publication No. 2022/0111962).

SUMMARY OF THE INVENTION

[0004] The conventional system described above does not perform a process to check the current condition of an alternative landing site. Accordingly, when a malfunctioning aircraft attempts to land at a predetermined alternative landing site, the alternative landing site may not be available. In this case, inconveniently, the malfunctioning aircraft cannot land at the alternative landing site.

[0005] An object of the application, which has been made in consideration of such background, is to provide an aircraft management system and an aircraft management method that can prevent a situation in which an alternative landing site cannot be found for an aircraft in flight in the event of a malfunction of the aircraft, bad weather, or other contingent circumstances.

[0006] As a first aspect to achieve the aforementioned object, an aircraft management system is provided, which includes: a flight condition recognition unit configured to recognize a flight condition of an aircraft flying a route to a destination point; a nearby available-for-landing port search unit configured to recognize a route passing timing, which is a timing at which the aircraft flies the route, based on a result of recognizing the flight condition of the aircraft by the flight condition recognition unit, and to search for a nearby available-for-landing port, which is a takeoff/landing port located within a predetermined determination threshold distance from the route and able to accept a landing within a predetermined time after the route passing timing; and an alternative candidate port determination unit configured to, if the nearby available-for-landing port is extracted by the nearby available-for-landing port search unit, designate the extracted nearby available-for-landing port as an alternative candidate port for accommodating an emergency landing of the aircraft, or to, if the nearby available-for-landing port is not extracted by the nearby available-for-landing port search unit, change the route of the aircraft to the destination point to a route in which a nearby available-for-landing port is extracted by the nearby available-for-landing port search unit, and then designate the nearby available-for-landing port extracted by the nearby available-for-landing port search unit for the changed route as the alternative candidate port.

[0007] In the above aircraft management system, the flight condition recognition unit may be configured to repeatedly perform a process of recognizing the flight condition of the aircraft during a flight of the aircraft, the nearby available-for-landing port search unit may be configured to repeatedly perform a process of searching for a nearby available-for-landing port based on a result of recognizing the flight condition of the aircraft by the flight condition recognition unit, and the alternative candidate port determination unit may be configured to repeatedly perform a process of determining the alternative candidate port based on whether or not the nearby available-for-landing port is extracted by the nearby available-for-landing port search unit.

[0008] In the above aircraft management system, the flight condition recognition unit may be configured to recognize the flight condition including a level of a malfunction occurring in the aircraft, and the nearby available-for-landing port search unit may be configured to change the determination threshold distance according to the level of the malfunction occurring in the aircraft recognized by the flight condition recognition unit.

[0009] In the above aircraft management system, the flight condition recognition unit may be configured to recognize the flight condition including a remaining flyable range of the aircraft, and the nearby available-for-landing port search unit may be configured to change the determination threshold distance according to the remaining flyable range of the aircraft recognized by the flight condition recognition unit.

[0010] The above aircraft management system may include: a flight hindrance factor recognition unit configured to recognize presence or absence of a flight hindrance factor that hinders a flight of the aircraft to the destination point; and an emergency landing response unit configured to change the route of the aircraft to an emergency route to the alternative candidate port when the presence of the flight hindrance factor is recognized by the flight hindrance factor recognition unit.

[0011] The above aircraft management system may include an alternative transportation means information provision unit configured to provide information on alternative transportation means to travel from the alternative candidate port to a predetermined area in which the destination point is located, if the route of the aircraft is changed to an emergency route by the emergency landing response unit.

[0012] As a second aspect to achieve the aforementioned object, an aircraft management method executed by a computer is provided, which includes: a flight condition recognition step of recognizing a flight condition of an aircraft flying a route to a destination point; a nearby available-for-landing port search step of recognizing a route passing timing, which is a timing at which the aircraft flies the route, based on a result of recognizing the flight condition of the aircraft by the flight condition recognition step, and searching for a nearby available-for-landing port, which is a takeoff/landing port located within a predetermined determination threshold distance from the route and able to accept a landing within a predetermined time after the route passing timing; and an alternative candidate port determination step of, if the nearby available-for-landing port is extracted by the nearby available-for-landing port search step, designating the extracted nearby available-for-landing

port as an alternative candidate port for accommodating an emergency landing of the aircraft, or, if the nearby available-for-landing port is not extracted by the nearby available-for-landing port search step, changing the route of the aircraft to the destination point to a route in which a nearby available-for-landing port is extracted by the nearby available-for-landing port search step, and then designating the nearby available-for-landing port extracted by the nearby available-for-landing port search step for the changed route as the alternative candidate port.

[0013] The aircraft management system and the aircraft management method described above can prevent a situation in which an alternative landing site cannot be found for an aircraft in flight in the event of a malfunction of the aircraft, bad weather, or other contingent circumstances.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. **1** is a block diagram of an aircraft management system;

[0015] FIG. **2** is an illustration of a process of changing the route of an aircraft to ensure alternative candidate ports; and

[0016] FIG. **3** is a flowchart of an alternative candidate port determination process.

DETAILED DESCRIPTION OF THE INVENTION

1. Configuration of Aircraft Management System

[0017] The configuration of an aircraft management system **1** in the present embodiment will be described with reference to FIGS. **1** and **2**. Referring to FIG. **1**, the aircraft management system **1** monitors the flight condition of an aircraft **100** flying a route R**1** from a departure point Ps to a destination point Pd, and executes a process to determine an alternative candidate port for accommodating an emergency landing due to contingent circumstances.

[0018] The aircraft **100** is, for example, an electric vertical take-off and landing aircraft (eVTOL). The aircraft management system **1** is a computer system including a processor **10**, a memory **20**, and a communication unit **30**. The processor **10** corresponds to a computer according to this disclosure. The aircraft management system **1** communicates with the aircraft **100**, a takeoff/landing port management system **210**, a transportation information server **220**, and a weather information server **230** via a communication network **200** by means of a communication unit **30**.

[0019] The takeoff/landing port management system **210** recognizes the usage of a plurality of takeoff/landing ports located in the area to be managed, including the route R**1**, through communication with a management system placed at each takeoff/landing port, and records usage data indicating the real-time usage of each takeoff/landing port in a takeoff/landing port database (DB) **211** as needed. The weather information server **230** provides weather information for the area to be managed, including the route R**1**. The transportation information server **220** provides information on transportation operating within the area to be managed, including the route R**1**.

[0020] The memory **20** of the aircraft management system **1** stores a program **21** for controlling the aircraft management system **1** and a flight operation DB **22** that records flight information (flight routes, flight implementation schedules, etc.) for aircrafts managed by the aircraft management system **1** for their operations. By reading and executing the program **21**, the processor **10** functions as a flight condition recognition unit **11**, a nearby available-for-landing port search unit **12**, an alternative candidate port determination unit **13**, a flight hindrance factor recognition unit **14**, an emergency landing response unit **15**, and an alternative transportation means information provision unit **16**.

[0021] The process performed by the flight condition recognition unit **11** corresponds to the flight condition recognition step in the aircraft management method of the present disclosure, and the process performed by the nearby available-for-landing port search unit **12** corresponds to the nearby available-for-landing port search step in the aircraft management method of the present disclosure. The process performed by the alternative candidate port determination unit **13** corresponds to the alternative candidate port determination step in the aircraft management method of the present disclosure.

[0022] The flight condition recognition unit **11** receives flight condition information Fsi transmitted from the aircraft **100** and recognizes the flight condition of the aircraft **100**. The flight condition information Fsi includes the route R**1** of the aircraft **100** to the destination point Pd, the current position and flight speed of the aircraft **100**, the overall condition of the aircraft **100** (the presence or absence of a malfunction and the level of the malfunction if present), the remaining flyable range of the aircraft **100**, and the weather in the flight area of the aircraft **100**. The flight condition recognition unit **11** records the recognized information on the flight condition of the aircraft **100** in the flight operation DB **22**.

[0023] The nearby available-for-landing port search unit **12** sets a plurality of check positions Pc**11**, Pc**12**, Pc**13**, and Pc**14** that the aircraft **100** will pass based on the route R**1** to the destination point Pd, the current position Pp, the flight speed, etc. of the aircraft **100** recognized by the flight condition recognition unit **11**, and recognizes a timing at which the aircraft **100** will pass each checkpoint (route passing timing). Then, for each check position, the nearby available-for-landing port search unit **12** searches for a nearby available-for-landing port, which is a takeoff/landing port located within a determination threshold distance from the check position and able to accept landing of the aircraft **100** within a predetermined time (e.g., within tens of minutes to several hours) after the timing at which the aircraft **100** passes the check position.

[0024] The nearby available-for-landing port search unit **12** accesses the takeoff/landing port management system **210** and refers to the takeoff/landing port DB **211** to search for a nearby available-for-landing port for each check position. The nearby available-for-landing port search unit **12** may determine whether each takeoff/landing port can accept landing of the aircraft **100** by communicating with the management system placed at the takeoff/landing port to recognize the usage of the takeoff/landing port. FIG. **1** illustrates the case where for check positions Pc**11**-Pc**14**, nearby available-for-landing ports Cp**11**, Cp**12**, Cp**13**, and Cp**14** are extracted respectively in search areas Ar**11**-Ar**14** within the determination threshold distance.

[0025] Here, the check positions are set so that the search areas of adjacent check positions overlap, which ensures that there is always some nearby available-for-landing port within the determination threshold distance from the aircraft

100 while the aircraft 100 is heading toward the destination point Pd. In FIG. 1, four check positions Pc11-Pc14 are shown as an example, but the number of check positions may be changed according to the distance of the route R1, the determination threshold distance, etc. if appropriate.

[0026] If a nearby available-for-landing port is extracted by the nearby available-for-landing port search unit 12 for every one of the check positions Pc11-Pc14, the alternative candidate port determination unit 13 designates the extracted nearby available-for-landing ports as alternative candidate ports for emergency landing of the aircraft 100. In contrast, if no nearby available-for-landing port is extracted by the nearby available-for-landing port search unit 12 for any of the check positions, the alternative candidate port determination unit 13 changes the route of the aircraft 100 toward the destination point Pd to a route in which a nearby available-for-landing port is extracted for every one of the check positions.

[0027] FIG. 2 illustrates a situation in which, when the aircraft 100 flies the route R1 and approaches the check position Pc12, the nearby available-for-landing port Cp12, which has been designated as an alternative candidate port, becomes unable to accept landing. In this case, the alternative candidate port determination unit 13 changes the route of the aircraft 100 to a route R2 in which a nearby available-for-landing port is extracted by the nearby available-for-landing port search unit 12 for every one of the check positions Pc22, Pc23, and Pc24, as shown by the arrow Y.

[0028] In the route R2, nearby available-for-landing ports Cp22, Cp23, and Cp24 are extracted respectively from the search areas Ar22, Ar23, and Ar24 of the check positions Pc22, Pc23, and Pc24, and the alternative candidate port determination unit 13 designates the nearby available-for-landing ports Cp22, Cp23, and Cp24 as alternative candidate ports. This ensures that there is always some alternative candidate port available for landing that is located within the determination threshold distance from the aircraft 100 flying toward the destination point Pd. The alternative candidate port determination unit 13 records information on the changed route in the flight operation DB 22.

[0029] The flight hindrance factor recognition unit 14 recognizes flight hindrance factors that hinder the flight of the aircraft 100 to the destination point, such as a malfunction of the aircraft and bad weather, based on flight condition information Fsi transmitted from the aircraft 100 and weather information Wsi transmitted from the weather information server 230 for the areas where the aircraft 100 flies.

[0030] When the emergency landing response unit 15 determines that it is difficult for the aircraft 100 to fly to the destination point due to a flight hindrance factor recognized by the flight hindrance factor recognition unit 14, the emergency landing response unit 15 changes the route to an emergency route to the nearest alternative candidate port from the current position of the aircraft and transmits emergency response information indicating landing at the alternative candidate port. This makes it possible to quickly arrange a response for emergency landing at an alternative candidate port when a contingent flight hindrance factor happens to the aircraft 100.

[0031] When the route of aircraft 100 is changed to an emergency route to an alternative candidate port by the emergency landing response unit 15, the alternative transportation means information provision unit 16 accesses the transportation information server 220 to obtain transportation information Tri, thereby searching for an alternative transportation means to travel from the alternative candidate port to the vicinity of the destination point. The alternative transportation means information provision unit 16 then provides the passengers of the aircraft 100 with information on alternative transportation means available to travel from the alternative candidate port to the vicinity of the destination point.

[0032] FIG. 1 illustrates the case where the route R1 of the aircraft 100 is changed to an emergency route Re to a nearby available-for-landing port Cp12 that is designated as an alternative candidate port. In this case, the alternative transportation means information provision unit 16 transmits to mobile terminals used by the passengers, for example, information on the ground transportation means 110 from the nearby available-for-landing port Cp12 to a predetermined point Px in the area Ard including the destination point Pd. The ground transportation means 110 is public transportation such as buses, trains, and shared vehicles. In addition to the ground transportation means, information on an alternative flight that can be arranged may be transmitted to the mobile terminals as the information on alternative transportation means.

2. Alternative Candidate Port Determination Process

[0033] The procedure of an alternative candidate port determination process performed by the aircraft management system 1 for the aircraft 100 in flight shown in FIG. 1 is described according to the flowchart shown in FIG. 3. The aircraft management system 1 repeatedly executes the process according to the flowchart shown in FIG. 3 with a predetermined control cycle while the aircraft 100 is flying toward the destination point Pd.

[0034] In step S1 in FIG. 3, the flight condition recognition unit 11 receives flight condition information Fsi transmitted from the aircraft 100 and recognizes the route, current position, and flight speed of the aircraft 100. In the following step S2, the nearby available-for-landing port search unit 12 recognizes a timing at which the aircraft 100 passes each of the check positions Pc11-Pc14 set in the route R1 from the departure point Ps to the destination point Pd of the aircraft 100.

[0035] The loop process of the subsequent steps S3-S11 determines an alternative candidate port to accommodate an emergency landing for each of the check positions Pc11-Pc14 or, if the route of the aircraft 100 is changed, for each new check position after the change. In the following, a check position being processed by steps S4-S8 is referred to as a target check position.

[0036] In step S4, the nearby available-for-landing port search unit 12 refers to the takeoff/landing port DB 211 of the takeoff/landing port management system 210 to search for a nearby available-for-landing port located within the determination threshold distance from the target check position. Then, the nearby available-for-landing port search unit 12 advances the process to step S6 if a takeoff/landing port located within the determination threshold distance from the target check position is extracted, or to step S9 if no takeoff/landing port located within the determination threshold distance from the target check position is extracted. If the route of the aircraft 100 to the destination point has been determined so that a takeoff/landing port is located within the determination threshold distance from each check position, the processes in steps S4 and S5 can be omitted.

[0037] In step S**6**, the nearby available-for-landing port search unit **12** refers to the takeoff/landing port DB **211** to determine whether the extracted takeoff/landing port is able to accept landing of the aircraft **100**. In the following step S**7**, the nearby available-for-landing port search unit **12** advances the process to step S**8** if the extracted takeoff/landing port is able to accept landing (i.e., if a nearby available-for-landing port is extracted), or step S**9** if the extracted takeoff/landing port is not able to accept landing.

[0038] In step S**8**, the alternative candidate port determination unit **13** designates the takeoff/landing port (nearby available-for-landing port) extracted by the nearby available-for-landing port search unit **12** as an alternative candidate port for an emergency landing. In step S**9**, the alternative candidate port determination unit **13** changes the route of the aircraft **100** to a route in which, for every one of the check positions, the nearby available-for-landing port search unit **12** extracts a takeoff/landing port (nearby available-for-landing port) located within the determination threshold distance from the check position and able to accept landing of the aircraft **100**, as described above in reference to FIG. **2**.

[0039] In the following step S**10**, the alternative candidate port determination unit **13** designates the nearby available-for-landing ports extracted for the changed route as alternative candidate ports for an emergency landing. If the alternative candidate port determination unit **13** changes the route of the aircraft **100** by the process in step S**9**, the alternative candidate port determination unit **13** transmits route change information indicating the route change to the aircraft **100** to instruct the aircraft **100** to change its route.

[0040] After the route of the aircraft **100** is changed in step S**9**, the aircraft management system **1** executes the process according to the flowchart in FIG. **3** for the changed route. This makes it possible to further change the route when nearby available-for-landing ports for the changed route are no longer extracted adequately, so as to ensure that there is always some alternative candidate port within the determination threshold distance from the current position of the aircraft **100** flying toward the destination point Pd.

3. Alternative Embodiments

[0041] In the above embodiment, if the aircraft **100** continues to fly to the destination point Pd when a malfunction of the aircraft occurs because the level of the malfunction is less severe than the level at which the emergency landing response unit **15** determines that it is difficult to fly to the destination, the nearby available-for-landing port search unit **12** may change the determination threshold distance for searching for nearby available-for-landing ports according to the level of the malfunction recognized by flight condition recognition unit **11** based on flight condition information Fsi. For example, the higher the level of the malfunction is (the greater the impact on the flight of the aircraft **100** is), the shorter the determination threshold distance may be.

[0042] In the above embodiment, the nearby available-for-landing port search unit **12** may change the determination threshold distance for searching for nearby available-for-landing ports according to the remaining flyable range of the aircraft **100** recognized by the flight condition recognition unit **11**. For example, if the remaining flyable range of the aircraft **100** is sufficiently long, the determination threshold distance may be increased. The remaining flyable range of the aircraft **100** is recognized based on the amount of remaining energy (such as fuel and electricity stored in batteries) to drive the aircraft **100**, weather, etc.

[0043] In the above embodiment, the aircraft management system of the present disclosure is configured by using the aircraft management system **1**, which is a computer system communicating with the aircraft **100**, but the aircraft management system of the present disclosure may be configured to be installed on the aircraft **100**. In this case, the aircraft management system on the aircraft **100** is configured to communicate with the takeoff/landing port management system or a management system placed at each takeoff/landing port to search for nearby available-for-landing ports. Part of the configuration of the aircraft management system **1** may also be configured to be provided on the aircraft **100**.

[0044] FIG. **2** is a schematic diagram illustrating the functional configuration of the aircraft management system **1** divided according to the main processing features, to facilitate understanding of the present invention, but the configuration of the aircraft manager system **1** may be divided in different ways. The processing of each component may be performed by a single hardware unit or by a plurality of hardware units. The processing by each component shown in FIG. **3** may be performed by a single program or by a plurality of programs.

4. Configurations Supported by Above Embodiments

[0045] The above embodiments are examples of the following configurations.

[0046] (Configuration 1) An aircraft management system, comprising: a flight condition recognition unit configured to recognize a flight condition of an aircraft flying a route to a destination point; a nearby available-for-landing port search unit configured to recognize a route passing timing, which is a timing at which the aircraft flies the route, based on a result of recognizing the flight condition of the aircraft by the flight condition recognition unit, and to search for a nearby available-for-landing port, which is a takeoff/landing port located within a predetermined determination threshold distance from the route and able to accept a landing within a predetermined time after the route passing timing; and an alternative candidate port determination unit configured to, if the nearby available-for-landing port is extracted by the nearby available-for-landing port search unit, designate the extracted nearby available-for-landing port as an alternative candidate port for accommodating an emergency landing of the aircraft, or to, if the nearby available-for-landing port is not extracted by the nearby available-for-landing port search unit, change the route of the aircraft to the destination point to a route in which a nearby available-for-landing port is extracted by the nearby available-for-landing port search unit, and then designate the nearby available-for-landing port extracted by the nearby available-for-landing port search unit for the changed route as the alternative candidate port.

[0047] With the aircraft management system in configuration 1, for an aircraft flying a route to a destination point, a route passing timing at which the aircraft flies the route is recognized, and a nearby available-for-landing port is searched for, which is located within a determination threshold distance from the route and able to accept a landing within a predetermined time after the route passing timing. If the nearby available-for-landing port is extracted, the

nearby available-for-landing port is designated as an alternative candidate port for accommodating an emergency landing, or if no nearby available-for-landing port is extracted, the route of the aircraft is changed to a route in which a nearby available-for-landing port is extracted. This ensures that there is always some alternative candidate port for the aircraft in flight, and thus can prevent a situation in which an alternative landing site cannot be found for the aircraft in flight in the event of a malfunction of the aircraft, bad weather, or other contingent circumstances.

[0048] (Configuration 2) The aircraft management system according to configuration 1, wherein the flight condition recognition unit is configured to repeatedly perform a process of recognizing the flight condition of the aircraft during a flight of the aircraft, the nearby available-for-landing port search unit is configured to repeatedly perform a process of searching for a nearby available-for-landing port based on a result of recognizing the flight condition of the aircraft by the flight condition recognition unit, and the alternative candidate port determination unit is configured to repeatedly perform a process of determining the alternative candidate port based on whether or not the nearby available-for-landing port is extracted by the nearby available-for-landing port search unit.

[0049] With the aircraft management system in configuration 2, by repeatedly performing the process of searching for a nearby available-for-landing port as the aircraft flies, the alternative candidate port can be updated in response to changes in the flight condition of the aircraft or in the case where the takeoff/landing port that has been designated as the alternative candidate port becomes unable to accept a landing.

[0050] (Configuration 3) The aircraft management system according to configuration 1 or configuration 2, wherein the flight condition recognition unit is configured to recognize the flight condition including a level of a malfunction occurring in the aircraft, and the nearby available-for-landing port search unit is configured to change the determination threshold distance according to the level of the malfunction occurring in the aircraft recognized by the flight condition recognition unit.

[0051] With the aircraft management system in configuration 3, an alternative candidate port available for an emergency landing can be determined according to the level of a malfunction occurring in the aircraft.

[0052] (Configuration 4) The aircraft management system according to any one of configurations 1 to 3, wherein the flight condition recognition unit is configured to recognize the flight condition including a remaining flyable range of the aircraft, and the nearby available-for-landing port search unit is configured to change the determination threshold distance according to the remaining flyable range of the aircraft recognized by the flight condition recognition unit.

[0053] With the aircraft management system in configuration 4, an alternative candidate port available for an emergency landing can be determined according to the remaining flyable range of the aircraft.

[0054] (Configuration 5) The aircraft management system according to any one of configurations 1 to 4, comprising: a flight hindrance factor recognition unit configured to recognize presence or absence of a flight hindrance factor that hinders a flight of the aircraft to the destination point; and an emergency landing response unit configured to change the route of the aircraft to an emergency route to the alternative candidate port when the presence of the flight hindrance factor is recognized by the flight hindrance factor recognition unit.

[0055] With the aircraft management system in configuration 5, even when a flight hindrance factor of the aircraft occurs, a safe flight can be ensured for the aircraft by changing the route of the aircraft to an emergency route to an alternative candidate port.

[0056] (Configuration 6) The aircraft management system according to any one of configurations 1 to 5, comprising: an alternative transportation means information provision unit configured to provide information on alternative transportation means to travel from the alternative candidate port to a predetermined area in which the destination point is located, if the route of the aircraft is changed to an emergency route by the emergency landing response unit.

[0057] With the aircraft management system in configuration 6, when the aircraft lands at an alternative candidate port different from the original destination point, the use or arrangements of alternative transportation means to travel to the vicinity of the destination point can be supported by providing information on alternative transportation means to mobile terminals used by the passengers of the aircraft or the management system of the transportation company operating the aircraft.

[0058] (Configuration 7) An aircraft management method executed by a computer, comprising: a flight condition recognition step of recognizing a flight condition of an aircraft flying a route to a destination point; a nearby available-for-landing port search step of recognizing a route passing timing, which is a timing at which the aircraft flies the route, based on a result of recognizing the flight condition of the aircraft by the flight condition recognition step, and searching for a nearby available-for-landing port, which is a takeoff/landing port located within a predetermined determination threshold distance from the route and able to accept a landing within a predetermined time after the route passing timing; and an alternative candidate port determination step of, if the nearby available-for-landing port is extracted by the nearby available-for-landing port search step, designating the extracted nearby available-for-landing port as an alternative candidate port for accommodating an emergency landing of the aircraft, or, if the nearby available-for-landing port is not extracted by the nearby available-for-landing port search step, changing the route of the aircraft to the destination point to a route in which a nearby available-for-landing port is extracted by the nearby available-for-landing port search step, and then designating the nearby available-for-landing port extracted by the nearby available-for-landing port search step for the changed route as the alternative candidate port.

[0059] By executing the aircraft management method in configuration 7 by a computer, the same effect as the aircraft management system in configuration 1 can be achieved.

[0060] **1** . . . aircraft management system, **10** . . . processor, **11** . . . flight condition recognition unit, **12** . . . nearby available-for-landing port search unit, **13** . . . alternative

candidate port determination unit, **14** . . . flight hindrance factor recognition unit, **15** . . . emergency landing response unit, **16** . . . alternative transportation means information provision unit, **20** . . . memory, **21** . . . program, **22** . . . flight operation DB, **30** . . . communication unit, **100** . . . aircraft, **110** . . . alternative transportation means, **200** . . . communication network, **210** . . . takeoff/landing port management system, **211** . . . takeoff/landing port DB, **220** . . . transportation information server, **230** . . . weather information server.

1. An aircraft management system, comprising:

a flight condition recognition unit configured to recognize a flight condition of an aircraft flying a route to a destination point;

a nearby available-for-landing port search unit configured to recognize a route passing timing, which is a timing at which the aircraft flies the route, based on a result of recognizing the flight condition of the aircraft by the flight condition recognition unit, and to search for a nearby available-for-landing port, which is a takeoff/landing port located within a predetermined determination threshold distance from the route and able to accept a landing within a predetermined time after the route passing timing; and

an alternative candidate port determination unit configured to, if the nearby available-for-landing port is extracted by the nearby available-for-landing port search unit, designate the extracted nearby available-for-landing port as an alternative candidate port for accommodating an emergency landing of the aircraft, or to, if the nearby available-for-landing port is not extracted by the nearby available-for-landing port search unit, change the route of the aircraft to the destination point to a route in which a nearby available-for-landing port is extracted by the nearby available-for-landing port search unit, and then designate the nearby available-for-landing port extracted by the nearby available-for-landing port search unit for the changed route as the alternative candidate port.

2. The aircraft management system according to claim **1**, wherein

the flight condition recognition unit is configured to repeatedly perform a process of recognizing the flight condition of the aircraft during a flight of the aircraft,

the nearby available-for-landing port search unit is configured to repeatedly perform a process of searching for a nearby available-for-landing port based on a result of recognizing the flight condition of the aircraft by the flight condition recognition unit, and

the alternative candidate port determination unit is configured to repeatedly perform a process of determining the alternative candidate port based on whether or not the nearby available-for-landing port is extracted by the nearby available-for-landing port search unit.

3. The aircraft management system according to claim **1**, wherein

the flight condition recognition unit is configured to recognize the flight condition including a level of a malfunction occurring in the aircraft, and

the nearby available-for-landing port search unit is configured to change the determination threshold distance according to the level of the malfunction occurring in the aircraft recognized by the flight condition recognition unit.

4. The aircraft management system according to claim **1**, wherein

the flight condition recognition unit is configured to recognize the flight condition including a remaining flyable range of the aircraft, and

the nearby available-for-landing port search unit is configured to change the determination threshold distance according to the remaining flyable range of the aircraft recognized by the flight condition recognition unit.

5. The aircraft management system according to claim **1**, comprising:

a flight hindrance factor recognition unit configured to recognize presence or absence of a flight hindrance factor that hinders a flight of the aircraft to the destination point; and

an emergency landing response unit configured to change the route of the aircraft to an emergency route to the alternative candidate port when the presence of the flight hindrance factor is recognized by the flight hindrance factor recognition unit.

6. The aircraft management system according to claim **5**, comprising

an alternative transportation means information provision unit configured to provide information on alternative transportation means to travel from the alternative candidate port to a predetermined area in which the destination point is located, if the route of the aircraft is changed to the emergency route by the emergency landing response unit.

7. An aircraft management method executed by a computer, comprising:

a flight condition recognition step of recognizing a flight condition of an aircraft flying a route to a destination point;

a nearby available-for-landing port search step of recognizing a route passing timing, which is a timing at which the aircraft flies the route, based on a result of recognizing the flight condition of the aircraft by the flight condition recognition step, and searching for a nearby available-for-landing port, which is a takeoff/landing port located within a predetermined determination threshold distance from the route and able to accept a landing within a predetermined time after the route passing timing; and

an alternative candidate port determination step of, if the nearby available-for-landing port is extracted by the nearby available-for-landing port search step, designating the extracted nearby available-for-landing port as an alternative candidate port for accommodating an emergency landing of the aircraft, or, if the nearby available-for-landing port is not extracted by the nearby available-for-landing port search step, changing the route of the aircraft to the destination point to a route in which a nearby available-for-landing port is extracted by the nearby available-for-landing port search step, and then designating the nearby available-for-landing port extracted by the nearby available-for-landing port search step for the changed route as the alternative candidate port.

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