(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 May 2020 (22.05.2020)

WIPO | PCT

(10) International Publication Number
WO 2020/099366 A1

(51) International Patent Classification:
G06Q 10/00 (2012.01) *G06Q 10/06* (2012.01)
G06Q 10/08 (2012.01) *G06Q 50/28* (2012.01)

(21) International Application Number:
PCT/EP2019/080948

(22) International Filing Date:
12 November 2019 (12.11.2019)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10 2018 219 643.5
16 November 2018 (16.11.2018) DE

(71) Applicants: **ZF FRIEDRICHSHAFEN AG** [DE/DE]; Löwentaler Straße 20, 88046 Friedrichshafen (DE). **ZF PADOVA SRL.** [IT/IT]; Via Penghe, 48, 35030 Caselle di Selvazzano (PD) (IT).

(72) Inventors: **HAGENACKER, Martin**; Hinterhof 1/1, 88048 Friedrichshafen (DE). **D'INCAU, Gianni**; Via Chini, 2/3, 38123 Trento (IT).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(54) Title: MAINTENANCE SYSTEM FOR CONTROLLING MAINTENANCE OF A VESSEL

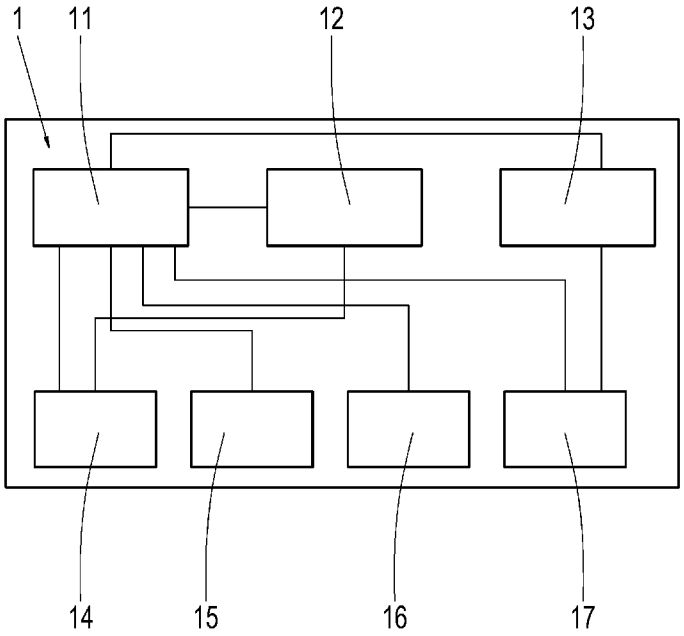

Fig. 1

(57) Abstract: Provided is a maintenance system for controlling maintenance of a vessel. The system comprising a storage unit for storing vessel information data comprising at least technical specification data of the vessel to be controlled by the system, marina information data comprising at least map data of a marina where the vessel is located, and service provider data comprising at least information on provided services, technical specifications, and corresponding maintenance area information for each of a plurality of service providers, respectively, and a control unit configured to determine at least one service provider among the plurality of service providers suitable for maintain the vessel based on the vessel information data and the service provider data, and output control information to the vessel for maneuvering the vessel to a maintenance area of one of the at least one determined service provider based on the marina information data and the maintenance area information.

WO 2020/099366 A1

[Continued on next page]

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

MAINTENANCE SYSTEM FOR CONTROLLING MAINTENANCE OF A VESSEL

Technical field

The present invention is directed to maintenance system and method for controlling maintenance of a vessel.

Technical Background

US 2018/0202822 A1 is directed to manage maintenance of autonomous vehicles in general but preferably of autonomous cars. A system according US 2018/0202822 is configured to detect, by the autonomous vehicle, a need for service; send, over a network interface of the autonomous vehicle, a request for service; determine a rendezvous location at which the service will be received; maneuver, by the autonomous vehicle, to the rendezvous location; receive, by the autonomous vehicle over a network, an authentication code; in response to receiving the authentication code, enable, by the autonomous vehicle, access to components of the autonomous vehicle; determine, by the autonomous vehicle, that the service is complete; and transmit, by the autonomous vehicle, an indication that the service is complete.

However, as outlined above, US 2018/0202822 A1 is directed to a system for managing maintenance of autonomous vehicles in general. In the field of vessels (water vehicles) special requirements and burdens result due to a wide range of different specifications and structures, e.g. different sizes of boats, suitability of water routes and so on.

Object of the invention

In view of the above described problems it is an object of the present invention to provide both, a maintenance system and a method, suitable for controlling maintenance of a vessel.

This object is accomplished by a maintenance system comprising features according to claim 1 and a method comprising steps according to claim 13.

More specifically, the maintenance system for controlling maintenance of a vessel comprises a storage unit and a control unit. The system may comprise one or more computers. A computer is a device that can be instructed to carry out sequences of arithmetic or logical operations automatically via computer programming. The computer can follow generalized sets of operations, i.e. programs. The computer comprises hardware and/or software. The term hardware covers all of those parts of the computer that are tangible physical objects, e.g. the storage unit. The software (computer software) is a collection of data or computer instructions that tell the computer how to work, in contrast to the physical hardware from which the system is built. The computer software is all information processed by computer systems, programs and data. Computer software includes computer programs, libraries and related non-executable data, such as online documentation or digital media. The control unit may be part of the hardware and/or the software. The computer comprises a central processing unit (CPU) configured to manipulate data by performing computations, i.e. executing programs. The CPU may for example be configured according to Von Neumann architecture or Harvard architecture. In the Von Neumann architecture, the CPU consists of two main parts, i.e. a control unit and an arithmetic logic unit (ALU). The former controls the flow of data between the CPU and memory, while the latter performs arithmetic and logical operations on data. The Harvard architecture is a computer architecture with physically separate storage and signal pathways for instructions and data. The system may further be part of a cloud. Cloud computing means shared pools of configurable computer system resources and higher-level services that can be connected to each other, e.g. via Internet. The cloud computing relies on sharing of resources of the computers forming part of the cloud.

The storage unit is configured to store vessel information data, marina information data, and service provider data. The storage unit may be a data storage which is configured to record (store) of data in a storage medium. More specifically, the storage unit may be a computer data storage (memory). The storage unit may comprise a volatile or non-volatile memory. The non-volatile memory retains, in contrast to the volatile memory, stored information even if not constantly supplied with electric power. However, the storage unit may also request information stored in the cloud (see above) and may therefore also be formed by software.

The vessel information data comprises at least technical specification data of the vessel to be controlled by the system, such as height, width and/or draught. The marina information data comprises at least map data of a marina where the vessel is located. The service provider data comprises at least information on provided services, technical specifications, and corresponding maintenance area information for each of a plurality of service providers, respectively. The term data generally relates to a sequence of bits comprising information usable and readable by respective software. The provided services define maintenance services carried out, i.e. offered, by the service provider, such as washing the vessel, refill a refrigerant, refueling, recharging, repairing operations and/or putting the vessel out of water. The technical specifications relate to tools, instruments, and/or know how of the service provider for the respective offered/provided services. The maintenance area information is not only the concrete place, e.g. expressed in coordinates, where the service provider provides the services but may also include dimension of berth used by the service provider.

The control unit is configured to determine at least one service provider among the plurality of service providers suitable for maintaining the vessel based on the vessel information data and the service provider data. More specifically, the control unit may be configured to compare the technical specification data of the vessel with the technical specifications of the plurality of service providers and, if these data match with each other or a compatible specification such that the two entities can interact to fulfill the service request, determine, i.e. select, at least one suitable service provider.

Furthermore, the control unit is configured to output control information to the vessel for maneuvering the vessel to a maintenance area of one of the at least one determined service provider based on the marina information data and the maintenance area information. The control information may include information for directly and/or indirectly control propulsion and/or steering control units of the vessel. Furthermore, the control information may also be information to be used by a navigational system of the vessel. The vessel may be configured to autonomously navigate to the mainte-

nance area based on the control information. Computations necessary for autonomously navigating may be carried out by the vessel itself and/or by the system. For determining a current state of the vessel, various sensors may be provided at the vessel like for example a filling level sensor for the tank and/or the battery, a camera, a Lidar sensor, a Radar sensor, and a GPS sensor. The sensors may transmit the sensor data directly or indirectly via the vessel to the system. The vessel may also be completely remotely controlled by the system.

Lidar (light detection and ranging or laser detection and ranging) is a surveying method that measures distance to a target by illuminating the target with pulsed laser light and measuring the reflected pulses with a sensor. Differences in laser return times and wavelengths can then be used to make digital 3-D representations of the target.

Radar (radio detection and ranging or radio direction and ranging) is an object-detection system that uses radio waves to determine range, angle, or velocity of objects. It can be used to detect aircraft, ships, spacecraft, guided missiles, motor vehicles, weather formations, and/or terrain. A radar system consists of a transmitter producing electromagnetic waves in radio or microwaves domain, a transmitting antenna, a receiving antenna (the same antenna may be used for transmitting and receiving), a receiver and optionally a processor to determine properties of detected object(s). Radio waves (pulsed or continuous) from the transmitter reflect off the object and return to the receiver, giving information about the object's location and speed.

GPS (Global Positioning System) is a satellite-based radionavigation system. It is a global navigation satellite system that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. In other words, the GPS sensor allows to determine a position of the vessel and may be matched with the map data of the marina.

The technical specification data of the vessel may comprise at least one of dimensions of the vessel, positional information of connectors of the vessel, fuel type of the vessel, and tank size of the vessel. Connectors of the vessel may comprise at least

one of a fuel port connected to a tank of the vessel, a port for transmitting electrical energy to a batterie of the vessel, wherein the battery may be used for storing and supplying electrical power to an electrical motor and/or a board network of the vessel, and other connectors like for example a water port.

The vessel information data may further comprise technical status information of the vessel. The technical status information of the vessel may comprise at least one of a filling level of a fuel tank of the vessel, a charging state of a battery of the vessel, a filling level of a water tank of the vessel, and sensor data. The sensor data preferably includes at least one of camera data, light detection and ranging data, radio detection and ranging data, and global positioning system data (see above).

The system may further comprise a vessel interface for transmitting control information from the control unit to the vessel. Preferably, the vessel interface may also be configured to receive the technical status information of the vessel. The interface is a shared boundary between two units across which two or more separate components for example of a computer system exchange information. The exchange can be between software, computer hardware, peripheral devices such as sensors, humans and combinations of these. The interface may by a hardware interface and/or a software interface. Hardware interface exist for example in data buses, storage devices, other I/O devices, etc. A hardware interface is described by the mechanical, electrical and logical signals at the interface and a protocol for sequencing them (sometimes called signaling). The hardware interface may be a standard interface, such as SCSI, decouples the design and introduction of computing hardware, such as I/O devices, from the design and introduction of other components of a computing system, thereby allowing users and manufacturers flexibility in the implementation of computing systems. The Hardware interface can be parallel with several electrical connections carrying parts of data simultaneously, or serial where data are sent one bit at a time. A software interface may refer to a wide range of different types of interface at different levels. That is, an operating system may interface with pieces of hardware. Applications or programs running on the operating system may need to interact via data streams, filters, and pipelines; and in object-oriented programs, objects within an ap-

plication may need to interact via methods. The interface may be realized as application, web application and/or web portal.

The marina data may further comprise at least one of maximum dimensions for vessels in berths, navigational rules of the marina, and routes of the marina. The term marina, i.e. port, includes marinas for all types of vessels and is not limited to a specific type thereof, but preferably the marina is suitable for yachts and sport boats. A berth is a designated location in the marina used for mooring vessels when they are not at sea. Berths are designated by the management of a facility, e.g. a port authority or harbor master. Vessels are assigned to berths by these authorities. Berths may provide a vertical front which allows safe and secure mooring that can then facilitate unloading and/or loading of cargo or people from vessels. The berth may be a solid structure berth and/or an open structure berth. In the solid structure berth, a solid vertical structure is created to contain fill material which is brought all the way to the structure. The solid structure berth can be constructed using either a gravity wall structure where the front wall of the structure uses its own weight and friction to contain the fill or with a sheet pile structure where an anchoring plate is used to contain the weight of the fill dirt. The open structure berth feature structures supported by piles set slightly off shore from the natural extent of land or farthest extent of fill dirt. This style of berth can offer more flexibility in specificity of construction. Preferably the berth is located substantially alongside pontoons and accessed by hinged bridges (in tidal locations) to shore. The berths may be built with modular capabilities to adjust berth dimensions for various shapes and sizes of recreational craft. Preferably equipment for keeping vessels out of water is provided. The marina may also include floating docks. The marina may comprise a plurality of berth and (water) routes connecting the berths to each other and/or connecting the marina to sea, ocean, lake and/or river. The marina may at least one maintenance area for refueling, washing and/or repair vessels. The marina may further include maintenance areas comprising slipways (or vessel ramps) for transferring a trailered boat into water and/or a boat hoist (a traveling crane). The marina may also include maintenance areas comprising both in- and out-of-water boat storage. In the maintenance areas and normal berths the vessels may be moored on buoys, on fixed and/or floating walkways which may be tied to an anchoring piling by a roller or ring mechanism (floating docks, pon-

toons). The marina may comprise locks to maintain a water level substantially constant for several hours before and after low water. All equipment in the maintenance areas may be controlled, preferably remotely, by the system. Therefore, several sensors and actuators in the maintenance areas may be connected wire or wireless to the system. The controlling of the equipment may also be based on sensor data (see above) send from the vessel to be maintained to the system, like for example the GPS information.

The system may further comprise a specification input interface for inputting at least one of the technical specification data and the marina information data. The description relating to the vessel interface applies also the specification input interface.

The service provider data may further comprise an available quantity and/or time data corresponding to the maintenance service information. In other words, both, the available quantity and the time data, corresponds to the maintenance service information. When the service provider data includes the available quantity and/or the time data determination of the at least one service provider can further be enhanced.

The system may further comprise a service provider interface for receiving the service provider data. The description relating to the vessel interface applies also the service provider interface.

The system may further comprise a customer's interface for receiving a customer's request for a maintenance service and inputting the requested maintenance service to the control unit. The control unit may further be configured to determine the at least one service provider also based on the requested maintenance service. The description relating to the vessel interface applies also the customer's interface.

Preferably the customer's interface is further configured to filter the maintenance service information based on at least one of the vessel information data, the service provider data, and the marina data, and output the filtered maintenance service information to the customer. The filtering may be carried out as follows: In a first step all service providers are sorted out which do not have the technical specifications need-

ed for carrying out the requested service. In a second step the maintenance area information may be taken into account such that under the remaining service providers those are sorted out, which do not have a berth with needed dimension for the vessel. In a third step the remaining suitable service providers may be sorted based on offered prices for the respective service, as well as a distance from a current location of the vessel to the respective maintenance area. However, it is also possible to change an order of the steps and the invention is not limited to the order as outlined above.

The system may further comprise a digital wallet unit which is configured to store customer credit data and executing a payment operation based on the service provider data and the customer credit data. The description relating to the storage unit also applies to the digital wallet unit. A digital wallet refers to an electronic device or online service that allows the customer to make electronic transactions. This can include purchasing items on-line and/or at a store with a computer and/or a smartphone. Customer's bank account may also be linked to the digital wallet. The customer might also have his/her driver's license, health care card, loyalty card(s) and/or other ID documents stored in the digital wallet unit allowing to identify the customer. Credentials may be passed to a merchant's terminal for example of the service provider wirelessly via a customer's smartphone comprising part of the customer's interface and near field communication (NFC). The digital wallet unit may also be configured to verify identity (see above) of the customer when the customer selects a service to higher safety of the system. The digital wallet unit may also be configured as a cryptocurrency wallet which is a digital wallet where private keys are stored for cryptocurrencies.

Furthermore, a method for controlling maintenance of a vessel is provided. The method comprises a step of determining and a step of outputting. The step of determining comprises determining at least one service provider among a plurality of service providers suitable for maintaining the vessel based on vessel information data and service provider data. The step of outputting comprises outputting control information to the vessel for maneuvering the vessel to a maintenance area of one of the at least one determined service provider based on marina information data and

maintenance area information. The vessel information data comprises at least technical specification data of the vessel to be controlled by the system. The marina information data comprises at least map data of a marina where the vessel is located. The service provider data comprising at least information on provided services, technical specifications, and corresponding maintenance area information for each of the plurality of service providers, respectively. The descriptions made above in connection with the system also apply to the method.

The method may further comprise a step of executing a payment operation based on the service provider data and a customer credit data stored in a digital wallet unit. The step of executing the payment operation is preferably based on a blockchain technology. A blockchain is a growing list of records, called blocks, which are linked using cryptography. Each block contains a cryptographic hash of a previous block, a timestamp, and transaction data (generally represented as a merkle tree root hash). Through its design the blockchain is resistant to modification of the data contained therein. The blockchain is configured as an open, distributed ledger that can record transactions between two parties and in a verifiable and permanent way. For use as a distributed ledger, a blockchain is typically managed by a peer-to-peer network collectively adhering to a protocol for inter-node communication and validating new blocks. Once recorded, the data in any given block cannot be altered retroactively without alteration of all subsequent blocks, which requires consensus of the network majority. Blockchain was invented by Satoshi Nakamoto in 2008 to serve as the public transaction ledger of the cryptocurrency bitcoin.

Brief description of figures

Figure 1 shows one embodiment of a maintenance system for controlling maintenance of a vessel.

Figure 2 shows one embodiment of a method for controlling maintenance of a vessel.

Detailed description of embodiments

In the following a maintenance system for controlling maintenance of a vessel according one embodiment of the present invention will be described with reference to figure 1.

The maintenance system 1 comprises a storage unit 11, a control unit 12, a digital wallet unit 13, a vessel interface 14, a specification input interface 15, a service provider interface 16, and a customer's interface 17.

The storage unit 11 is connected to the digital wallet unit 13, the vessel interface 14, the specification input interface 15, the service provider interface 16, and the customer's interface 17 such that data can be transferred from and to the storage unit, respectively. The storage unit 11 stores vessel information data, marina information data, and service provider data.

The vessel information data comprises technical specification data and technical status information of the vessel to be controlled by the system. The technical specification data of the vessel comprises dimensions of the vessel, positional information of connectors of the vessel, fuel type of the vessel, and tank size of the vessel. The technical status information comprises a filling level of a fuel tank of the vessel, a charging state of a battery of the vessel, a filling level of a water tank of the vessel, content of a fridge of the vessel, and sensor data. The sensor data includes camera data, light detection and ranging data, radio detection and ranging data, global positioning system data, and inside temperature of the vessel.

The marina information data comprises map data of a marina where the vessel is located, maximum dimensions for vessels in berths in the marina, navigational rules of the marina, and routes of the marina.

The service provider data comprises information on provided services, technical specifications, and corresponding maintenance area information for each of a plurality of service providers, respectively. The service provider data further comprises an available quantity and time data corresponding to the maintenance service information.

The specification input interface 15 is configured to receive and input, i.e. transmit, the technical specification data and the marina information data to the storage unit 11. In this embodiment, the specification input interface 15 is provided as a web portal. The service provider interface 16 is configured to receive the service provider data and transmit it to the storage unit 11. In this embodiment, the service provider interface 16 is provided as a web application.

The vessel interface 14 is configured to transmit control information from the control unit 12 to the vessel. Therefore, the vessel interface 14 is connected not only to the storage unit 11 but also to the control unit 12. The vessel interface 14 is configured to receive the technical status information (see above) of the vessel to be controlled. The technical status information is then transmitted to the control unit 12 and the storage unit 11. The storage unit 11 stores the technical status information and assigns it to other information corresponding to the respective vessel. In other words, the technical status information forms part of the vessel information data and is therefore stored together with the technical specification data also forming part of the vessel information data. The control unit 12 is then configured to request this information from the storage unit 11 and, in case of real time controlling the vessel, directly receiving the information from the vessel via the vessel interface 14. But the storage unit 11 is also configured to assign the technical status information received from the vessel via the vessel interface 14 to the marina information data and the service provider data.

The control unit 12 is configured to request and receive all these data from the storage unit 11 and process these data. The control unit 12 is configured to determine at least one service provider among the plurality of service providers suitable for maintain the vessel based on the vessel information data and the service provider data stored in the storage unit 11. More specifically, the control unit 12 requests the vessel information data and the service provider data from the storage unit 11. As outlined above, the vessel information data comprises the technical status information of the vessel. The technical status information, comprising among other the charging state of the battery of the vessel, are analyzed by the control unit. In case the charging

state of the battery falls below a predetermined minimum the control unit determines a need for charging the battery. The control unit therefore analyses the service provider data comprising the information on provided services. The control unit matches the service provider and the vessel based on the information on provided services and the needed service. This matching is carried out by the control unit for all information included in the technical status information, respectively. The control unit thereby also takes into account the technical specification data of the vessel to determine if the service provider has the respective equipment to carry out the needed service. Furthermore, also the marina data is considered since it might be possible that a service has the equipment to carry out the needed service but water routes to reach the respective maintenance area are not suitable for the vessel. In conclusion, the control unit 12 is configured to filter the maintenance service information based on at least one of the vessel information data, the service provider data, and the marina data. Thus, a list of service providers results which are suitable to carry out the needed services.

This filtered list is then displayed, i.e. output, in a prioritized manner via the customer's interface 17 to the customer. The customer's interface 17 is therefore connected to the storage unit 11 such that it can transmit data to and receive data from the storage unit 11. The customer's interface 17 is realized a s web application. The customer is then able to select a service and a respective service provider from the list. The list prioritized at a first level based on a price offered by the service providers, respectively. At a second level, if the price of two or more service providers is identically for the same service, the list prioritized based on a distance from the location of the vessel to the respective maintenance area. The customer's interface 17 is further configured to receive a customer's request for a maintenance service and inputting the requested maintenance service to the control unit 12. In conclusion, the control unit 12 is also configured to determine the at least one service provider based on the requested maintenance service.

The control unit 12 is further configured to output control information to the vessel for maneuvering the vessel to a maintenance area of one of the at least one determined service provider based on the marina information data and the maintenance area

information. More specifically, as outlined above, the storage unit 11 is configured to assign the vessel information with the marina information data and the service provider data. When the control unit 12 has matched a needed service of the vessel with a suitable service provider, the control unit 12 is then configured to determine, based on the service provider data, the maintenance area where the service provider carries out the needed service. Based on this information and the marina information data the control unit 12 can determine a suitable route for the vessel to the maintenance area.

The vessel therefore comprises a vessel maneuvering system. The vessel maneuvering comprises a navigational system, a processor, a storage, and propulsion and steering control units connected to respective actuators via CAN bus (Controller Area Network bus). CAN is a multi-master serial bus standard for connecting Electronic Control Units (ECUs) also known as nodes. Two or more nodes are required on the CAN network to communicate. All nodes are connected to each other through a two wire bus. The wires are a twisted pair with a 120 Ω (nominal) characteristic impedance.

In the embodiment the vessel is an autonomous vessel which is configured to maneuver to the maintenance area based on GPS data received from the system 1, i.e. from the control unit 12 via the vessel interface 14, by use of its own sensors.

After the service is carried out by the service provider, the system receives a notification from the service provider. The system 1 is configured to maneuver the vessel back to its initial position in the same manner as outlined above.

The system 1 is configured to output via the customer's interface 17 a current state of maintenance to the customer.

The system 1 further comprises the digital wallet unit 13. The digital wallet unit 13 is configured to store customer credit data, i.e. uses a part of the storage unit 11, and execute a payment operation based on the service provider data and the customer credit data. More specifically, as outlined above, the service data comprises prizes

for offered services. When the customer choses a service from the output list, the customer's interface 17 is configured to transmit this information to the digital wallet unit 13. The customer's interface 17 is thus connected to the digital wallet unit 13 in such a way that data can least be transmitted to from the customer's interface 17 to the digital wallet unit 13. Furthermore, the digital wallet unit 13 is configured to output confirmation of payment via the customer's interface 17. The customer's interface 17 is thus connected to the digital wallet unit 13 in such a way that data can transmitted to and received from the digital wallet unit 13. The digital wallet unit 13 subtracts the prize for the requested service from the stored customer's credit data and thus executes a payment operation based on the service provider data and the customer credit data.

The whole maintenance operation will now be discribed in detail with reference to Figure 2 showing one embodiment of a method for controlling maintenance of a vessel.

The method for controlling maintenance of the vessel comprises a first step S1 of determining at least one service provider among a plurality of service providers suitable for maintaining the vessel based on vessel information data and service provider data in the manner as outlined above. More specifically, in the first step S1, the customer orders a service and selects a service provider from the list generated, by the control unit 12, as outlined above. The ordering is accomplished by using the customer's interface 17, i.e. the customer uses a web application to request a service in the first step S1.

In a second step S2 a contract between the customer and the service provider is closed using the digital wallet unit 13. That is, the second step S2 comprises executing a payment operation based on the service provider data and the customer's credit data stored in the digital wallet unit 13 as described above. The second step of executing the payment operation is based on a blockchain technology such that in the storage unit 11 a respective blockchain is stored which is continuously updated by the digital wallet unit 13.

In a third step S3, when a time for carrying out the requested service is due, the system, i.e. the control unit 12 and the vessel interface 14, outputs control information to the vessel for maneuvering the vessel to the respective maintenance area in the manner as described above. During this third step S3 the vessel uses its autonomous docking function for setting off/departure at the berth and landing at the maintenance area. Cast-off and/or undocking may also be in the responsibility of the service provider and can be done manually by the staff of the service provider, if corresponding automatic or autonomous devices and functions are not available.

In a fourth step S4, when the vessel has reached and landed at the maintenance area, the requested service is executed by the service provider. The service provider inputs a current state of maintenance to the system.

In a fifth step S5, the system moves the vessel back to the berth. The berth is again using its autonomous docking function. The service provider secures the vessel at the berth.

In a sixth step S6 a confirmation/feedback, that the request is completely, is sent via the customer's interface 17 (web application) to the customer. Furthermore, the customer is able to choose an option for regularly repeating the request, i.e. the maintenance operation.

Reference signs

1	maintenance system
11	storage unit
12	control unit
13	digital wallet unit
14	vessel interface
15	specification input interface
16	service provider interface
17	customer's interface
S1	step of determining suitable service provider
S2	step of paying
S3	step of outputting control information
S4	step of executing service
S5	step of controlling back vessel (outputting control information)
S6	step of outputting confirmation

Claims

1. Maintenance system (1) for controlling maintenance of a vessel, the system (1) comprising:

a storage unit (11) for storing

vessel information data comprising at least technical specification data of the vessel to be controlled by the system,

marina information data comprising at least map data of a marina where the vessel is located, and

service provider data comprising at least information on provided services, technical specifications, and corresponding maintenance area information for each of a plurality of service providers, respectively, and

a control unit (12) configured to

determine at least one service provider among the plurality of service providers suitable for maintain the vessel based on the vessel information data and the service provider data, and

output control information to the vessel for maneuvering the vessel to a maintenance area of one of the at least one determined service provider based on the marina information data and the maintenance area information.

2. Maintenance system (1) according to claim 1, wherein the technical specification data of the vessel comprising at least one of dimensions of the vessel, positional information of connectors of the vessel, fuel type of the vessel, and tank size of the vessel.

3. Maintenance system (1) according to claim 1 or 2, wherein the vessel information data further comprises technical status information of the vessel, the technical status information of the vessel comprising at least one of a filling level of a fuel tank of the vessel, a charging state of a battery of the vessel, a filling level of a water tank of the vessel, and sensor data, the sensor data preferably including at least one of camera data, light detection and ranging data, radio detection and ranging data, and global positioning system (1) data.

4. Maintenance system (1) according to claim anyone of claims 1 to 3, further comprising a vessel interface (14) for transmitting control information from the control unit (12) to the vessel.

5. Maintenance system (1) according to claim 4, when dependent on claim 3, wherein the vessel interface (14) is configured to receive the technical status information of the vessel.

6. Maintenance system (1) according to anyone of the preceding claims, wherein the marina data further comprises at least one of maximum dimensions for vessels in berths, navigational rules of the marina, and routes of the marina.

7. Maintenance system (1) according to anyone of the preceding claims, further comprising a specification input interface (15) for inputting at least one of the technical specification data and the marina information data.

8. Maintenance system (1) according to anyone of the preceding claims, wherein the service provider data further comprises an available quantity and/or time data corresponding to the maintenance service information.

9. Maintenance system (1) according to anyone of the preceding claims, further comprising a service provider interface (16) for receiving the service provider data.

10. Maintenance system (1) according to anyone of the preceding claims, further comprising a customer's interface (17) for receiving a customer's request for a maintenance service and inputting the requested maintenance service to the control unit (12),

wherein the control unit (12) is further configured to determine the at least one service provider also based on the requested maintenance service.

11. Maintenance system (1) according to claim 10, wherein the customer's interface (17) is further configured to:

filter the maintenance service information based on at least one of the vessel information data, the service provider data, and the marina data, and

output the filtered maintenance service information to the customer.

12. Maintenance system (1) according to anyone of the preceding claims, wherein the system (1) further comprises a digital wallet unit (13) which is configured to store customer credit data and executing a payment operation based on the service provider data and the customer credit data.

13. Method for controlling maintenance of a vessel, the method comprising steps of:

determining (S1) at least one service provider among a plurality of service providers suitable for maintaining the vessel based on vessel information data and service provider data, and

outputting (S3) control information to the vessel for maneuvering the vessel to a maintenance area of one of the at least one determined service provider based on marina information data and maintenance area information,

wherein

the vessel information data comprises at least technical specification data of the vessel to be controlled by the system,

the marina information data comprises at least map data of a marina where the vessel is located, and

the service provider data comprising at least information on provided services, technical specifications, and corresponding maintenance area information for each of the plurality of service providers, respectively.

14. Method according to claim 13, further comprising a step of executing (S2) a payment operation based on the service provider data and a customer credit data stored in a digital wallet unit (13).

15. Method according to claim 14, wherein the step of executing (S2) the payment operation is based on a blockchain technology.

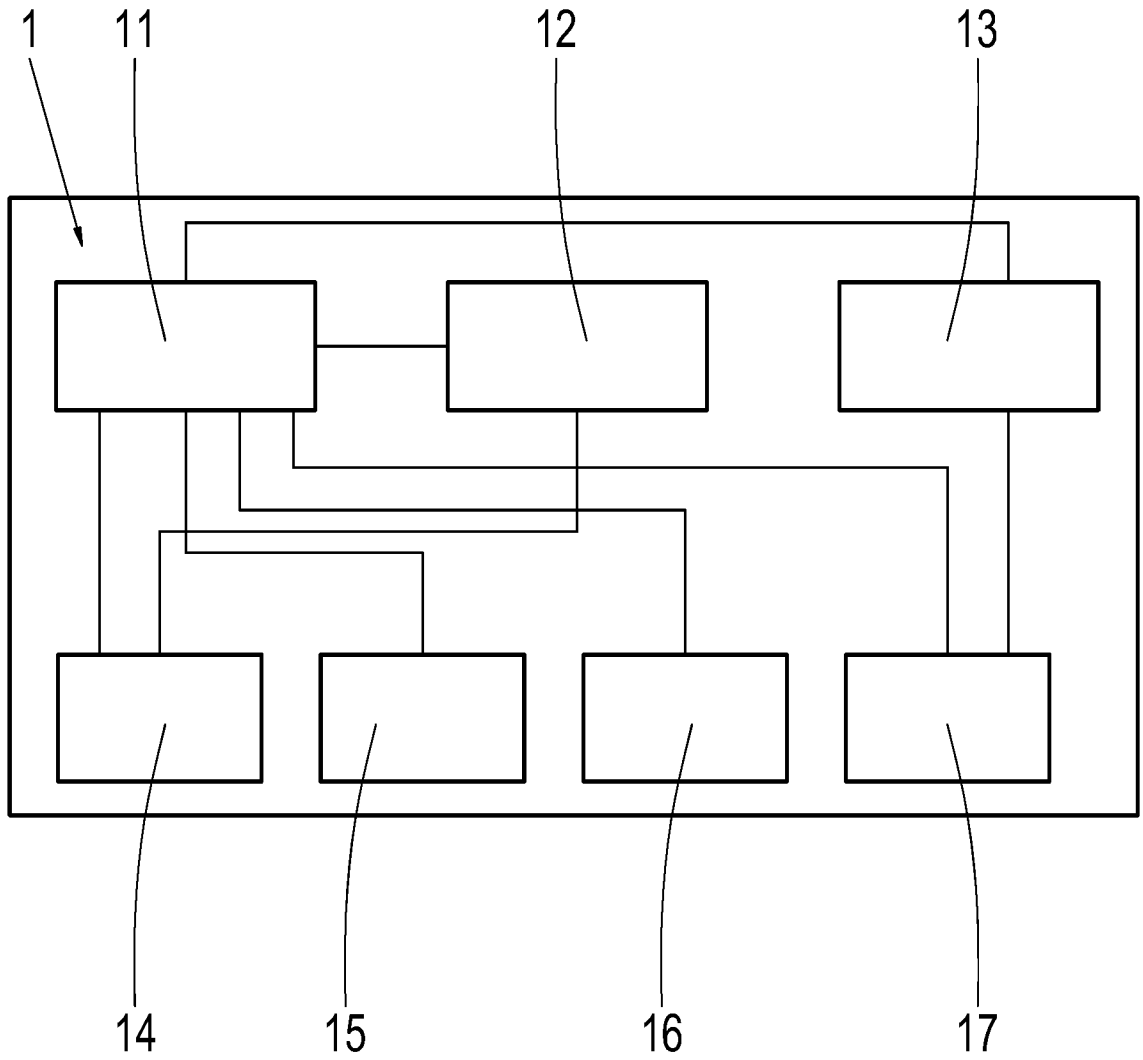

Fig. 1

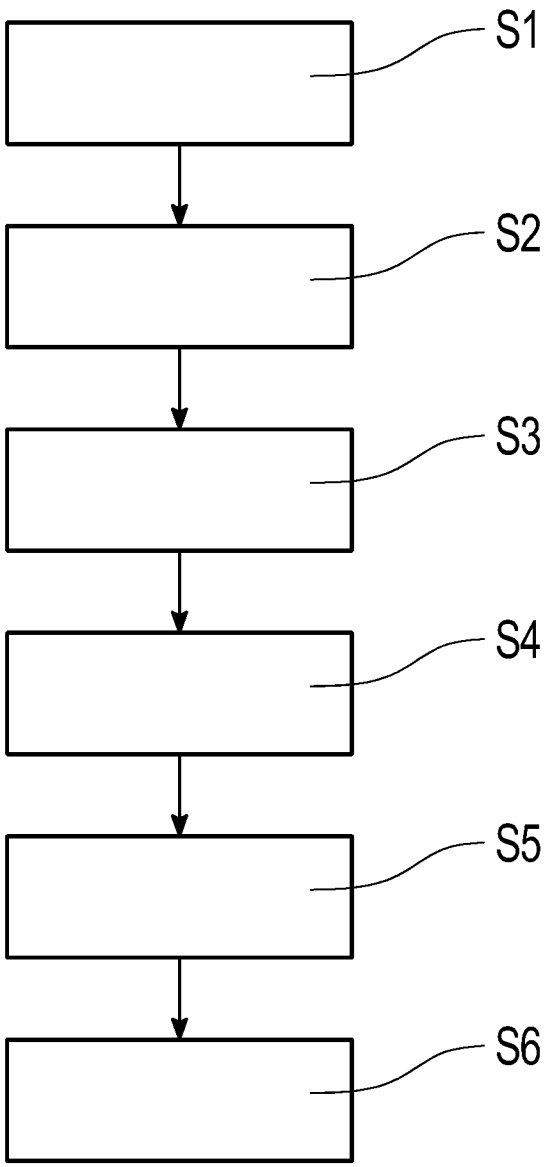

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/080948

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06Q10/00 G06Q10/08 G06Q10/06 G06Q50/28
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 3 336 777 A1 (PALANTIR TECHNOLOGIES INC [US]) 20 June 2018 (2018-06-20) abstract paragraph [0001] - paragraph [0004] paragraph [0050] - paragraph [0055] paragraph [0070] - paragraph [0071] paragraph [0098] - paragraph [0102] paragraph [0139] - paragraph [0142] figures 2,13 -----	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 December 2019	02/01/2020

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Härdeman, David

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2019/080948

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3336777 A1	20-06-2018	EP 3336777 A1	20-06-2018
		US 2018173217 A1	21-06-2018