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(54) **UNMANNED MACHINE SYNCHRONIZATION USING ROBOTIC SENSING**

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(51) **Int. Cl.**

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G08G 5/55	(2025.01)
G08G 5/57	(2025.01)

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CPC ***G08G 5/56*** (2025.01); ***G08G 5/21*** (2025.01); ***G08G 5/55*** (2025.01); ***G08G 5/57*** (2025.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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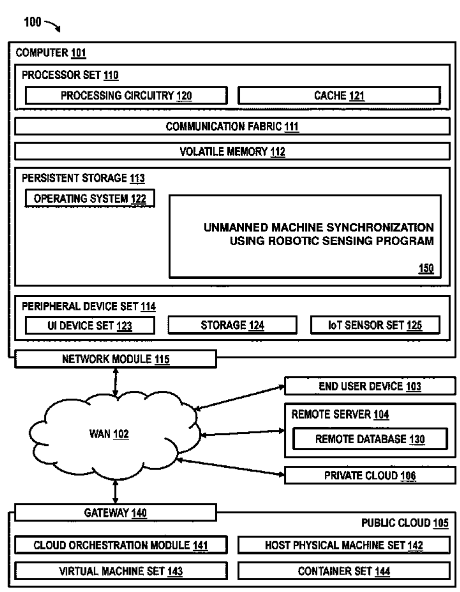
(57) **ABSTRACT**

The present inventive concept provides for a method of unmanned machine synchronization using robotic sensing. The method includes generating at least one physical signal in the vicinity of at least one unmanned machine. The at least one generated physical signal is received by the at least one unmanned machine. At least one task is performed by the at least one unmanned machine based on the at least one received generated physical signal.

20 Claims, 3 Drawing Sheets



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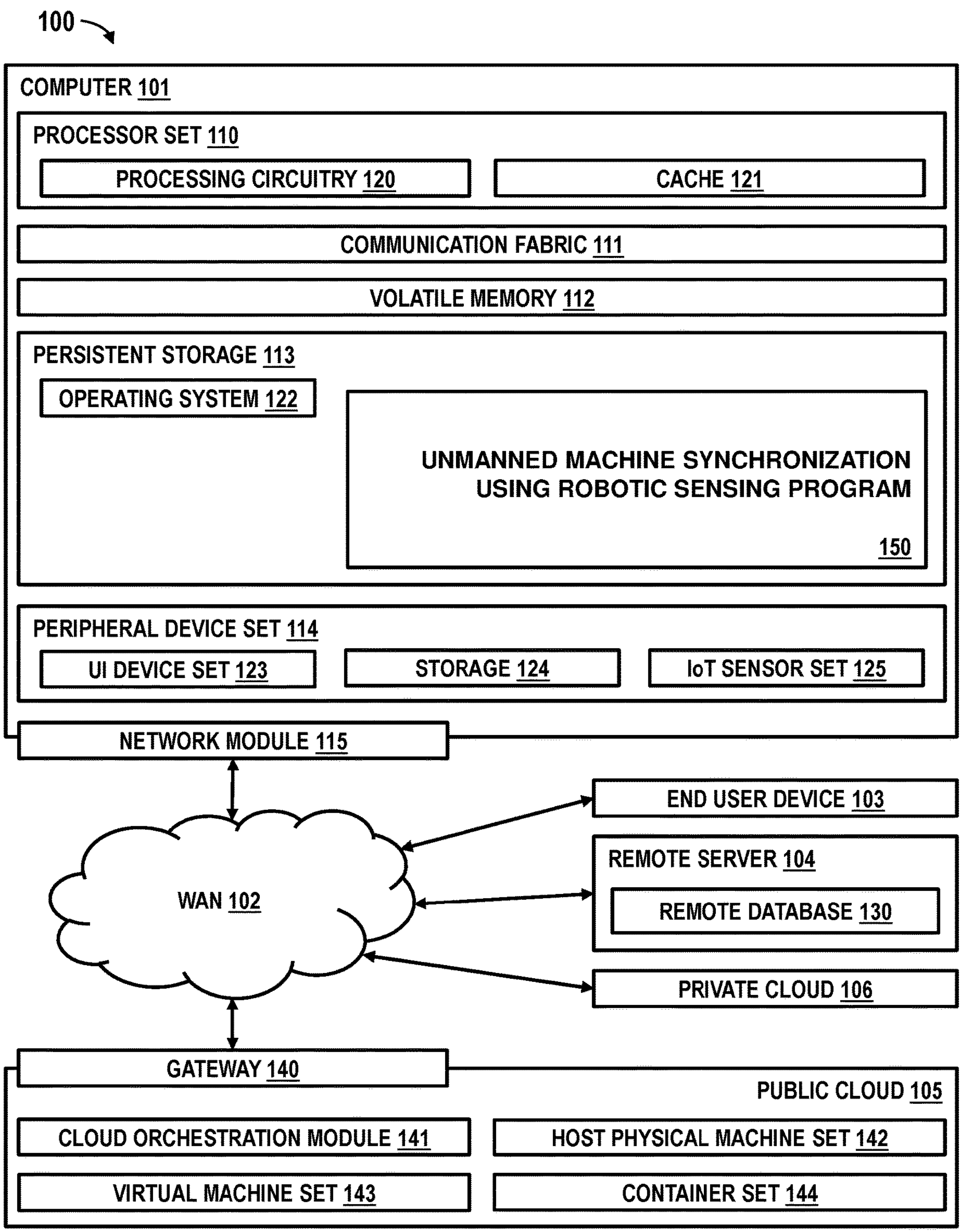
100
COMPUTER 101
PROCESSOR SET 110
PROCESSING CIRCUITRY 120
CACHE 121
COMMUNICATION FABRIC 111
VOLATILE MEMORY 112
PERSISTENT STORAGE 113
OPERATING SYSTEM 122
UNMANNED MACHINE SYNCHRONIZATION USING ROBOTIC SENSING PROGRAM
150
PERIPHERAL DEVICE SET 114
UI DEVICE SET 123
STORAGE 124
IoT SENSOR SET 125
NETWORK MODULE 115
END USER DEVICE 103
REMOTE SERVER 104
REMOTE DATABASE 130
WAN 102
PRIVATE CLOUD 106
GATEWAY 140
PUBLIC CLOUD 105
CLOUD ORCHESTRATION MODULE 141
HOST PHYSICAL MACHINE SET 142
VIRTUAL MACHINE SET 143
CONTAINER SET 144

FIG. 1

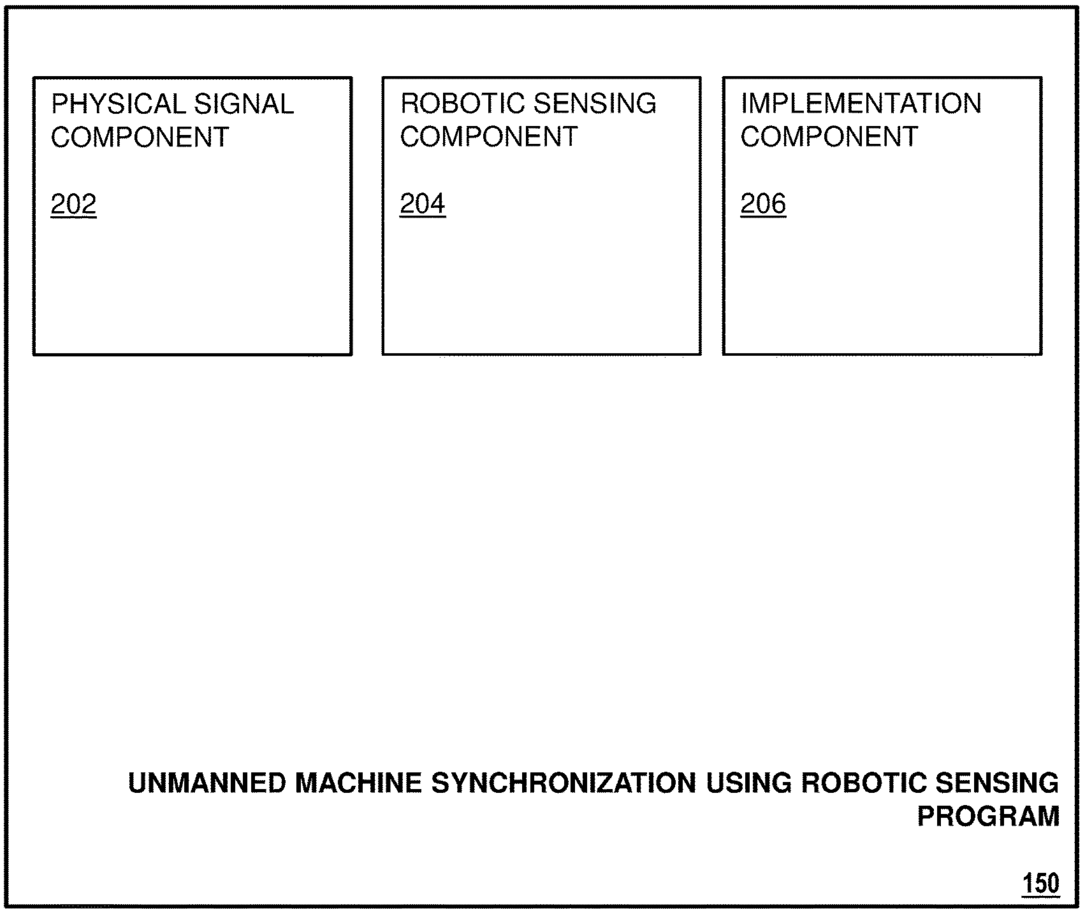
PHYSICAL SIGNAL COMPONENT
202
ROBOTIC SENSING COMPONENT
204
IMPLEMENTATION COMPONENT
206
UNMANNED MACHINE SYNCHRONIZATION USING ROBOTIC SENSING PROGRAM
150

FIG. 2

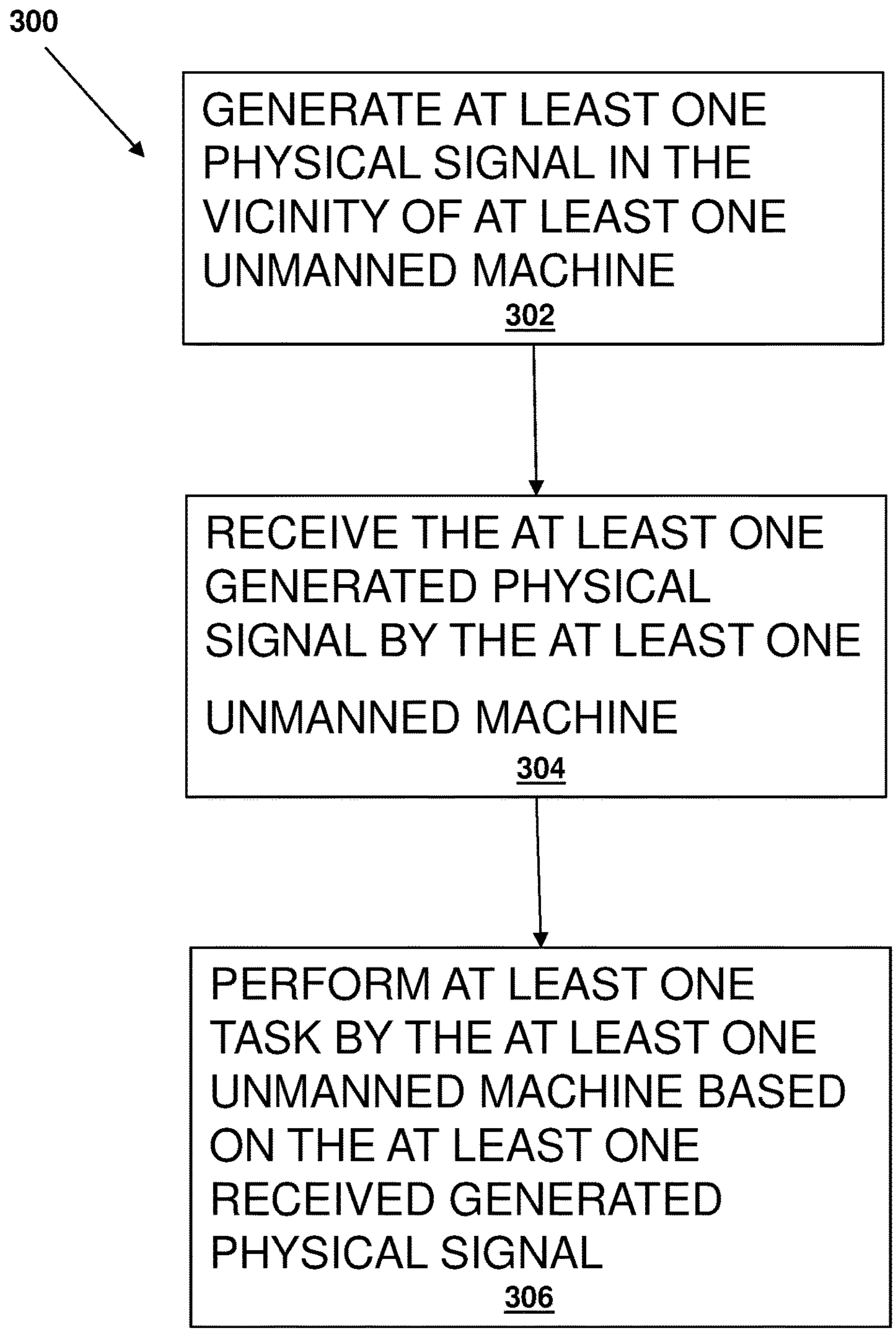
300
GENERATE AT LEAST ONE PHYSICAL SIGNAL IN THE VICINITY OF AT LEAST ONE UNMANNED MACHINE
302
RECEIVE THE AT LEAST ONE GENERATED PHYSICAL SIGNAL BY THE AT LEAST ONE UNMANNED MACHINE
304
PERFORM AT LEAST ONE TASK BY THE AT LEAST ONE UNMANNED MACHINE BASED ON THE AT LEAST ONE RECEIVED GENERATED PHYSICAL SIGNAL
306

FIG. 3

UNMANNED MACHINE SYNCHRONIZATION USING ROBOTIC SENSING

BACKGROUND

Exemplary embodiments of the present inventive concept relate to unmanned machine synchronization, and more particularly, to unmanned machine synchronization using robotic sensing.

Unmanned machines (e.g., UAVs) receive instructions to perform a multitude of different tasks via wireless transmissions. Some of these tasks require a coordinated effort by a plurality of unmanned machines each performing specific roles. For example, a plurality of unmanned machines can collectively survey a large area with each unmanned machine receiving a wireless transmission to survey a designated portion of the overall area. Such multicast coordination can be implemented by a "coordinator". However, multicast coordination requires consistent network connectivity of the coordinator and each of the unmanned machines to be successful. In addition, unmanned machines with different specific roles require unique generation and dissemination of a corresponding wireless transmission. Furthermore, wireless transmissions render unmanned machines susceptible to jamming, interception, interference, and hacking.

SUMMARY

Exemplary embodiments of the present inventive concept relate to a method, a computer program product, and a system for unmanned machine synchronization using robotic sensing.

According to an exemplary embodiment of the present inventive concept, a method of unmanned machine synchronization using robotic sensing is provided. The method includes generating at least one physical signal in the vicinity of at least one unmanned machine. The at least one generated physical signal is received by the at least one unmanned machine. At least one task is performed by the at least one unmanned machine based on the at least one received generated physical signal. Thus, by the provided method, unmanned machine synchronization can be accomplished using robotic sensing of physical signals without necessary reliance on wireless transmissions.

According to an exemplary embodiment of the present inventive concept, a computer program product for unmanned machine synchronization using robotic sensing is provided. The computer program product includes one or more computer-readable storage media and program instructions stored on the one or more non-transitory computer-readable storage media capable of performing a method. The method includes generating at least one physical signal in the vicinity of at least one unmanned machine. The at least one generated physical signal is received by the at least one unmanned machine. At least one task is performed by the at least one unmanned machine based on the at least one received generated physical signal. Thus, by the provided computer program product, unmanned machine synchronization can be accomplished using robotic sensing of physical signals without necessary reliance on wireless transmissions.

According to an exemplary embodiment of the present inventive concept, a computer system is provided for unmanned machine synchronization using robotic sensing. The computer system includes one or more computer processors, one or more computer-readable storage media, and program instructions stored on the one or more of the computer-readable storage media for execution by at least one of the one or more processors capable of performing a method. The method includes generating at least one physical signal in the vicinity of at least one unmanned machine. The at least one generated physical signal is received by the at least one unmanned machine. At least one task is performed by the at least one unmanned machine based on the at least one received generated physical signal. Thus, by the provided computer system, unmanned machine synchronization can be accomplished using robotic sensing of physical signals without necessary reliance on wireless transmissions.

According to an exemplary embodiment of the present inventive concept, the at least one generated signal is an audio or visual signal. Thus, unmanned machine synchronization can be accomplished without using wireless transmissions.

According to an exemplary embodiment of the present inventive concept, the performed at least one task is based on a position of the at least one unmanned machine relative to the at least one received generated physical signal. Thus, physical signal attributes, as received by the unmanned machine, can correspond to different predetermined synchronization instructions.

According to an exemplary embodiment of the present inventive concept, the at least one performed task includes synchronizing the plurality of unmanned machines. Thus, complex tasks involving specific roles of unmanned machines can be accomplished without necessary reliance on wireless transmissions.

BRIEF DESCRIPTION OF THE DRAWINGS

The following detailed description, given by way of example and not intended to limit the exemplary embodiments solely thereto, will best be appreciated in conjunction with the accompanying drawings, in which:

FIG. **1** illustrates a schematic diagram of computing environment **100** including an unmanned machine synchronization using robotic sensing program **150**, in accordance with an exemplary embodiment of the present inventive concept.

FIG. **2** illustrates a block diagram of components included in the unmanned machine synchronization using robotic sensing program **150**, in accordance with an exemplary embodiment of the present inventive concept.

FIG. **3** illustrates a flowchart of a method of unmanned machine synchronization using robotic sensing **300**, in accordance with an exemplary embodiment of the present inventive concept.

It is to be understood that the included drawings are not necessarily drawn to scale/proportion. The included drawings are merely schematic examples to assist in understanding of the present inventive concept and are not intended to portray fixed parameters. In the drawings, like numbering may represent like elements.

DETAILED DESCRIPTION

Exemplary embodiments of the present inventive concept are disclosed hereafter. However, it shall be understood that the scope of the present inventive concept is dictated by the claims. The disclosed exemplary embodiments are merely illustrative of the claimed system, method, and computer program product. The present inventive concept may be embodied in many different forms and should not be construed as limited to only the exemplary embodiments set forth herein. Rather, these included exemplary embodiments are provided for completeness of disclosure and to facilitate an understanding to those skilled in the art. In the detailed description, discussion of well-known features and techniques may be omitted to avoid unnecessarily obscuring the presented exemplary embodiments.

References in the specification to “one embodiment,” “an embodiment,” “an exemplary embodiment,” etc., indicate that the embodiment described may include a particular feature, structure, or characteristic, but not every embodiment may necessarily include that feature, structure, or characteristic. Moreover, such phrases are not necessarily referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to implement such feature, structure, or characteristic in connection with other embodiments whether explicitly described.

In the interest of not obscuring the presentation of the exemplary embodiments of the present inventive concept, in the following detailed description, some processing steps or operations that are known in the art may have been combined for presentation and for illustration purposes, and in some instances, may have not been described in detail. Additionally, some processing steps or operations that are known in the art may not be described at all. The following detailed description is focused on the distinctive features or elements of the present inventive concept according to various exemplary embodiments.

As described above, implementing action by unmanned machines presently requires receipt of wireless transmissions. These wireless transmissions rely upon consistent network connectivity and are vulnerable to jamming, interception, interference, and hacking. Moreover, in the case of an unmanned machine task that involves the coordinated synchronization of a plurality of unmanned machines, multiple different role-specific wireless transmission signals are required, which is inefficient and creates delay. The present inventive concept provides for unmanned machine synchronization using robotic sensing via generated physical signals.

FIG. **1** illustrates a schematic diagram of computing environment **100** including the unmanned machine synchronization using robotic sensing program **150**, in accordance with an exemplary embodiment of the present inventive concept.

Various aspects of the present disclosure are described by narrative text, flowcharts, block diagrams of computer systems and/or block diagrams of the machine logic included in computer program product (CPP) embodiments. With respect to any flowcharts, depending upon the technology involved, the operations can be performed in a different order than what is shown in a given flowchart. For example, again depending upon the technology involved, two operations shown in successive flowchart blocks may be performed in reverse order, as a single integrated step, concurrently, or in a manner at least partially overlapping in time.

A computer program product embodiment (“CPP embodiment” or “CPP”) is a term used in the present disclosure to describe any set of one, or more, storage media (also called “mediums”) collectively included in a set of one, or more, storage devices that collectively include machine readable code corresponding to instructions and/or data for performing computer operations specified in a given CPP claim. A “storage device” is any tangible device that can retain and store instructions for use by a computer processor. Without limitation, the computer readable storage medium may be an electronic storage medium, a magnetic storage medium, an optical storage medium, an electromagnetic storage medium, a semiconductor storage medium, a mechanical storage medium, or any suitable combination of the foregoing. Some known types of storage devices that include these mediums include: diskette, hard disk, random access memory (RAM), read-only memory (ROM), erasable programmable read-only memory (EPROM or Flash memory), static random access memory (SRAM), compact disc read-only memory (CD-ROM), digital versatile disk (DVD), memory stick, floppy disk, mechanically encoded device (such as punch cards or pits/lands formed in a major surface of a disc) or any suitable combination of the foregoing. A computer readable storage medium, as that term is used in the present disclosure, is not to be construed as storage in the form of transitory signals per se, such as radio waves or other freely propagating electromagnetic waves, electromagnetic waves propagating through a waveguide, light pulses passing through a fiber optic cable, electrical signals communicated through a wire, and/or other transmission media. As will be understood by those of skill in the art, data is typically moved at some occasional points in time during normal operations of a storage device, such as during access, de-fragmentation or garbage collection, but this does not render the storage device as transitory because the data is not transitory while it is stored.

Computing environment **100** contains an example of an environment for the execution of at least some of the computer code involved in performing the inventive methods, such as the unmanned machine synchronization using robotic sensing program **150**. In addition to block **150**, computing environment **100** includes, for example, computer **101**, wide area network (WAN) **102**, end user device (EUD) **103**, remote server **104**, public cloud **105**, and private cloud **106**. In this embodiment, computer **101** includes processor set **110** (including processing circuitry **120** and cache **121**), communication fabric **111**, volatile memory **112**, persistent storage **113** (including operating system **122** and block **150**, as identified above), peripheral device set **114** (including user interface (UI) device set **123**, storage **124**, and Internet of Things (IoT) sensor set **125**), and network module **115**. Remote server **104** includes remote database **130**. Public cloud **105** includes gateway **140**, cloud orchestration module **141**, host physical machine set **142**, virtual machine set **143**, and container set **144**.

COMPUTER **101** may take the form of a desktop computer, laptop computer, tablet computer, smart phone, smart watch or other wearable computer, mainframe computer, quantum computer or any other form of computer or mobile device now known or to be developed in the future that is capable of running a program, accessing a network or querying a database, such as remote database **130**. As is well understood in the art of computer technology, and depending upon the technology, performance of a computer-implemented method may be distributed among multiple computers and/or between multiple locations. On the other hand, in this presentation of computing environment **100**, detailed discussion is focused on a single computer, specifically computer **101**, to keep the presentation as simple as possible. Computer **101** may be located in a cloud, even though it is not shown in a cloud in FIG. **1**. On the other hand, computer **101** is not required to be in a cloud except to any extent as may be affirmatively indicated.

PROCESSOR SET **110** includes one, or more, computer processors of any type now known or to be developed in the future. Processing circuitry **120** may be distributed over multiple packages, for example, multiple, coordinated integrated circuit chips. Processing circuitry **120** may implement multiple processor threads and/or multiple processor cores. Cache **121** is memory that is located in the processor chip package(s) and is typically used for data or code that should be available for rapid access by the threads or cores running on processor set **110**. Cache memories are typically organized into multiple levels depending upon relative proximity to the processing circuitry. Alternatively, some, or all, of the cache for the processor set may be located "off chip." In some computing environments, processor set **110** may be designed for working with qubits and performing quantum computing.

Computer readable program instructions are typically loaded onto computer **101** to cause a series of operational steps to be performed by processor set **110** of computer **101** and thereby effect a computer-implemented method, such that the instructions thus executed will instantiate the methods specified in flowcharts and/or narrative descriptions of computer-implemented methods included in this document (collectively referred to as "the inventive methods"). These computer readable program instructions are stored in various types of computer readable storage media, such as cache **121** and the other storage media discussed below. The program instructions, and associated data, are accessed by processor set **110** to control and direct performance of the inventive methods. In computing environment **100**, at least some of the instructions for performing the inventive methods may be stored in block **150** in persistent storage **113**.

COMMUNICATION FABRIC **111** is the signal conduction path that allows the various components of computer **101** to communicate with each other. Typically, this fabric is made of switches and electrically conductive paths, such as the switches and electrically conductive paths that make up busses, bridges, physical input/output ports and the like. Other types of signal communication paths may be used, such as fiber optic communication paths and/or wireless communication paths.

VOLATILE MEMORY **112** is any type of volatile memory now known or to be developed in the future. Examples include dynamic type random access memory (RAM) or static type RAM. Typically, volatile memory **112** is characterized by random access, but this is not required unless affirmatively indicated. In computer **101**, the volatile memory **112** is located in a single package and is internal to computer **101**, but, alternatively or additionally, the volatile memory may be distributed over multiple packages and/or located externally with respect to computer **101**.

PERSISTENT STORAGE **113** is any form of non-volatile storage for computers that is now known or to be developed in the future. The non-volatility of this storage means that the stored data is maintained regardless of whether power is being supplied to computer **101** and/or directly to persistent storage **113**. Persistent storage **113** may be a read only memory (ROM), but typically at least a portion of the persistent storage allows writing of data, deletion of data and re-writing of data. Some familiar forms of persistent storage include magnetic disks and solid state storage devices. Operating system **122** may take several forms, such as various known proprietary operating systems or open source Portable Operating System Interface-type operating systems that employ a kernel. The code included in block **150** typically includes at least some of the computer code involved in performing the inventive methods.

PERIPHERAL DEVICE SET **114** includes the set of peripheral devices of computer **101**. Data communication connections between the peripheral devices and the other components of computer **101** may be implemented in various ways, such as Bluetooth connections, Near-Field Communication (NFC) connections, connections made by cables (such as universal serial bus (USB) type cables), insertion-type connections (for example, secure digital (SD) card), connections made through local area communication networks and even connections made through wide area networks such as the internet. In various embodiments, UI device set **123** may include components such as a display screen, speaker, microphone, wearable devices (such as goggles and smart watches), keyboard, mouse, printer, touchpad, game controllers, and haptic devices. Storage **124** is external storage, such as an external hard drive, or insertable storage, such as an SD card. Storage **124** may be persistent and/or volatile. In some embodiments, storage **124** may take the form of a quantum computing storage device for storing data in the form of qubits. In embodiments where computer **101** is required to have a large amount of storage (for example, where computer **101** locally stores and manages a large database) then this storage may be provided by peripheral storage devices designed for storing very large amounts of data, such as a storage area network (SAN) that is shared by multiple, geographically distributed computers. IoT sensor set **125** is made up of sensors that can be used in Internet of Things applications. For example, one sensor may be a thermometer and another sensor may be a motion detector.

NETWORK MODULE **115** is the collection of computer software, hardware, and firmware that allows computer **101** to communicate with other computers through WAN **102**. Network module **115** may include hardware, such as modems or Wi-Fi signal transceivers, software for packetizing and/or de-packetizing data for communication network transmission, and/or web browser software for communicating data over the internet. In some embodiments, network control functions and network forwarding functions of network module **115** are performed on the same physical hardware device. In other embodiments (for example, embodiments that utilize software-defined networking (SDN)), the control functions and the forwarding functions of network module **115** are performed on physically separate devices, such that the control functions manage several different network hardware devices. Computer readable program instructions for performing the inventive methods can typically be downloaded to computer **101** from an external computer or external storage device through a network adapter card or network interface included in network module **115**.

WAN **102** is any wide area network (for example, the internet) capable of communicating computer data over non-local distances by any technology for communicating computer data, now known or to be developed in the future. In some embodiments, the WAN **102** may be replaced and/or supplemented by local area networks (LANs) designed to communicate data between devices located in a local area, such as a Wi-Fi network. The WAN and/or LANs typically include computer hardware such as copper transmission cables, optical transmission fibers, wireless transmission, routers, firewalls, switches, gateway computers and edge servers.

END USER DEVICE (EUD) **103** is any computer system that is used and controlled by an end user (for example, a customer of an enterprise that operates computer **101**), and may take any of the forms discussed above in connection with computer **101**. EUD **103** typically receives helpful and useful data from the operations of computer **101**. For example, in a hypothetical case where computer **101** is designed to provide a recommendation to an end user, this recommendation would typically be communicated from network module **115** of computer **101** through WAN **102** to EUD **103**. In this way, EUD **103** can display, or otherwise present, the recommendation to an end user. In some embodiments, EUD **103** may be a client device, such as thin client, heavy client, mainframe computer, desktop computer and so on.

REMOTE SERVER **104** is any computer system that serves at least some data and/or functionality to computer **101**. Remote server **104** may be controlled and used by the same entity that operates computer **101**. Remote server **104** represents the machine(s) that collect and store helpful and useful data for use by other computers, such as computer **101**. For example, in a hypothetical case where computer **101** is designed and programmed to provide a recommendation based on historical data, then this historical data may be provided to computer **101** from remote database **130** of remote server **104**.

PUBLIC CLOUD **105** is any computer system available for use by multiple entities that provides on-demand availability of computer system resources and/or other computer capabilities, especially data storage (cloud storage) and computing power, without direct active management by the user. Cloud computing typically leverages sharing of resources to achieve coherence and economics of scale. The direct and active management of the computing resources of public cloud **105** is performed by the computer hardware and/or software of cloud orchestration module **141**. The computing resources provided by public cloud **105** are typically implemented by virtual computing environments that run on various computers making up the computers of host physical machine set **142**, which is the universe of physical computers in and/or available to public cloud **105**. The virtual computing environments (VCEs) typically take the form of virtual machines from virtual machine set **143** and/or containers from container set **144**. It is understood that these VCEs may be stored as images and may be transferred among and between the various physical machine hosts, either as images or after instantiation of the VCE. Cloud orchestration module **141** manages the transfer and storage of images, deploys new instantiations of VCEs and manages active instantiations of VCE deployments. Gateway **140** is the collection of computer software, hardware, and firmware that allows public cloud **105** to communicate through WAN **102**.

Some further explanation of virtualized computing environments (VCEs) will now be provided. VCEs can be stored as "images." A new active instance of the VCE can be instantiated from the image. Two familiar types of VCEs are virtual machines and containers. A container is a VCE that uses operating-system-level virtualization. This refers to an operating system feature in which the kernel allows the existence of multiple isolated user-space instances, called containers. These isolated user-space instances typically behave as real computers from the point of view of programs running in them. A computer program running on an ordinary operating system can utilize all resources of that computer, such as connected devices, files and folders, network shares, CPU power, and quantifiable hardware capabilities. However, programs running inside a container can only use the contents of the container and devices assigned to the container, a feature which is known as containerization.

PRIVATE CLOUD **106** is similar to public cloud **105**, except that the computing resources are only available for use by a single enterprise. While private cloud **106** is depicted as being in communication with WAN **102**, in other embodiments a private cloud may be disconnected from the internet entirely and only accessible through a local/private network. A hybrid cloud is a composition of multiple clouds of different types (for example, private, community or public cloud types), often respectively implemented by different vendors. Each of the multiple clouds remains a separate and discrete entity, but the larger hybrid cloud architecture is bound together by standardized or proprietary technology that enables orchestration, management, and/or data/application portability between the multiple constituent clouds. In this embodiment, public cloud **105** and private cloud **106** are both part of a larger hybrid cloud.

FIG. **2** illustrates a block diagram of components included in the unmanned machine synchronization using robotic sensing program **150**, in accordance with an exemplary embodiment of the present inventive concept.

The physical signal component **202** can generate at least one physical signal corresponding to implementation instructions for at least one unmanned machine (e.g., a UAV) in the vicinity (e.g., within a robotic sensing/physical signal measuring distance and/or a predetermined range) to perform a task singly or in coordination (e.g., synchronization). The physical signal component **202** can be included in at least one unmanned machine (e.g., a coordinator unmanned machine and/or an unmanned machine also involved in performing the at least one task) and/or can be connected thereto via a network. The physical signal component **202** can include a display device (e.g., a wraparound screen) and/or speakers. The physical signal component **202** can generate the at least one physical signal based on detected environmental conditions (e.g., interruption of wireless transmissions, network connectivity loss/impairment, smoke, heat, temperature, audio cues, visual cues, proximity/tasks/network status of unmanned machines at a predetermined location, presence of detected physical obstacles to robotic sensing/physical signal measurement, etc.), predetermined times, and/or user input. In an embodiment, a coordinator unmanned machine including the physical signal component **202** can maintain a predetermined position (e.g., above, below, lateral, ahead, and/or behind) and/or a predetermined distance from at least one other unmanned machine. The at least one generated physical signal can include at least one of audio, visual, infrared, and/or chemical signal, etc. which can be detected by unmanned machines in the vicinity. The generated visual signal can include at least one of polarized light, QR codes, animations, symbols (e.g., morse code), text, images, etc., and/or combinations thereof. The generated audio signal can include various sounds which can be inside and/or outside the human audible spectrum, such as at least a portion of song, melody, ping, speech, noise, spoken implementation instructions, etc., and/or combinations thereof. The at least one physical signal can be generated by the physical signal component **202** on a time-internal basis that might only take one round trip delay of light (in an optimal case) between the unmanned machine including the physical signal component **202** and at least one other unmanned machine including the robotic sensing component **204** (described below). The implementation instructions, the generated at least one physical signal, and/or the use of error correction codes can be encrypted (e.g., public-key cryptography).

For example, a user selects a predetermined formation for displaying a multi-screen streaming video using the unmanned machine synchronization using robotic sensing program **150**. A coordinator unmanned machine connected to a physical signal component **202** displays a physical signal in the form of a wraparound symbolic sentence in the vicinity of various other unmanned machines which is unintelligible without unique decryption by an unmanned machine including the robotic sensing component **204**.

The robotic sensing component **204** can receive the at least one generated physical signal, analyse physical signal attributes, and extract corresponding implementation instructions to perform at least one task. The robotic sensing component **204** can be included in at least one unmanned machine (e.g., a coordinator unmanned machine and/or an unmanned machine also involved in performing the at least one task) and/or can be connected thereto via the network. The robotic sensing component **204** can be equipped with various robotic sensing capabilities and/or physical signal measuring devices. The extracted implementation instructions corresponding to a same physical signal can vary depending on the analyzed physical signal attributes relative to an unmanned machine, such as a corresponding magnitude, intensity, timing, and/or at least one of relative orientation, position, distance, clarity, and/or angle. Combinations of different physical signals, durations, and/or timings thereof can correspond to the same or different extracted implementation instructions. In an embodiment of the present inventive concept, a plurality of unmanned machines connected to the robotic sensing component **204** can be provided, at least some of which can receive extracted implementation instructions related to performing a coordinated task (e.g., synchronization). The extracted implementation instructions for the coordinated task can include implementation instructions for at least two different subtasks (e.g., roles, positions, actions, etc.). The robotic sensing component **204** can cooperate with the physical signal component **202** to cascade, repeat, exhibit predetermined cue behaviors, relay, and/or otherwise transmit extracted implementation instructions and/or physical signals to adjacent unmanned machines (e.g., unmanned machines which are unresponsive, outside robotic sensing/physical signal measurement range, and/or are encountering a detected physical obstruction, etc.) via a recipient unmanned machine or a coordinator unmanned machine. In an embodiment of the present inventive concept, the robotic sensing component **204** can take an inventory of expected recipient unmanned machines. The robotic sensing component **204** can use machine learning (e.g., computer vision) to determine whether at least one physical obstacle (e.g., trees, ambient noise, visual noise, etc.) is interfering with receipt of the at least one physical signal and act accordingly (e.g., move the intended recipient unmanned machine, the coordinator unmanned machine, and/or an adjacent recipient device).

For example, the robotic sensing component **204** connected to the various other unmanned machines in the vicinity of the coordinator unmanned machine receives the wraparound symbolic sentence from different vantages and with different light intensities. The robotic sensing component **204** connected to the various other unmanned machines extracts implementation instructions based on respective vantages and corresponding light intensities. However, one unmanned machine is outside of robotic sensing distance of the wraparound symbolic sentence and another unmanned machine is within a robotic sensing distance, but trees are determined to obstruct its field of view. The robotic sensing component **204** deploys an adjacent recipient unmanned machine to physically relay the signal.

The implementation component **206** can perform the at least one task (e.g., surveying, hazard mitigation, alert dissemination, etc.) associated with the extracted implementation instructions by mobilizing at least one unmanned machine to take at least one action. The implementation component **206** can be included in at least one unmanned machine (e.g., a coordinator unmanned machine and/or an unmanned machine also involved in performing the at least one task) and/or can be connected thereto via the network. The actions can include movement, angulation, repositioning, etc. of at least one unmanned machine. The implementation component **206** can synchronize unmanned machine actions to assemble in a formation, engage in a concerted action, and/or assume roles/sub-tasks, etc. The implementation component **206** can determine and coordinate performance of actions, which can include implementing relative positions, timings and/or durations of actions. The implementation component **206** can calculate adjustments to the extracted implementation instructions associated with actions and/or an overall task based upon environmental conditions, relative capabilities of unmanned machines in the vicinity, efficiency of performance, modified task directives, etc. and can cooperate with the physical signal component **202** to generate new physical signals accordingly. The implementation component **206** can perform the at least one task automatically upon extracting the implementation instructions unless a predetermined environmental condition is detected and/or a user initiates an override. In an embodiment of the present inventive concept, the implementation component **206** can determine if the at least one task, constituent actions, and/or a synchronization is properly implemented. If an unmanned machine fails to take proper actions associated with corresponding extracted implementation instructions, the implementation component **206** can cause the physical signal component **202** to repeat a corresponding physical signal, such as by use of an adjacent unmanned machine (e.g., a nearest unmanned machine, the coordinator unmanned machine, an idle unmanned machine, etc.). In addition, the implementation component **206** can determine if a physical obstacle is interfering with the performed tasks, synchronization, and/or individual actions and act accordingly (e.g., cooperate with the physical signal component **202** to generate new physical signals and/or autonomously alter actions of unmanned machines).

For example, the various other unmanned machines automatically perform actions associated with their respective extracted implementation instructions via the implementation component **206**. The various other unmanned machines assume respective relative locations to display a coherent streaming video across multiple screens. However, one unmanned machine fails to properly position in the formation. The implementation component **206** detects the discrepancy in the formation and the causative obstructing tree. The implementation component **206** moves the entire unmanned machine formation forward a few feet to ameliorate the obstruction of the tree.

FIG. **3** illustrates a flowchart of unmanned machine synchronization using robotic sensing **300**, in accordance with an exemplary embodiment of the present inventive concept.

The physical signal component **202** can generate at least one physical signal in the vicinity of at least one unmanned machine (step **302**).

The robotic sensing component **204** can receive the at least one generated physical signal by the at least one unmanned machine (step **304**).

The implementation component **206** can perform at least one task by the at least one unmanned machine based on the at least one received generated physical signal (step **306**).

Based on the foregoing, a computer system, method, and computer program product have been disclosed. However, numerous modifications, additions, and substitutions can be made without deviating from the scope of the exemplary embodiments of the present inventive concept. Therefore, the exemplary embodiments of the present inventive concept have been disclosed by way of example and not by limitation.

What is claimed is:

1. A method of unmanned machine synchronization using robotic sensing, the method comprising:

generating at least one physical signal in the vicinity of at least one unmanned machine, wherein the physical signal includes only a visual signal, audio signal and chemical signal;

receiving the at least one generated physical signal by the at least one unmanned machine; and

performing at least one task by the at least one unmanned machine based on the at least one received generated physical signal.

2. The method of claim **1**, wherein the at least one unmanned machine is a plurality of unmanned machines.

3. The method of claim **1**, wherein the at least one unmanned machine is a UAV.

4. The method of claim **1**, wherein the generated physical signal is a plurality of physical signals.

5. The method of claim **1**, wherein the visual signal and the audio signal are generated by a display device and a speaker, respectively.

6. The method of claim **1**, wherein the performed at least one task is based on a position of the at least one unmanned machine relative to the at least one received generated physical signal.

7. The method of claim **2**, wherein the at least one performed task includes synchronizing the plurality of unmanned machines.

8. A computer program product for unmanned machine synchronization using robotic sensing comprising:

one or more computer-readable storage media and program instructions stored on the one or more non-transitory computer-readable storage media capable of performing a method, the method comprising:

generating at least one physical signal in the vicinity of at least one unmanned machine, wherein the physical signal includes only a visual signal, audio signal and chemical signal;

receiving the at least one generated physical signal by the at least one unmanned machine; and

performing at least one task by the at least one unmanned machine based on the at least one received generated physical signal.

9. The computer program product of claim **8**, wherein the at least one unmanned machine is a plurality of unmanned machines.

10. The computer program product of claim **8**, wherein the at least one unmanned machine is a UAV.

11. The computer program product of claim **8**, wherein the generated physical signal is a plurality of physical signals.

12. The computer program product of claim **8**, wherein the visual signal and the audio signal are generated by a display device and a speaker, respectively.

13. The computer program product of claim **8**, wherein the performed at least one task is based on a position of the at least one unmanned machine relative to the at least one received generated physical signal.

14. The computer program product of claim **9**, wherein the at least one performed task includes synchronizing the plurality of unmanned machines.

15. A computer system for unmanned machine synchronization using robotic sensing, the computer system comprising:

one or more computer processors, one or more computer-readable storage media, and program instructions stored on the one or more of the computer-readable storage media for execution by at least one of the one or more processors capable of performing a method, the method comprising:

generating at least one physical signal in the vicinity of at least one unmanned machine, wherein the physical signal includes only a visual signal, audio signal and chemical signal;

receiving the at least one generated physical signal by the at least one unmanned machine; and

performing at least one task by the at least one unmanned machine based on the at least one received generated physical signal.

16. The computer system of claim **15**, wherein the at least one unmanned machine is a plurality of unmanned machines.

17. The computer system of claim **15**, wherein the at least one unmanned machine is a UAV.

18. The computer system of claim **15**, wherein the generated physical signal is a plurality of physical signals.

19. The computer system of claim **15**, wherein the visual signal and the audio signal are generated by a display device and a speaker, respectively.

20. The computer system of claim **15**, wherein the performed at least one task is based on a position of the at least one unmanned machine relative to the at least one received generated physical signal.

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