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(54) **UNMANNED VEHICLE MESSAGE CONVERSION SYSTEM**

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(51) **Int. Cl.**

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| ***G05D 3/00*** | (2006.01) |
| ***G06F 7/00*** | (2006.01) |
| ***G06F 17/00*** | (2006.01) |

(52) **U.S. Cl.** ............ **701/2**; 709/230; 709/231; 709/232; 709/246; 709/249; 244/75.1; 244/190; 370/466; 370/467

(58) **Field of Classification Search** ...... 701/2; 709/230, 709/231, 232, 246, 249; 244/75.1, 190; 370/466, 370/467, 469

See application file for complete search history.

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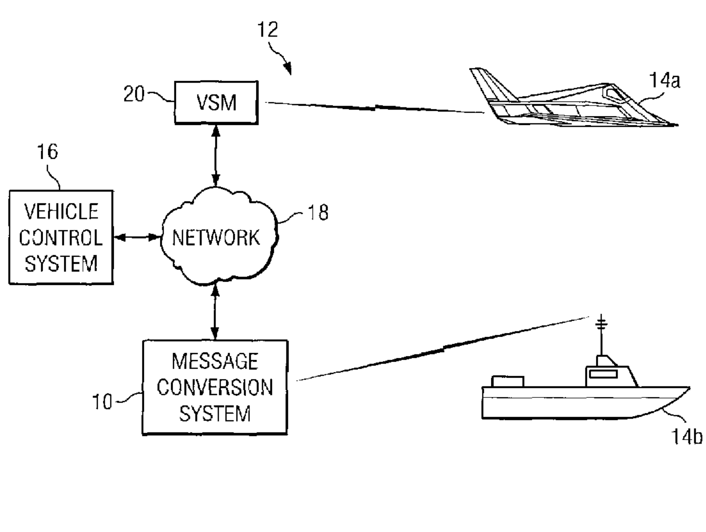
(57) **ABSTRACT**

According to one embodiment of the disclosure, an unmanned vehicle message conversion system generally includes a message interpreter that is coupled between a first unmanned vehicle control interface and a second unmanned vehicle control interface. The second unmanned vehicle control interface is configured to transmit and receive messages with a messaging protocol that is different than the first unmanned vehicle control interface. The message interpreter is operable to receive a first message from the unmanned vehicle control system, convert the first message to a second message having the second protocol, and transmit the second message to the unmanned vehicle.

**18 Claims, 2 Drawing Sheets**



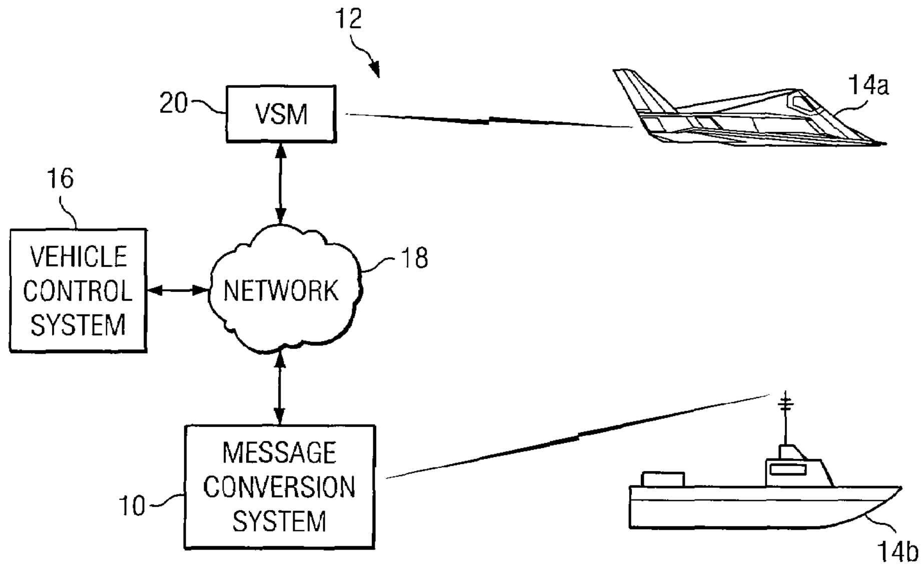

12
20
VSM
14a
16
VEHICLE CONTROL SYSTEM
NETWORK
18
MESSAGE CONVERSION SYSTEM
10
14b

*FIG. 1*

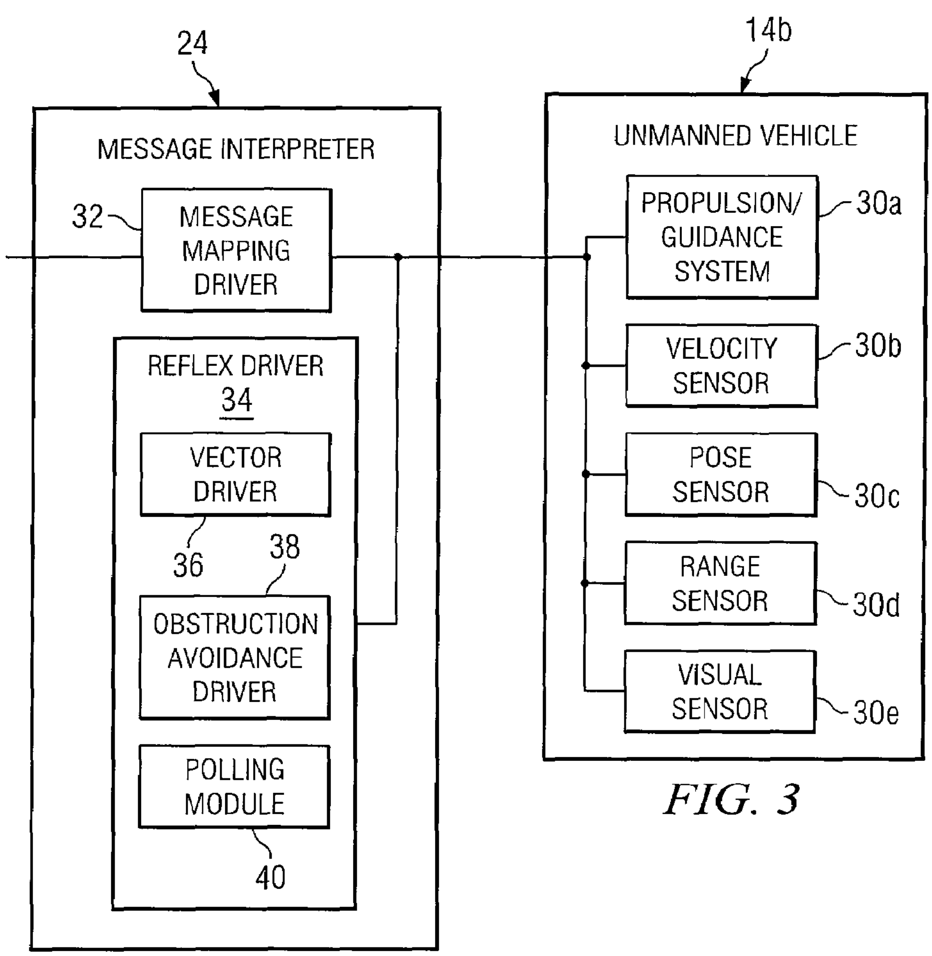

24
MESSAGE INTERPRETER
32
MESSAGE MAPPING DRIVER
REFLEX DRIVER
34
VECTOR DRIVER
36
38
OBSTRUCTION AVOIDANCE DRIVER
POLLING MODULE
40
14b
UNMANNED VEHICLE
PROPULSION/ GUIDANCE SYSTEM
30a
VELOCITY SENSOR
30b
POSE SENSOR
30c
RANGE SENSOR
30d
VISUAL SENSOR
30e

*FIG. 3*

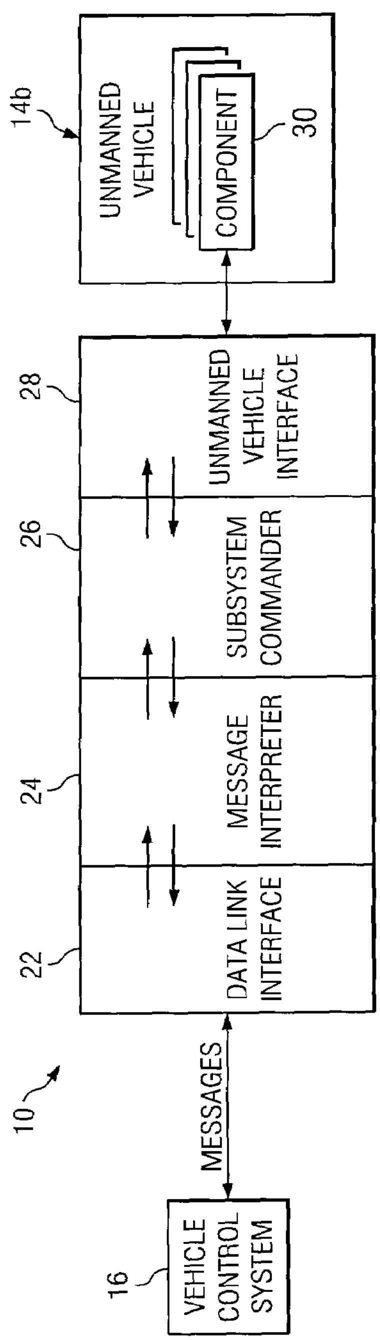

14b
UNMANNED VEHICLE
COMPONENT
30
28
UNMANNED VEHICLE INTERFACE
26
SUBSYSTEM COMMANDER
24
MESSAGE INTERPRETER
22
DATA LINK INTERFACE
10
MESSAGES
16
VEHICLE CONTROL SYSTEM

*FIG. 2*

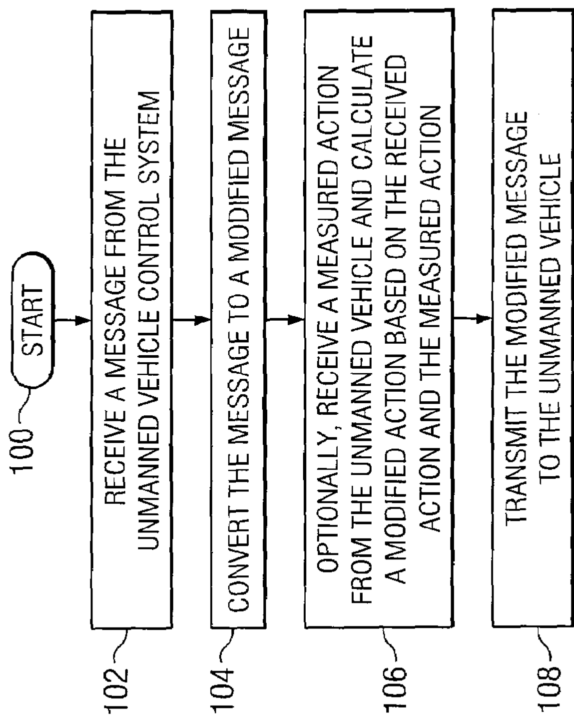

100
START
102
RECEIVE A MESSAGE FROM THE UNMANNED VEHICLE CONTROL SYSTEM
104
CONVERT THE MESSAGE TO A MODIFIED MESSAGE
106
OPTIONALLY, RECEIVE A MEASURED ACTION FROM THE UNMANNED VEHICLE AND CALCULATE A MODIFIED ACTION BASED ON THE RECEIVED ACTION AND THE MEASURED ACTION
108
TRANSMIT THE MODIFIED MESSAGE TO THE UNMANNED VEHICLE
110
END

*FIG. 4*

# UNMANNED VEHICLE MESSAGE CONVERSION SYSTEM

## GOVERNMENT RIGHTS

This invention was made with Government support under the Navy Interoperability Program. The Government may have certain rights in this invention.

## TECHNICAL FIELD OF THE DISCLOSURE

This disclosure relates generally to unmanned vehicles, and more particularly, to an unmanned vehicle message conversion system and a method for using the same.

## BACKGROUND OF THE DISCLOSURE

Various types of unmanned vehicles, such as unmanned surface vehicles (USVs) and unmanned aerial vehicles (UAVs), have been developed to enable transport of various payloads without an onboard crew. These unmanned vehicles may be used to accomplish tasks that may be generally too dangerous or impractical for direct human involvement. For example, unmanned vehicles may be used in military missions for reconnaissance of enemy forces over enemy lines to avoid deployment of military personnel in harm's way. Unmanned vehicles may also be used in harsh environments, such as chemically contaminated areas or at high altitudes that may be generally unsuitable for human habitation.

## SUMMARY OF THE DISCLOSURE

According to one embodiment of the disclosure, an unmanned vehicle message conversion system generally includes a message interpreter that is coupled between a first unmanned vehicle control interface and a second unmanned vehicle control interface. The second unmanned vehicle control interface is configured to transmit and receive messages using a messaging protocol that is different than the first unmanned vehicle control interface. The message interpreter is operable to receive a first message from an unmanned vehicle control system coupled to the first unmanned vehicle control interface, convert the first message to a second message having the second protocol, and transmit the second message to the unmanned vehicle.

Some embodiments of the invention may provide numerous technical advantages. Some embodiments may benefit from some, none, or all of these advantages. For example, one embodiment of the unmanned vehicle message conversion system may enable control of unmanned vehicles that communicate using a protocol having relatively poor reflexive characteristics, such as the joint architecture for unmanned systems protocol. The unmanned vehicle message conversion system may incorporate a reflex driver that modifies messages sent to the unmanned vehicle based upon one or more sensors that measure actual environmental conditions around the unmanned vehicle. Thus, unmanned vehicles having a joint architecture for unmanned systems compliant interface may be controlled using other unmanned vehicle control systems may not have relatively good reflexive characteristics, such as the standardization agreement 4586 protocol.

Other technical advantages may be readily ascertained by one of ordinary skill in the art.

## BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of embodiments of the disclosure will be apparent from the detailed description taken in conjunction with the accompanying drawings in which:



FIG. **1** is a diagram showing one embodiment of a unmanned vehicle conversion system that may be incorporated into an unmanned vehicle network;

FIG. **2** is a block diagram showing several elements of the unmanned vehicle conversion system of FIG. **1**;

FIG. **3** is a block diagram showing several elements of the message interpreter element of the unmanned vehicle conversion system of FIG. **1**; and

FIG. **4** is a flowchart showing one embodiment of a series of actions that may be performed by the unmanned vehicle conversion system of FIG. **1**.

## DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

The STANdardization AGreement (STANAG) 4586 protocol is one of several messaging protocols that has been implemented for use with unmanned vehicles. The standardization agreement 4586 specification, which defines its associated messaging protocol, has been written by member nations of the North Atlantic Treaty Organization (NATO) for the purpose of encouraging interoperability of unmanned vehicles among each member nation. Thus, unmanned vehicles having a standardization agreement 4586 compliant interface may be coordinated with those of other member nations using a common control system.

The Joint Architecture for Unmanned Systems (JAUS) is another messaging protocol that has been implemented for use with unmanned vehicles by the United States Department of Defense. The joint architecture for unmanned systems specification provides a generally hierarchal system of subsystems, nodes, and components that define various aspects of an unmanned vehicle network. Each subsystem may be an unmanned vehicle, a control system, or an intermediary subsystem for conveying messages between the unmanned vehicle and its respective control system. A node may be any portion of the unmanned vehicle that is configured to accomplish a particular task and may include one or more components that function together in order to accomplish that task. Numerous types of unmanned vehicles having a joint architecture for unmanned systems compliant interface have been developed. Because the joint architecture for unmanned systems messaging protocol is different from the standardization agreement 4586 messaging protocol, unmanned vehicles configured with a joint architecture for unmanned systems compliant interface are generally inoperable with control systems having a standardization agreement 4586 interface.

FIG. **1** shows one embodiment of a unmanned vehicle message conversion system **10** configured in an unmanned vehicle network **12** that may provide a solution to this problem as well as other problems. Unmanned vehicle network **12** may include a vehicle control system **16** for controlling movement, information interchange, and other various operations of one or more unmanned vehicles **14**. Vehicle control system **16** may communicate with unmanned vehicle **14*a*** using a first messaging protocol that in one embodiment, may be a standardization agreement 4586 protocol. According to the teachings of the present disclosure, the unmanned vehicle message conversion system **10** may also allow communication with unmanned vehicle **14*b*** that communicates using a messaging protocol different from the native messaging protocol of the vehicle control system **16**. In the particular embodiment shown, unmanned vehicle **14*a*** is an aircraft and unmanned vehicle **14*b*** is a boat; however, unmanned vehicles **14*a*** and **14*b*** may be any suitable type of vehicle that is capable of unmanned operation and controllable by vehicle control system **16**.

In one embodiment, unmanned vehicle **14***b* may communicate using a joint architecture for unmanned systems messaging protocol. Certain embodiments of the unmanned vehicle message conversion system **10** may provide an advantage in that control of differing types of unmanned vehicles **14** may be provided through a single vehicle control system **16**. In this manner, the operation of a number of differing types of unmanned vehicles **14** may be coordinated together for accomplishing a common goal, such as reconnaissance support over a battlefield or other relatively large scale tasks.

Vehicle control system **16** is configured to administer operation of unmanned vehicles **14***a* and **14***b* by a user. The vehicle control system **16** may receive input from the user and convert this input into various messages for communication with each of the unmanned vehicles **14***a* and **14***b*. These messages may include commands for performing a particular maneuver or requests for information from the unmanned vehicles **14***a* and **14***b*. In one embodiment, the vehicle control system **16** may transmit and receive messages using a standardization agreement 4586 messaging protocol. Vehicle control system **16** using a standardization agreement 4586 messaging protocol may communicate with the unmanned vehicles **14***a* and **14***b* through a network **18**, such as a UDP/IP network. Each type of unmanned vehicle **14** may communicate with the vehicle control system **16** using a vehicle specific module **20**. According to the teachings of the present disclosure, unmanned vehicle message conversion system **10** may be operable to enable control of the one or more unmanned vehicles **14***b* by the vehicle control system **16** having a messaging protocol that differs from the messaging protocol of the unmanned vehicles **14***b*.

FIG. **2** is a block diagram showing one embodiment of the unmanned vehicle message conversion system **10**. The unmanned vehicle message conversion system **10** may be executed on any suitable computing system using executable instructions stored in a memory. The unmanned vehicle message conversion system **10** may include several components, such as a data link interface (DLI) **22**, a message interpreter **24**, a subsystem commander **26**, and an unmanned vehicle interface **28**. The data link interface **22** is operable to transmit and receive standardization agreement 4586 compliant messages to and from the vehicle control system **16** through the network **18**. The message interpreter **24** is operable to convert messages from the vehicle control system **16** through the data link interface **22** to a messaging protocol suitable for use by unmanned vehicle **14***b*. The subsystem commander **26** may operate in a manner similar to an operator control unit (OCU) as specified in the joint architecture for unmanned systems specification. That is, the joint architecture for unmanned systems subsystem commander **26** may provide centralized control for various unmanned vehicles **14***b* that communicate with the unmanned vehicle message conversion system **10**.

The unmanned vehicle interface **28** may be provided to administer communication between the subsystem commander **26** and each unmanned vehicle **14***b*. Each unmanned vehicle **14***b* may have several components **30** that provide various functions, such as, for example, servo movement for control of the unmanned vehicle or sensor devices for gathering information. The unmanned vehicle interface **28** may be operable to delegate messages to each component **30** configured on the unmanned vehicle **14***b*.

FIG. **3** is a block diagram showing several elements of message interpreter **24** that may be used to communicate with various components **30** configured on unmanned vehicle **14***b*. The message interpreter **24** may include a message mapping driver **32** and a reflex driver **34** that will be described in greater detail below. The message mapping driver **32** may be operable to convert standardization agreement 4586 compliant messages transmitted from the unmanned vehicle control system **16** into joint architecture for unmanned systems compliant messages for use by the various components **30** configured in the unmanned vehicle **14***b*. The message mapping driver **32** may also be operable to convert joint architecture for unmanned systems compliant messages transmitted from the unmanned vehicle **14***b* into standardization agreement 4586 compliant messages for use by the unmanned vehicle control system **16**. In another embodiment, the message mapping driver **32** may be operable to convert mulitiple standardization agreement 4586 compliant messages from the unmanned vehicle control system **16** to a single joint architecture for unmanned systems message.

The unmanned vehicle **14***b* may have a number of components **30** that are operable to transmit and receive messages using a joint architecture for unmanned systems protocol. These components may include a propulsion and guidance system **30***a* and one or more sensors **30***b* through **30***e*. The propulsion and guidance system **30***a* supplies motive force for movement of the unmanned vehicle **14***b* and may include one or more guidance devices, such as control surfaces or steering mechanisms, that are controlled using joint architecture for unmanned systems compliant messages. Sensors **30***b* through **30***e* may be any suitable type of sensor device. In one embodiment, sensors **30***b* through **30***e* may be operable to sense various aspects of the unmanned vehicle's environment for controlling the path and velocity of the unmanned vehicle **14***b*. In another embodiment, sensors may include a velocity sensor **30***b*, a pose sensor **30***c*, a range sensor **30***d*, and a visual sensor **30***e*. The velocity sensor **30***b* and pose sensor **30***c* are configured to measure the velocity and current position respectively, of the unmanned vehicle **14***b*. The range sensor **30***d* may be operable to measure the distance from the unmanned vehicle **14***b* to particular targets, obstructions, or other objects around the unmanned vehicle **14***b*. The visual sensor **30***e* is operable to obtain images of the environment around the unmanned vehicle **14***b*.

The reflex driver **34** may be operable to modify messages transmitted from the message mapping driver **32** to the unmanned vehicle **14***b* based upon information provided by the one or more sensors **30***b* through **30***e* disposed on the unmanned vehicle **14***b*. That is, messages transmitted from the vehicle control system **16** may be translated by the message mapping driver **32** and modified by reflex driver **34** based upon information provided by the one or more sensors **30***b* through **30***e* for control of the unmanned vehicle **14***b*. The reflex driver **34** may provide reflexive control for any suitable controllable system configured on the joint architecture for unmanned systems compliant unmanned vehicle **14***b*. The unmanned vehicle **14***b* may have a number of controllable systems that may include a propulsion and guidance system **30***a*, such as previously described, a robotic device, such as a robotic arm, one or more surveillance cameras, and the like. The term reflexive control generally refers to the act of automatically manipulating a controllable system in direct response to one or more ambient conditions.

In one embodiment, the reflex driver **34** includes a vector driver **36** that may be operable to provide a modified waypoint and/or modified velocity to the unmanned vehicle **14***b* in response to varying ambient conditions experienced by the unmanned vehicle **14***b*. That is, the reflex driver **34** may use information provided by pose sensor **30***c*, or velocity sensor **30***b* to provide course correction to the unmanned vehicle **14***b*. A waypoint may be referred to as a desired destination of the unmanned vehicle **14***b* and may include latitude and longitude coordinates and in some embodiments may include an altitude coordinate.

Certain embodiments incorporating a reflex driver **34** may enable enhanced control of unmanned vehicles **14***b* from vehicle control systems using a messaging protocol, such as the standardization agreement 4586 protocol, that do not support reflexive logic for control of the unmanned vehicle's operation. For a particular example in which the unmanned vehicle **14***b* is a boat, the water in which the boat is traveling may be flowing in an oblique direction with reference to the direction of the boat. Known unmanned vehicles **14***b* using a joint architecture for unmanned systems compatible messaging protocol are designed to proceed in a direction specified by the waypoint without regard to ambient conditions, such as cross-flow ambient water currents. Thus, the boat may err from its intended destination due to these ambient conditions. The vector driver **36** may be operable to provide a modified waypoint to the unmanned vehicle **14***b* such that the unmanned vehicle **14***b* remains at a proper course heading in spite of these cross-flow ambient water currents.

In one embodiment, the reflex driver **34** may include an obstruction avoidance driver **38**. The obstruction avoidance driver **38** may be operable to automatically adjust for various impediments, such as obstructions or unforeseen hazards, to the unmanned vehicle **14***b*. As an example in which the unmanned vehicle **14***b* is a boat, a visual sensor **30***e* and/or range sensor **30***d* configured on the boat may recognize the presence of an island in its path of travel. The obstruction avoidance driver **38** may be operable to determine a new path that directs the boat safely around the island while maintaining a course generally in the direction of its desired waypoint.

In another embodiment, a polling module **40** may be included to periodically poll various sensors **30***b* through **30***e* configured on the joint architecture for the unmanned vehicle **14***b*. In one embodiment, the polling module **40** may be operable to periodically poll the pose sensor **30***c* and velocity sensor **30***c* for continual updating of the unmanned vehicle's **14***c* position and velocity. Using this information, the vector driver **36** may be operable to continually update the modified waypoint that is transmitted to the unmanned vehicle **14***b* during its operation. In another embodiment, the polling module **40** may be operable to periodically transmit a heartbeat message to the unmanned vehicle **14***b* and transmit a loss of heartbeat message to the unmanned vehicle control system **16** if a response message to the heartbeat message is not received from the unmanned vehicle **14***b*.

FIG. **4** is a flowchart showing a series of actions that may be taken by the unmanned vehicle message conversion system **10** to convert messages received from a vehicle control system **16** to a joint architecture for unmanned systems compliant unmanned vehicle **14***b*. In act **100**, the process is initiated. The process may be initiated by performing any bootstrapping operations to the unmanned vehicle message conversion system **10**, preparing the unmanned vehicle **14***b* for a particular mission, and launching the unmanned vehicle **14***b* on its mission.

In act **102**, the unmanned vehicle message conversion system **10** may receive a message from the unmanned vehicle control system **16**. The message may incorporate any suitable protocol for communicating with unmanned vehicle **14***a* and/or unmanned vehicle **14***b*. In one embodiment, the message is a standardization agreement 4586 compliant message. The message may include information for administering control or retrieving information from the unmanned vehicle **14***b*. In one embodiment, the message may include a desired action for the unmanned vehicle to perform, such as, for example, a waypoint that geospatially describes a desired destination, a desired movement of a robotic device configured on the unmanned vehicle **14***b*, or actuation of a peripheral device configured on the unmanned vehicle **14***b*.

In act **104**, the unmanned vehicle message conversion system **10** may convert the message into a modified message having a messaging protocol suitable for use by the unmanned vehicle **14***b*. In one embodiment, the unmanned vehicle message conversion system **10** may combine several standardization agreement 4586 messages into a joint archetecture for unmanned systems message suitable for use by the unmanned vehicle **14***b*. In another embodiment, the unmanned vehicle message conversion system **10** may convert a single standardization agreement 4586 compliant message into several joint architecture for unmanned systems compliant messages suitable for use by the unmanned vehicle **14***b*.

In act **106**, the unmanned vehicle message conversion system **10** may optionally receive a message that includes a measured action from the unmanned vehicle **14***b*. The measured action may be a measured value acquired by one or more sensors **30***b* through **30***e* configured on the unmanned vehicle **14***b*. These measured actions may be used to monitor actual actions taken by one or more controllable systems in response to desired actions received from the unmanned vehicle control system **16**. The unmanned vehicle message conversion system **10** may then calculate a modified action based upon the desired action and measured action and transmit this modified action to the unmanned vehicle **14***b*. In one embodiment in which the action is a waypoint or desired destination of the unmanned vehicle **14***b*, the modified action may include one or more alternate waypoints received from the unmanned vehicle control system **16** and temporarily stored in the unmanned vehicle message conversion system **10** for the duration of the mission.

Certain embodiments that calculate a modified action in response to a received measured action from the unmanned vehicle **14***b* may provide an advantage in that reflexive control may be provided for the various controllable systems configured on the unmanned vehicle **14***b*. Reflexive control generally refers to the ability of a system to adapt or change behavior in response to unforeseen impediments or changing ambient conditions. Certain unmanned vehicle control messaging protocols, such as the standardization agreement 4586 protocol, may not provide relatively good reflexive control characteristics. Thus, the unmanned vehicle message conversion system **10** may be operable to utilize the relatively poor reflexive control characteristics of protocols, such as the standardization agreement 4586 protocol, with other unmanned vehicle messaging protocols having relatively strong reflexive control characteristics in certain embodiments.

In act **108**, the unmanned vehicle message conversion system **10** may transmit the modified message to the unmanned vehicle **14***b*. Given this modified message, the unmanned vehicle **14***b* may take appropriate action as provided in the information portion of the modified message.

The previsously described series of actions **102** through **108** may be repeated for each message transmitted from the unmanned vehicle control system **16** to the unmanned vehicle **14***b*. Once transmission and receipt of messages between the unmanned vehicle control system **16** and unmanned vehicle **14***b* is no longer needed or desired, the unmanned vehicle message conversion system **10** may be halted at act **110** in which the unmanned vehicle's **14***b* mission is complete.

An unmanned vehicle message conversion system **10** has been described that may enable control of an unmanned vehicle **14***b* using a unmanned vehicle control system **16** with a messaging protocol that is different from a messaging protocol used by the unmanned vehicle **14***b*. The unmanned vehicle message conversion system **10** may be further operable to implement reflexive logic for various controllable systems configured on the unmanned vehicle **14***b* in which its native messaging protocol may not support relatively good reflexive logic characteristics. Using the unmanned vehicle message conversion system **10**, existing unmanned vehicles **14***b* may be coordinated with other unmanned vehicles **14***b* incorporating a different messaging protocol through a common unmanned vehicle control system **16**.

Although the present invention has been described with several embodiments, a myriad of changes, variations, alterations, transformations, and modifications may be suggested to one skilled in the art, and it is intended that the present invention encompass such changes, variations, alterations, transformation, and modifications as they fall within the scope of the appended claims.

What is claimed is:

**1**. An unmanned vehicle message conversion system comprising:

a first unmanned vehicle control interface that is configured to transmit messages, the messages having a standardization agreement 4586 messaging protocol;

a second unmanned vehicle control interface that is configured to receive messages, the messages having a joint architecture for unmanned ground system messaging protocol;

a message interpreter, wherein the message interpreter includes a reflex driver and a message mapping driver, wherein the reflex driver is operable to modify messages to be transmitted from the message mapping driver to the second unmanned vehicle control interface based on a sensor measurement, and wherein the message interpreter is coupled between the first unmanned vehicle control interface and the second unmanned vehicle control interface, and the message interpreter is operable to:

receive at least one first message including a desired action from the first unmanned vehicle control interface;

convert the at least one first message to at least one second message, the at least one second message having the joint architecture for unmanned ground system messaging protocol;

modify the second message, using the reflex driver, to a modified message; and

transmit the modified message to the second unmanned vehicle control interface.

**2**. An unmanned vehicle message conversion system comprising:

a first unmanned vehicle control interface that is configured to receive messages, the messages having a first messaging protocol;

a second unmanned vehicle control interface that is configured to transmit messages, the messages having a second messaging protocol that is different than the first messaging protocol;

a message interpreter, wherein the message interpreter includes a reflex driver and a message mapping driver, wherein the reflex driver is operable to modify messages to be transmitted from the message mapping driver to the first unmanned vehicle control interface based on a sensor measurement, and wherein the message interpreter is coupled between the first unmanned vehicle control interface and the second unmanned vehicle control interface, and wherein the message interpreter is operable to:

receive at least one first message from the second unmanned vehicle control interface, wherein the at least one first message includes a desired action;

convert the at least one first message to at least one second message, the at least one second message having the first messaging protocol;

modify the second message, with the reflex driver, to create a modified message; and

transmit the modified message to the first control interface.

**3**. The unmanned vehicle message conversion system of claim **2**, wherein the message interpreter is further operable to receive at least one fourth message from the second unmanned vehicle control interface, convert the at least one fourth message to at least one fifth message having the first messaging protocol, and transmit the at least one fifth message to the first unmanned vehicle control interface.

**4**. The unmanned vehicle message conversion system of claim **3**, wherein the at least one fourth message is a plurality of fourth messages, the message interpreter being further operable to assemble the plurality of fourth messages into a single fifth message.

**5**. The unmanned vehicle message conversion system of claim **2**, wherein the desired action is to travel to a desired waypoint, the sensor measurement is relevant to the desired action, and the modified message indicates to travel to a modified waypoint.

**6**. The unmanned vehicle message conversion system of claim **5**, wherein the desired waypoint and the sensor measurement each include longitude and latitude coordinates.

**7**. The unmanned vehicle message conversion system of claim **5**, wherein the desired waypoint and the sensor measurement each include an altitude coordinate.

**8**. The unmanned vehicle message conversion system of claim **2**, wherein the desired action is a desired velocity, the sensor measurement is a measured velocity, and the modified message indicates a modified velocity.

**9**. The unmanned vehicle message conversion system of claim **2**, wherein the first messaging protocol is a standardization agreement (STANAG) 4586messaging protocol.

**10**. The unmanned vehicle message conversion system of claim **2**, wherein the second messaging protocol is a joint architecture for unmanned ground system (JAUS) messaging protocol.

**11**. An unmanned vehicle message conversion system comprising:

a first unmanned vehicle control interface that is configured to transmit and receive messages, the messages having a first messaging protocol, wherein the vehicle control interface transmits messages to, and receives messages from, an unmanned vehicle control system;

a second unmanned vehicle control interface that is configured to receive messages, the messages having a second messaging protocol that is different than the first messaging protocol;

a message interpreter, wherein the message interpreter includes a component operable to modify messages based on a sensor measurement, and wherein the message interpreter is coupled between the first unmanned vehicle control interface and the second unmanned vehicle control interface, and the message interpreter is operable to:

receive at least one first message from the first unmanned vehicle control interface;

convert the at least one first message to at least one second message, the second message having the second messaging protocol;

modify the second message, with the component, to create a modified message;

transmit the modified message to the second unmanned vehicle control interface; and

periodically transmit a heartbeat message to the first unmanned vehicle control interface and transmit a loss of heartbeat message to the unmanned vehicle control system if a response message to the heartbeat message is not received from the first unmanned vehicle control interface.

**12**. A method comprising:

receiving at least one first message having a first protocol from an unmanned vehicle control system;

converting the at least one first message to at least one second message having a second protocol, the second protocol being different from the first protocol;

transmitting the at least one second message to an unmanned vehicle;

receiving a third message including a measured action from the unmanned vehicle;

determining a modified action based upon a desired action included in the first message and the measured action; and

including the modified action in the at least one second message.

**13**. The method of claim **12**, further comprising receiving at least one fourth message having the second protocol from an unmanned vehicle, converting the at least one fourth message to at least one fifth message having the first protocol, and transmitting the at least one fifth message to an unmanned vehicle control system.

**14**. The method of claim **12**, wherein receiving a third message including a measured action further comprises receiving a third message including a measured waypoint, and determining a modified action based upon a desired action included in the first message and the measured action further comprises determining a modified waypoint based upon a desired waypoint included in the first message and the measured waypoint.

**15**. The method of claim **12**, wherein receiving a third message including a measured action further comprises receiving a third message including a measured velocity, and determining a modified action based upon a desired action included in the first message and the measured action further comprises determining a modified velocity based upon a desired velocity included in the first message and the measured velocity.

**16**. The method of claim **12**, wherein receiving at least one first message having a first protocol further comprises receiving at least one first message having a standardization agreement 4586 protocol.

**17**. The method of claim **12**, wherein converting the at least one first message to at least one second message having a second protocol further comprises converting the at least one first message to the at least one second message having a joint architecture for unmanned systems protocol.

**18**. A method comprising:

receiving at least one first message, the first message having a first messaging protocol, from an unmanned vehicle control system;

converting the at least one first message to at least one second message having a second messaging protocol, the second messaging protocol being different from the first messaging protocol;

transmitting the at least one second message to an unmanned vehicle;

receiving a third message including a measured action from the unmanned vehicle;

determining a modified action based upon a desired action included in the first message and the measured action;

including the modified action in the at least one second message; and

periodically transmitting a heartbeat message to the unmanned vehicle and transmitting a loss of heartbeat message to the unmanned vehicle control system if a response message to the heartbeat message is not received from the unmanned vehicle.

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