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(54) **A MONITORING SYSTEM FOR A MILITARY VEHICLE**

(57) According to an aspect of the present invention, there is provided a monitoring system for a military vehicle, the monitoring system comprising: one or more sensors for use in monitoring a condition of a user of the

military vehicle; and a controller arranged to compare a monitored condition of a monitored user with a reference condition, and to provide an output relating to the comparison to one or more users of the military vehicle.

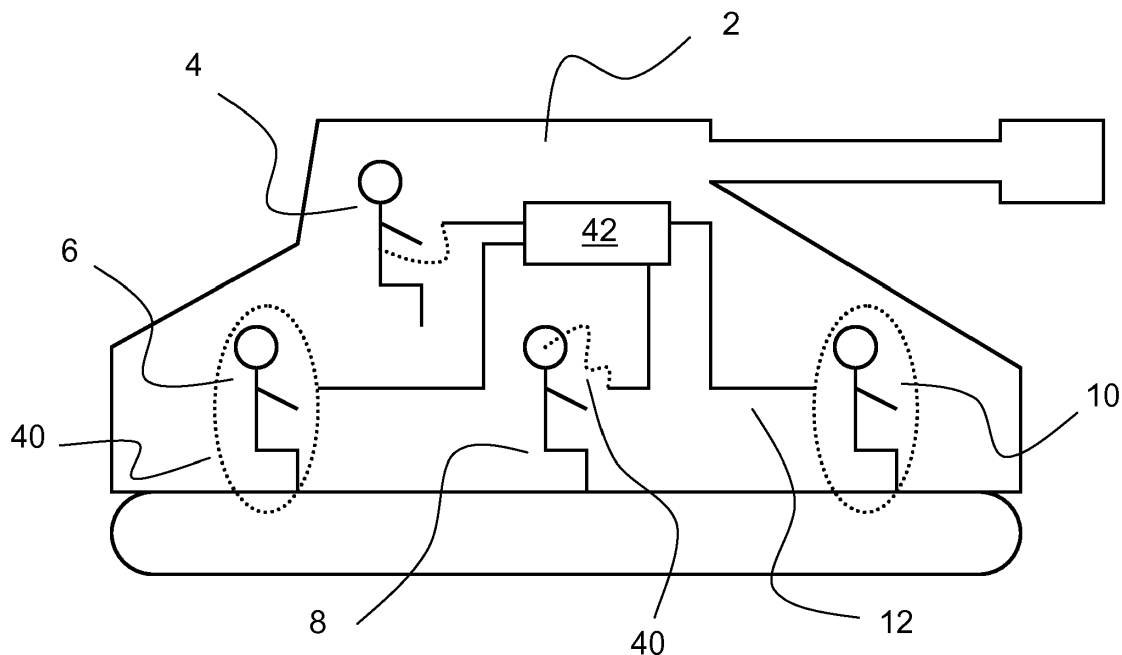


FIG. 6

Description

[0001] The present invention relates generally to a monitoring system for a military vehicle, and to a related monitoring method, and to a vehicle with such a monitoring system.

[0002] Military vehicles are used in a variety of environments. By the very nature of militaristic situations, such vehicles are often used in extremely demanding and strenuous environments. At the same time, users of such vehicles are also working in or under demanding and strenuous conditions. It is generally desirable to improve the control of military vehicles in such environments.

[0003] At the moment, and particularly the case for land-based military vehicles, the vehicle and/or its control systems are not particularly intelligent. For instance, the defence industry in general, and in particular in relation to land-based military vehicles, has not really changed the approach to vehicle control in any significant way in recent times. That is, most military vehicles still require a certain number of users (e.g. crew members) to control a certain number of vehicle functions, the certain vehicle functions being specific to each user. This ties the number of users to a particular vehicle. At the same time, users of such military vehicles may make decisions and perform functions, while at the same time not being in a suitable physical or mental state for making such decisions or undertaking such functions. It is of course desirable to improve the safety of users wherever possible, and minimise the chances of one or more users becoming injured, while at the same ensuring that vehicle functionality is implemented or executed in a rational, safe manner. At the moment, little if any consideration is given to user conditions in the implementation of control of the vehicle.

[0004] It is an example aim of example embodiments to at least partially overcome or avoid one or more disadvantages of the prior art, whether identified above or elsewhere, or to at least provide an alternative to existing methods and/or apparatus.

[0005] According to the present invention there is provided an apparatus and method as set forth in the appended claims. Other features of the invention will be apparent from the dependent claims, and the description which follows.

[0006] According to an aspect of the present invention, there is provided land-based military vehicle, comprising: a weapon firing control system, which requires direct user input to control; one or more other vehicle control systems; a user interface for facilitating interaction between a user of the land-based military vehicle and the one or more other vehicle control systems; wherein the user interface is arranged to be functionally asymmetric, in that a user interaction with the interface of a first functional level relates to an interaction between the interface and the one or more other vehicle control systems of a second functional level, wherein the second functional level is

greater than the first functional level.

[0007] The functional level might be greater, in that: at least a part of the interaction between the interface and the one or more other vehicle control systems is at least partially automated; and/or a number of processes is greater; and/or a complexity is greater; and/or user interaction with the interface is made to replicate interaction with the interface by multiple-users; and/or user interaction with the interface is made to replicate interaction with the interface by a different user.

[0008] The user interface might provide first user functionality, and second user functionality, and the user interface might be arranged to allow a first user to perform: first and second user functionality; and/or second user functionality.

[0009] The second functional level might be greater than the first functional level dependent on, and/or proportional to: a monitored condition of the military vehicle; and/or a monitored condition of a user of the military vehicle; and/or an operational requirement.

[0010] The land-based military vehicle might further comprise a monitoring system for one or more users of the military vehicle. The monitoring system might comprise one or more sensors for use in monitoring a condition of a user of the military vehicle. The user interface might be arranged to use a monitored condition of a monitored user to facilitate selective interaction between one or more users of the military vehicle and: the one or more other vehicle control systems; and/or the weapon firing control system.

[0011] The selective interaction might comprise limiting or preventing interaction. When (and optionally only when) the interaction is limited or prevented, the user interface might be arranged to allow for the greater functional level of interaction, to allow another user of the military vehicle to perform the full interaction of the monitored user.

[0012] The land-based military vehicle might further comprise a controller arranged to compare the monitored condition of the monitored user with a reference condition. The controller might be arranged to provide an output relating to the comparison.

[0013] The controller might be arranged to provide an output relating to the comparison to: the monitored user; and/or a user other than the monitored user; and/or the user interface to facilitate the selective interaction.

[0014] The reference condition might be: of the monitored user; and/or of one or more previous or existing users of the military vehicle.

[0015] The controller might be arranged to provide a real-time output relating to the comparison, and/or to provide the output relating to the comparison when the monitored condition is: greater than a value associated with the reference condition; and/or less than a value associated with the reference condition; and/or within a certain range of a value associated with the reference condition; and/or greater than a value associated with the reference condition, and for a preset period of time; and/or less

than a value associated with the reference condition, and for a preset period of time; and/or within a certain range of a value associated with the reference condition, and for a preset period of time.

[0016] The controller, and/or the one or more sensors, and/or the user interface might: form part of the vehicle; and/or be mobile within the vehicle; and/or be worn/wearable by the monitored user.

[0017] The condition of the user might be: an environment in which the user operates, or could operate; and/or a physiological condition of the user; and/or a physiological condition of the user, obtained by monitoring the user itself.

[0018] Implementation of the second functional level being greater than the first functional level, and/or the selective interaction, might be implemented at least partially, or wholly, in software.

[0019] According to an aspect of the invention, there is provided a method of controlling a land-based military vehicle, the military vehicle comprising: a weapon firing control system, which requires direct user input to control; one or more other vehicle control systems; and the method comprising: via a user interface, facilitating interaction between a user of the land-based military vehicle and the one or more other vehicle control systems; wherein the interaction is functionally asymmetric, in that a user interaction with the interface of a first functional level relates to an interaction between the interface and the one or more other vehicle control systems of a second functional level, wherein the second functional level is greater than the first functional level.

[0020] According to an aspect of the present invention, there is provided a monitoring system for a military vehicle, the monitoring system comprising: one or more sensors for use in monitoring a condition of a user of the military vehicle; and a controller arranged to compare a monitored condition of a monitored user with a reference condition, and to provide an output relating to the comparison to one or more users of the military vehicle.

[0021] The controller might be arranged to provide an output relating to the comparison to: the monitored user; and/or a user other than the monitored user.

[0022] The reference condition might be: of the monitored user; and/or of one or more previous or existing users of the military vehicle.

[0023] The controller might be arranged to provide a real-time output relating to the comparison.

[0024] The controller might be arranged to provide the output relating to the comparison, when the monitored condition is: greater than a value associated with the reference condition; and/or less than a value associated with the reference condition; and/or within a certain range of a value associated with the reference condition; and/or greater than a value associated with the reference condition, and for a preset period of time; and/or less than a value associated with the reference condition, and for a preset period of time; and/or within a certain range of a value associated with the reference condition, and for a

preset period of time.

[0025] The monitoring system might further comprise a user interface for facilitating interaction between a user of the military vehicle and one or more vehicle control systems of the vehicle. That user interface might be arranged to use the monitored condition of the monitored user to facilitate selective interaction between the monitored user and the one or more vehicle control systems.

[0026] The selective interaction might comprise limiting or preventing interaction between the monitored user and the one or more vehicle control systems.

[0027] When (and optionally only when) the interaction between the monitored user and the one or more vehicle control systems is limited or prevented, the user interface might be arranged to allow for another user of the military vehicle to perform the full interaction of the monitored user.

[0028] The controller might be arranged to provide an output relating to the comparison to the user interface to facilitate the selective interaction.

[0029] The selective interaction might be implemented at least partially, or wholly, in software.

[0030] The controller, and/or the one or more sensors, and/or the user interface might: form part of the vehicle; and/or be mobile within the vehicle; and/or be worn/wearable by the monitored user.

[0031] The condition of the user might be: an environment in which the user operates, or could operate; and/or a physiological condition of the user; and/or a physiological condition of the user, obtained by monitoring the user itself.

[0032] In a related aspect, there is provided a military vehicle comprising the monitoring system of the preceding aspect.

[0033] The military vehicle might comprise a weapon firing control system, which requires direct user input to control.

[0034] According to an aspect of the present invention, there is provided a method of monitoring one or more users of a military vehicle, the method comprising: monitoring a condition of a user of the military vehicle using one or more sensors; comparing a monitored condition of a monitored user with a reference condition, and providing an output relating to the comparison to one or more users of the military vehicle.

[0035] According to an aspect of the invention, there is provided a monitoring system for a military vehicle, the military vehicle comprising one or more vehicle control systems, the monitoring system comprising: a user interface for facilitating interaction between a user of the military vehicle and the one or more vehicle control systems; and one or more sensors for use in monitoring a condition of a user of the military vehicle; wherein the user interface is arranged to use a monitored condition of a monitored user to facilitate selective interaction between the monitored user and the one or more vehicle control systems.

[0036] The selective interaction might comprise limiting or preventing interaction between the monitored user

and the one or more vehicle control systems.

[0037] When (and optionally only when) the interaction between the monitored user and the one or more vehicle control systems is limited or prevented, the user interface might be arranged to allow for another user of the military vehicle to perform the full interaction of the monitored user.

[0038] The monitoring system might further comprise a controller arranged to compare the monitored condition of the monitored user with a reference condition. The controller might provide an output relating to the comparison.

[0039] The controller might be arranged to provide an output relating to the comparison to: the monitored user; and/or a user other than the monitored user.

[0040] The controller might be arranged to provide an output relating to the comparison to the user interface to facilitate the selective interaction.

[0041] The reference condition might be: of the monitored user; and/or of one or more previous or existing users of the military vehicle.

[0042] The controller might be arranged to provide a real-time output relating to the comparison.

[0043] The controller might be arranged to provide the output relating to the comparison, when the monitored condition is: greater than a value associated with the reference condition; and/or less than a value associated with the reference condition; and/or within a certain range of a value associated with the reference condition; and/or greater than a value associated with the reference condition, and for a preset period of time; and/or less than a value associated with the reference condition, and for a preset period of time; and/or within a certain range of a value associated with the reference condition, and for a preset period of time.

[0044] The controller, and/or the one or more sensors, and/or the user interface might: form part of the vehicle; and/or be mobile within the vehicle; and/or be worn/wearable by the monitored user.

[0045] The condition of the user might be: an environment in which the user operates, or could operate; and/or a physiological condition of the user; and/or a physiological condition of the user, obtained by monitoring the user itself.

[0046] The selective interaction might be implemented at least partially, or wholly, in software.

[0047] In a related aspect, there is provided a military vehicle comprising the monitoring system of the preceding aspect.

[0048] The military vehicle might comprise a weapon firing control system, which requires direct user input to control.

[0049] According to an aspect of the present invention, there is provided a method of monitoring one or more users of a military vehicle, the method comprising: monitoring a condition of a user of the military vehicle using one or more sensors; facilitating selective interaction between a monitored user and one or more vehicle control

systems of the military vehicle using a monitored condition of the monitored user.

[0050] From a reading of this disclosure, it will be readily apparent to the skilled person that one or more features described in relation to any one aspect of the present invention may be used in combination with, and/or in place of, one or more features of another aspect of the present invention. This is, of course, unless such combination and/or replacement would clearly be mutually exclusive from a perspective of the skilled person after reading this disclosure.

[0051] For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic Figures in which:

Figure 1 schematically depicts a land-based military vehicle including a plurality of users;

Figure 2 schematically depicts a land-based military vehicle according to an example embodiment, in which fewer users are required in comparison with a vehicle of Figure 1;

Figure 3 schematically depicts a land-based military vehicle according to an example embodiment, in which user conditions are monitored;

Figure 4 schematically depicts a land-based military vehicle according to an example embodiment, including a user provided with the functionality of multiple users;

Figure 5 schematically depicts a flow chart for controlling the land-based military vehicle of Figure 4, according to an example embodiment;

Figure 6 schematically depicts a land-based military vehicle according to an example embodiment, in which user conditions are monitored to improve or enhance user interaction with the vehicle; and

Figure 7 and 8 schematically depict flow charts of monitoring methods related to use of the vehicle of Figure 6, according to example embodiments.

[0052] According to example embodiments, and in general, it has been realised that many of the problems of the prior art may be at least partially overcome or avoided by making military vehicles, and in particular land-based military vehicles, more intelligent. This is to the extent that elements of vehicle control may be automated, such that the vehicle may operate with fewer crew members, or crew members that require less specialist training, or crew members that are incapable of competently operating the vehicle. At the same time, user conditions can be monitored in order to improve the safety of the users, or the safety of the users' operation of the

vehicle, or even to feedback that monitoring into the control of the vehicle in order to ensure the vehicle control is undertaken in a more rational, reliable, safe manner.

[0053] For instance, Figure 1 schematically depicts a typical land-based military vehicle 2. The vehicle 2 includes a first user 4, a second user 6, a third user 8, and fourth user 10. The conventional, long-standing view of the defence industry in general is that each of the users 4, 6, 8, 10 each have their own user-specific vehicle control functionality, and therefore all such users are required to properly and adequately control the vehicle 2.

[0054] In contrast, in accordance with example embodiments of the present invention, a step-change in user-vehicle interaction is proposed, by way of appropriately configured user interface (e.g. software implemented), thereby allowing the same vehicle 2 to be controlled by, for example, only a single user 4 (or at least fewer users), as shown in simplistic form in Figure 2.

[0055] Figure 3 goes on to show that, alternatively and/or additionally, user/vehicle interaction may be further improved by taking account of user conditions within the vehicle 2. For example, by tying in monitoring 12 of these conditions at a user interface/controller 14, the user-vehicle interaction may be made to more rational, more consistent or simply safer than without such monitoring and tying in.

[0056] In Figure 4, the vehicle 2 is shown as comprising a weapon firing control system 20, which requires direct user input to control. Direct user input means that the weapon cannot be fired in an entirely automatic manner, i.e. without some form of user input. The vehicle also comprises one or more other vehicle control systems 22, for example perhaps relating to communications, movement, navigation, counter measures etc.

[0057] User interface 14 is arranged to facilitate interaction between a user 4 of the land-based military vehicle 2 and the one or more other vehicle control systems 22. In this particular embodiment, the user interface 14 is arranged to be functionally asymmetric. In this embodiment, this means that a user interaction with the interface 14 of a first functional level relates to interaction between the interface 14 and the one or more other vehicle control system 22 of a second functional level, and that the second functional level is greater than the first functional level. The functional level might be greater, in that at least a part of the interaction between the interface 14 and one or more other vehicle control systems 22 is at least partially automated. For instance, whereas in the past a single user input might result in a single user output, in accordance with example embodiment a single user input may result in a number of automatically generated number of outputs. This might alternatively or additionally be defined as the functional level being greater, in that a number of processes is greater, and/or a complexity is greater. That is, the user interface can scale up or scale down a number or complexity on instructions or processes.

[0058] In a more practical example, driving from posi-

tion A to position B in an existing vehicle might require a command from a first user, navigation from a second user and then movement of the vehicle by a third user. In accordance with an example embodiment of the present invention, however, a single user may instruct the user interface 14 to move the vehicle from location A to location B, and the user interface 14 will be able to automatically implement this via appropriate interaction with the one or more vehicle control systems 22.

[0059] The functional level might be described as being greater in that user interaction with the interface 14 is made to replicate interaction with the interface by multiple-users; and/or to replicate interaction with interface 14 by a different user.

[0060] In terms of replicating multiple-users, this might mean that the vehicle needs to be crewed by fewer users. Alternatively and/or additionally, this might mean that a single user can control the functionality typically controlled by other users, when for example other users are not present or are incapable of implementing that functionality.

[0061] The same/similar is true in terms of a user being able to control a functionality of different user. So, for instance, the user interface 14 might provide a first user functionality, and second user functionality, and the user interface 14 might be arranged to allow a first user to perform first and second user functionality; and/or second user functionality.

[0062] The different user functionality may be actual user functionality, in terms of functionality that is actually controllable by different users within the vehicle 2, or may be more generally referred to as typical user functionality, which functionality is typically considered to be related to that of an individual user in a military vehicle environment. So, for instance, different functionalities might relate to navigation and/or separately, movement of the vehicle. In one instance, and for one vehicle, this might be actual functionality that is normally controlled by two different users, and the implementation of the invention might allow one user to control both types of functionality, or allow one user control a different functionality of a second user. In another example, the invention might simply allow such control from the outset, in that the vehicle can be designed such that multiple users as described previously are simply not required.

[0063] As a result of the above, the whole control of/interaction with vehicle 2 and its control systems 22 is more flexible and intelligent and can be implemented partially, mainly or solely in software.

[0064] The second function level being greater than the first function level may be dependent on, and/or proportional to a monitored condition of the military vehicle; and/or a monitored condition of a user of the vehicle; and/or an operational requirement.

[0065] So, in one example, monitoring of the vehicle using one or more sensors may reveal that one or more parts of the vehicle has become damaged. This damage might affect vehicle functionality in that part of the vehicle

or might indirectly indicate that a user within that part of the vehicle may be incapable of implementing that functionality. Such monitoring may allow for the increase in control of a given user to be ramped up as the damage increases to a certain part of the vehicle, or as damages increases to increasing amounts of the vehicle, thus allowing a user to still control the vehicle without necessarily needing input from other users of the vehicle, or even parts of the vehicle.

[0066] The same of similar might apply to a situation when the users themselves are more directly monitored, for example using one or more sensors in the vicinity of user, or worn by the user. That is, monitoring of a user may indicate that the user is incapacitated, or is incapable of safely implementing certain functionality. At this point, a second function level may be greater than the first function level dependent on and/or proportional to the severity of the user's poor condition, or the number of such users in such a condition, and so on.

[0067] Operational requirements (e.g. military requirements) relating to the military vehicle or the users therein may also have a direct impact on the degree in which second functional level of control is greater than the first functional level of control. For instance, in a training environment the user interface may be configured such that a first user may only ever be allowed a certain degree of control over a certain amount of functionality of the vehicle. In a combat environment, the allowed degree of control of the first user may be increased, to allow for control of one or more other functions of the vehicle, for example typically associated with other users of the vehicle. In a severe or critical military environment, the user may be allowed full control of the entire vehicle. Of course, these are just examples, but are used to get across the degree to which the degree of interaction may be linked to other circumstances, and for examples might be tiered depending on a tiered set of operational requirements.

[0068] Monitoring of a user is described in more detail below, and may be used in combination with changes in functional control (as described above) or independently (as described in more detail below).

[0069] It will be understood that, thus far, the interaction has mainly described as a user having an increasing amount of control, for instance, of the vehicle, via the user interface. However, something close to the opposite might also be of use. That is the vehicle control systems may also interact with the user in an increased functional manner, again tied in with the different circumstances discussed above. For instance, in typical systems, a user responsible for navigation may feedback navigational information to a command user. A user associated with movement of the vehicle may feedback movement commands or information to the command user. However, in accordance with an example embodiment, this feedback, with or without direct user input, may be consolidated by the user interface and fed back to the command user, negating the need for so many users, or at least simpli-

fying the control of the vehicle as a whole (e.g. providing a combined input to a user, rather than a number of discrete inputs).

[0070] For instance, a vehicle sensor may detect a threat at a certain location. Another sensor may determine the degree of movement of the vehicle in order to safely avoid that threat. The user interface 14 can take this information and present to a single user this consolidated information, for example the fact that a threat has been detected and the movement that is required to safely avoid that threat.

[0071] As discussed in more detail below, monitoring of the condition of a user may not be used only for increasing or decreasing the degree of functional control of the vehicle, but may also be used to enhance or facilitate interaction between one or more users of the vehicle and the weapon firing system 20 and/or the one or more other vehicle control systems 22. For instance, this might allow for more rational and/or safe control of the vehicle to be undertaken. Briefly, it might be determined via user monitoring that a particular user is in an extremely stressed state. When monitoring reveals such a situation, that particular user may be have their interaction with vehicle control systems limited to certain functionality, for example movement of the vehicle and so on, but restricted with respect to, for instance, weapon firing functionality.

[0072] Figure 5 is a flow chart schematically depicting a method of controlling the land-based military vehicle described above. The method comprises facilitating interaction between a user of the land-based military vehicle and one or more of its control systems 30. The interaction is arranged to be functionally asymmetric, in that a user interaction of a first functional level relates to interaction between a user interface and the one or more vehicle control systems of a second functional level, when the second functional level is greater than the first functional level.

[0073] The monitoring of user conditions has already been briefly described above. However, the monitoring of user conditions is not necessarily dependent on the different functional levels of control as described in relation to that monitoring. That is, the user monitoring can be used independently, and for different reasons. In that respect, and in another example aspect of the present invention, there is provided a monitoring system for a land-based military vehicle. The monitoring system comprises one or more sensors for use in monitoring a condition of a user of the vehicle. This system comprises a controller (which may be the user interface described above, or connected thereto, or forming part thereof, etc.) arranged to compare the condition of a monitored user with a reference condition and to provide an output relating to the comparison to one or more users of the military vehicle. Monitoring the conditions of one or more users allows more rational and often safer decisions to be implemented by the monitored user, or by another user of the vehicle, or by user interface which takes inputs

from the monitoring system. Outputting the comparison allows for the monitored user, or other users, to have a better appreciation of the user conditions, and to perhaps use that appreciation for better control of the vehicle.

[0074] Figure 6 shows the land-based military vehicle 2 already described above. The monitoring system is shown as comprising one or more sensors 40 for use in monitoring a condition of a user 4, 6, 8, 10 of the vehicle 2. The sensors 40 are connected in a wired or wireless manner to a controller 42, which could be the controller or user interface described above, or forming part thereof, or connected thereto.

[0075] The controller 42 is arranged to compare a monitored condition of a monitored user with a reference condition, and to provide an output relating to the comparison to one or more users 4, 6, 8, 10 of the military vehicle 2. The output relating to the comparison may be provided to the monitored user itself. For instance, the monitored user may be alerted to the fact that their heart rate is too high, or their pulse too slow. Alternatively and/or additionally, the output may be provided to a user other than a monitored user, so that the other user can be aware of the condition of the monitored user. It is envisaged that all users may be inter-connected, so that all users may be aware of the condition of all other users within the vehicle. Monitoring in this way allows the actual condition of the user to be used in some way with the interaction of the vehicle, if only to be aware that of the fact that certain users are stressed or in a poor condition - i.e. the general user-vehicle interaction can be enhanced.

[0076] The reference condition might be of the monitored user and/or of one or more previous or existing users of the land-based military vehicle 2. For instance, the reference condition could be a maximum recommended heart rate, or low temperature tolerance, of a particular monitored user. Alternatively, the reference condition could be, for instance, an average or typical condition of one or more previous or existing users of the land-based military vehicle. For instance, it might be known that users in a hot environment of the vehicle typically become dehydrated more quickly than other users within the vehicle, and this information, from previous users, can be used to better monitor the hydration levels of a user of the vehicle.

[0077] The output may be provided in real-time, so that the or each user may be able to monitor the comparison in real-time. This might be useful in certain circumstances, where one or more users want to continuously monitor a condition. On the other hand, real-time, continuous output could be distracting, or unnecessary. So, the controller might be arranged to provide the output relating to the comparison when the monitored condition meets specific predetermined criteria. For example, the output relating to the comparison might be provided when the monitored condition is: greater than the value associated with the reference condition; less than the value associated with the reference condition; within a certain range of a value associated with a reference condition (which includes

equalling the reference condition or that value); greater than the value associated with a reference condition, and for a pre-set period of time; less than a value associated with a reference condition, and for a pre-set period of time; within a certain range of a value associated with a reference condition for a pre-set period of time. That is, the output might be triggered by an event, or a prolonged event.

[0078] As already alluded to above, the monitoring system/military vehicle may further comprise a user interface, which may be the controller 42, be coupled to the controller 42, comprise the controller 42, or which may be a part of the controller 42. The user interface is arranged to facilitate interaction between a user 4, 6, 8, 10 of the land-based military vehicle 2 and one or more vehicle control systems as already described above. The user interface is arranged to use the monitored condition or the monitored user to facilitate certain selective interaction between the monitored user and the one or more vehicle control systems. Typically, the use of the monitored condition, at least in this embodiment, will be dependent on the comparison with the reference condition. In similar examples, the selective interaction will comprise limiting or preventing interaction between the monitored user and any one or more of the control systems. For example, it can be envisaged that when a user is too dehydrated, or too stressed, they are prevented from interacting with critical vehicle functionality, or weapons control systems, or similar.

[0079] When (and optionally only when) the interaction between the monitored user and the one or more of the control systems is limited or prevented, the user interface may be arranged to allow for another user of the military vehicle to perform the full interaction of the monitored user. That is, the user may take over the full functionality of the monitored user, when the monitored user is for instance not well enough to take appropriate decisions, or implement certain functionality. This ties back in with the aspect of the invention described above, where the functional level of interaction between the users of the vehicle and the vehicle itself may be dependent on monitored conditions of one or more users of the military vehicle.

[0080] The selective interaction may, again, be implemented at least partially, mainly or wholly in software. This is in contrast with, for example, a more mechanical base form of selective interaction, for example movement of a switch being physically restricted, or opening of a hatch or door being physically prevented. Of course, software may play at least a part in such physical restrictions, but it will be of course apparent that is the software that will be undertaking the comparisons and monitoring etc. in the first place.

[0081] One, more, or all of the controller, and/or user interface and/or the one or more sensors discussed above may form part of the military vehicle, for example being attached to or embedded in a part of the vehicle in which a user is operating, or would typically operate. That

is, in that embodiment, the controller/sensors/user interface may not be mobile within the vehicle. In another embodiment, the controller, and/or the one or more sensors, and/or the user interface may be mobile within the vehicle, for example not being fixed in position relative to the vehicle. For instance, in this embodiment, there is a possibility that the controller/sensors/user interface may be portable or similar, for example being or forming part of a smart device, which might be a smart phone or a tablet. In yet another embodiment, the controller, and/or the one or more sensors, and/or the user interface may be worn by a user and in particular a user that is being monitored. This might allow for more convenient monitoring of a user, and/or control of the vehicle by the user, irrespective of their position within the vehicle. Conveniently, the controller, and/or the one or more sensors, and/or the interface might be embodied within a commercial-off-the-shelf (COTS) item, for example a smart phone, a heart rate monitoring belt or band, a blood pressure sensor, or similar. This might reduce the cost, complexity or maintenance costs associated with the apparatus as a whole.

[0082] The user interface and/or controller may take the form of one or more computers or computational devices, likely with some form of display screen for use in providing a graphical user interface to a user. Other interaction options may be provided, for example hardware buttons, levers, sliders, speakers, lights, vibration elements, etc. Touch/haptic input might be useful for ease of input. Haptic feedback might be useful for inputs, e.g. touch inputs, so that the user has confidence that the input has been correctly made. Each user may be provided with their own dedicated user interface/controller, or there could be provided a single user interface/controller (for example a central computer or brain), which users may interact with in some way, for example via user-specific terminals/screens/other input devices or similar. Direct cable links between the user interface(s)/controller(s)/terminal(s) or parts thereof, e.g. as opposed to wireless links, may make for a more rugged connection, both in terms of physical and security robustness. Any hardware may be suitable ruggedized, for example with appropriate casings, covers, protectors, seals, etc., for use in a demanding military environment. These features, and others described herein, allow for much of the control of the vehicle to be in software or to be 'digitized', thus allowing for all of the benefits and flexibilities associated with software implementations - speed, reliability, flexibility, user-specificity, upgradability, maintenance, interaction, and so on.

[0083] A condition of a user as mentioned above may take a number of different forms or interpretations. For instance, in one example, the condition of the user may not necessarily be a physiological condition of the user itself. For instance, the condition of the user may be an environment in which the user operates or could operate. So, in one example, the condition may be an environmental temperature, or environmental radiation expo-

sure level, noise or brightness level, level of vibration, or similar. In fact, there may not actually be a user present in that environment in order for useful conditional monitoring to take place. For instance, such monitoring may reveal that it is not safe for a user to operate in a certain part of the vehicle, or to operate for a certain length of time in that location. Of course, the condition of the user might well be a physiological condition, and in particular a physiological condition obtained by directly monitoring the user itself, which might give more accurate measurements than remote monitoring of the physiological condition/use of prestored user data.

[0084] Environmental condition examples might relate to radiation, temperature, vibration, noise, brightness, humidity and so on. A physiological condition might relate to oxygen levels, blood pressure, sugar levels, temperature, hydration, heart rate, cortisol stress levels, brain activity, consciousness, responsiveness, and so on. In general, the monitored condition of the user might be anything which might affect the performance of the user, and might be obtained by monitoring of the user environment or by physiological monitoring of the user.

[0085] As mentioned above, the monitoring, and/or actions taken in respect of such monitoring, might be performed relative to a reference condition. The reference condition may be stored or otherwise provided in any convenient manner. For instance, in different embodiments the reference condition might be stored within the vehicle in some way, for example within a vehicle system or sub-system, or within the sensor, or the user interface, or within the controller, or in a storage that is connected to one or more of these. In another example, the reference condition could be provided from outside of the vehicle, and for example transmitted into the vehicle as and when needed. This might provide some enhanced functionality in more advanced vehicles, where for example users can "log in" to the vehicle and then obtain specific reference conditions for that user within that specific vehicle, for example from a database. In a similar example, that very same database might be provided local to the vehicle or the user, with all necessary reference condition information being local to the vehicle or user.

[0086] The output provided to the user discussed above might conveniently be a sensory output that is in some way perceptible by the user, for example, to function as some kind of indicator or alert. The output may therefore be audible, visual and/or tactile/haptic in form, or a combination of one or more of these. The output might be dependent on the environment in which the vehicle is operating, or in which the user operates. In a noisy environment a visual output might be preferable to an audible or tactile/haptic output. In an environment where light levels are constantly changing, an audible or tactile/haptic alert might be preferable. A controller/user interface may be arranged to provide multiple types of sensory output, and/or arranged to provide one or more particular outputs suited to the conditions. For example, if a user is to be alerted to a brightness being too high, the

user interface will not use a visual indicator. If the noise levels are too high, an audible output would not make sense, and so on.

[0087] The controller, user interface, and/or sensors discussed above will likely be connected or coupled together in some way, for example in a wired or wireless manner. In different embodiments, it is clearly plausible that the controller could be a part of the user interface, or the user interface part of the controller. Similarly, any one or more of the controller, user interface, and sensor, could form part of a single object or item or product, for example a smart watch, a smart phone, or some other form of smart sensor or the like.

[0088] As already alluded to above, a user interface may be arranged to use monitored conditions of a monitored user to implement or allow for selective interaction between the monitored user and the one or more vehicle control systems. In the above examples, the selective interaction has been described in relation to different function levels of control, and/or to with reference to reference conditions of the monitored user or similar. However, this selective interaction can be used independently of these other, admittedly related, concepts. That is, it may not be necessary to implement such selective interaction between a monitored user and one or more vehicle control systems based on a reference condition. For instance, detection of a user being incapacitated or stressed or dehydrated, without necessarily any specific reference might still offer significant advantages in the monitoring of a military vehicle, or conditions of users in military vehicles, and thus allow for control of the vehicle in general in a safer and/or more rational manner.

[0089] Figures 7 and 8 are flow charts schematically depicting methods of monitoring one or more users of a military vehicle as described above. The methods may be used independently of one another, or with a degree of overlap or combination with each other.

[0090] In the method of Figure 7, the method comprises monitoring a condition of a user of the military vehicle using one or more sensors 50. The method also comprises comparing a monitored condition of a monitored user with a reference condition 52. The method then comprises providing an output relating to the comparison to one or more users of the military vehicle 54.

[0091] In the related method of Figure 7, the method comprises monitoring a condition of a user of the military vehicle using one or more sensors 60. The method then comprises facilitating selective interaction between a monitored user and one or more vehicle control systems of the military vehicle using a monitored condition of the monitored user 62.

[0092] It will be appreciated from the above that the implementation of the one or more different aspects of the invention allows for a generally more intelligent way of monitoring and/or controlling a military vehicle, and in particular a land-based military vehicle. This allows for the military vehicle to be controlled with a greater degree of intelligence based on the specific users within the ve-

hicle and, optionally, the condition of those users, or even of the condition of the vehicle itself. This might also allow the vehicle to be controlled more rationally and safely in certain scenarios.

[0093] The invention might find particular use in applications relating to land-based military vehicles, where advances in approaches user-vehicle interaction have, for whatever reasons, stagnated. Despite the stagnation, the examples described above have very clear, functional and technical benefits over existing methods and apparatus, and solve long-standing problems in the field relating to (presently) relatively poor user-vehicle interaction.

[0094] Although a few preferred embodiments have been shown and described, it will be appreciated by those skilled in the art that various changes and modifications might be made without departing from the scope of the invention, as defined in the appended claims.

[0095] Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0096] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0097] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0098] The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A monitoring system for a military vehicle, the monitoring system comprising:

one or more sensors for use in monitoring a condition of a user of the military vehicle; and
a controller arranged to compare a monitored condition of a monitored user with a reference condition, and to provide an output relating to the comparison to one or more users of the military vehicle.

2. The monitoring system of claim 1, wherein the controller is arranged to provide an output relating to the comparison to:
 - the monitored user; and/or
 - a user other than the monitored user.
3. The monitoring system of claim 1 or claim 2, wherein the reference condition is:
 - of the monitored user; and/or
 - of one or more previous or existing users of the military vehicle.
4. The monitoring system of any preceding claim, wherein the controller is arranged to provide a real-time output relating to the comparison.
5. The monitoring system of any preceding claim, wherein the controller is arranged to provide the output relating to the comparison, when the monitored condition is:
 - greater than a value associated with the reference condition;
 - less than a value associated with the reference condition;
 - within a certain range of a value associated with the reference condition;
 - greater than a value associated with the reference condition, and for a preset period of time;
 - less than a value associated with the reference condition, and for a preset period of time;
 - within a certain range of a value associated with the reference condition, and for a preset period of time.
6. The monitoring system of any preceding claim, further comprising a user interface for facilitating interaction between a user of the military vehicle and one or more vehicle control systems of the vehicle; wherein the user interface is arranged to use the monitored condition of the monitored user to facilitate selective interaction between the monitored user and the one or more vehicle control systems.
7. The monitoring system of claim 6, wherein the selective interaction comprises limiting or preventing interaction between the monitored user and the one or more vehicle control systems.
8. The monitoring system of claim 7, wherein when the interaction between the monitored user and the one or more vehicle control systems is limited or prevented, the user interface is arranged to allow for another user of the military vehicle to perform the full interaction of the monitored user.
9. The monitoring system of any of claims 6 to 8, wherein the controller is arranged to provide an output relating to the comparison to the user interface to facilitate the selective interaction.
10. The monitoring system of any of claims 6 to 9, wherein the selective interaction is implemented at least partially, or wholly, in software.
11. The monitoring system of any preceding claim, wherein the controller, and/or the one or more sensors, and/or the user interface of claim 6:
 - form(s) part of the vehicle; and/or
 - is/are mobile within the vehicle; and/or
 - is/are worn by the monitored user.
12. The monitoring system of any preceding claim, wherein the condition of the user is:
 - an environment in which the user operates, or could operate;
 - a physiological condition of the user;
 - a physiological condition of the user, obtained by monitoring the user itself.
13. A military vehicle comprising the monitoring system of any preceding claim.
14. The military vehicle of claim 13, wherein the military vehicle comprises a weapon firing control system, which requires direct user input to control.
15. A method of monitoring one or more users of a military vehicle, the method comprising:
 - monitoring a condition of a user of the military vehicle using one or more sensors;
 - comparing a monitored condition of a monitored user with a reference condition, and providing an output relating to the comparison to one or more users of the military vehicle.

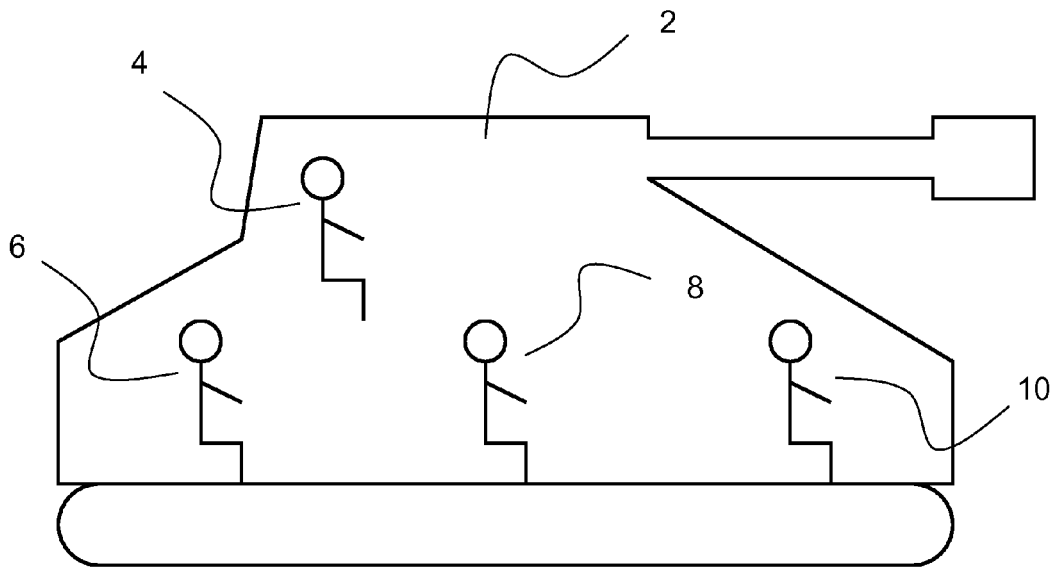


FIG. 1

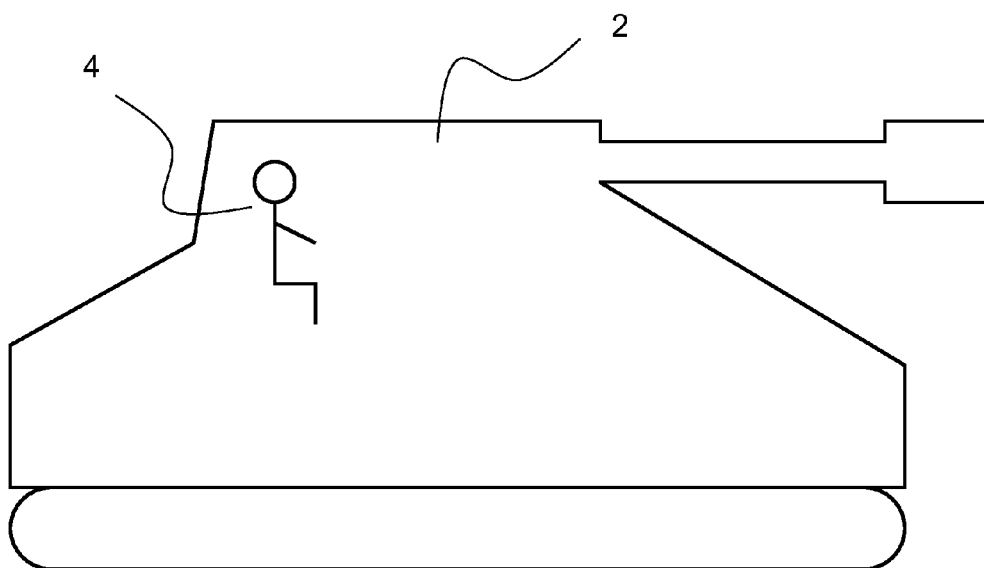
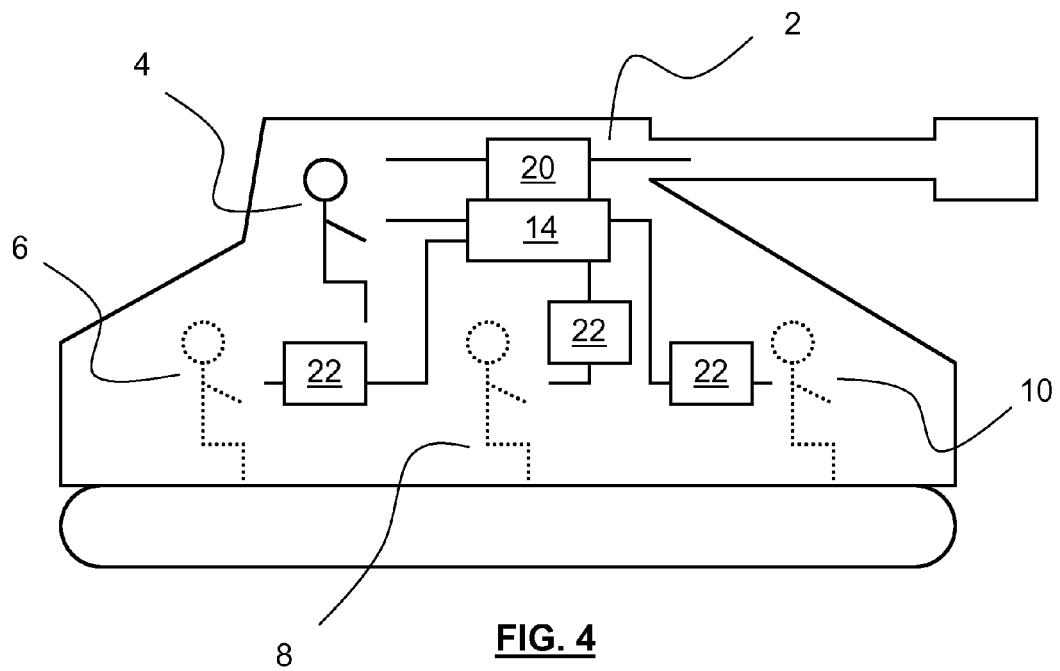
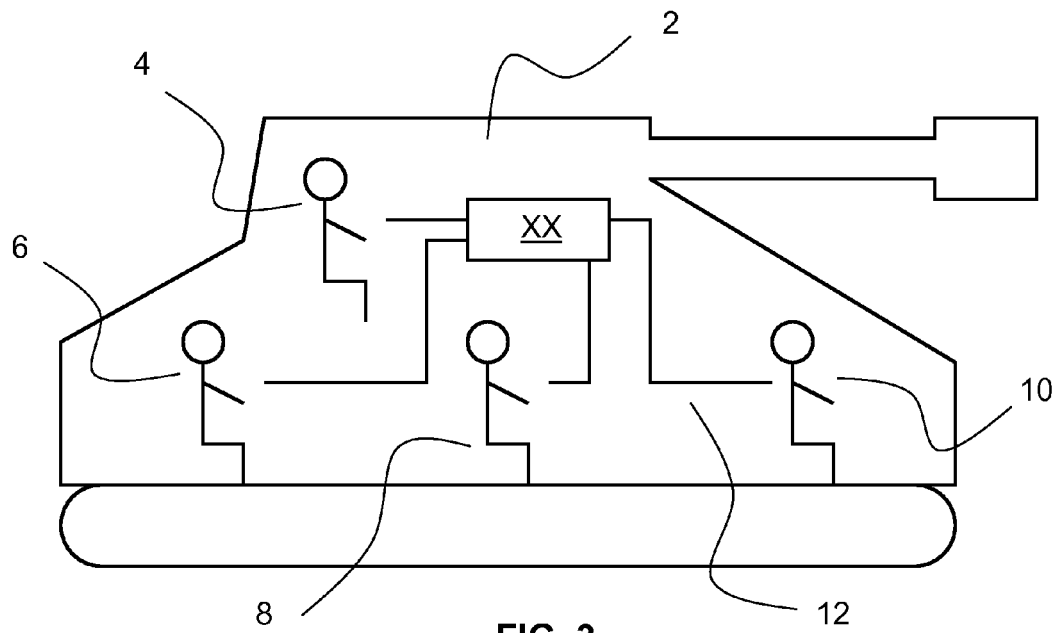


FIG. 2



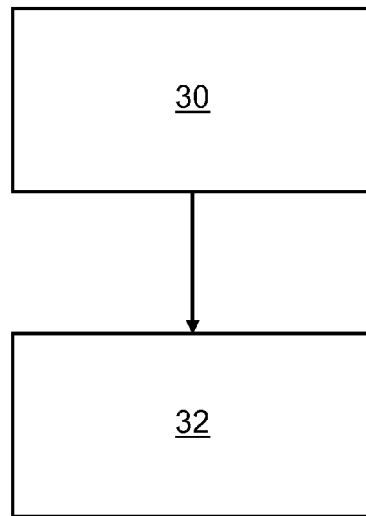


FIG. 5

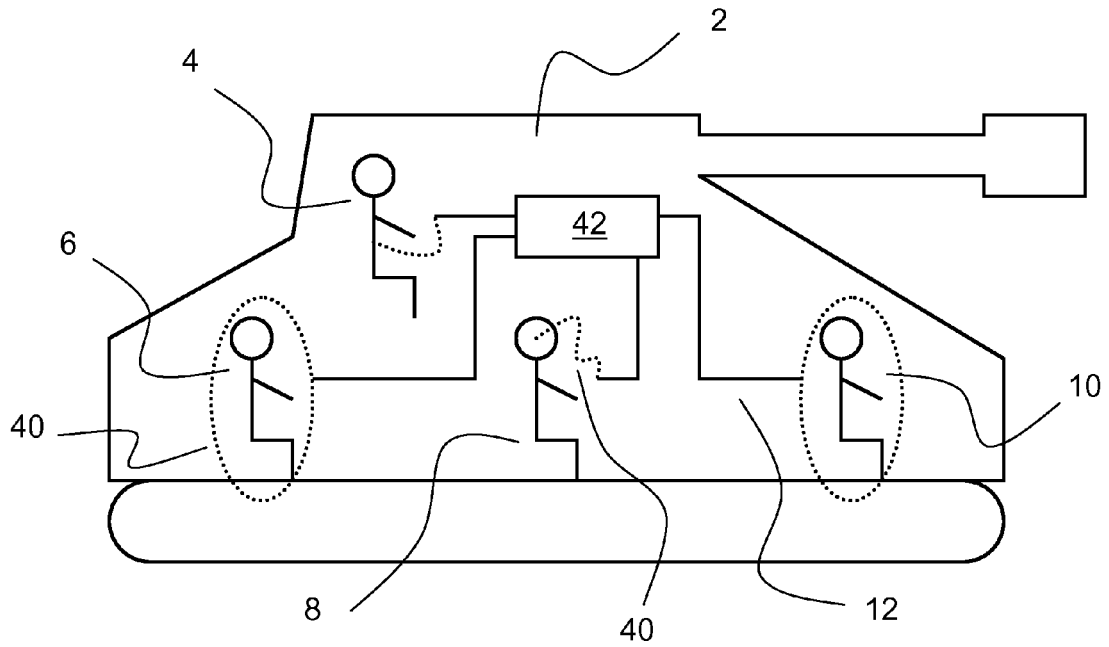


FIG. 6

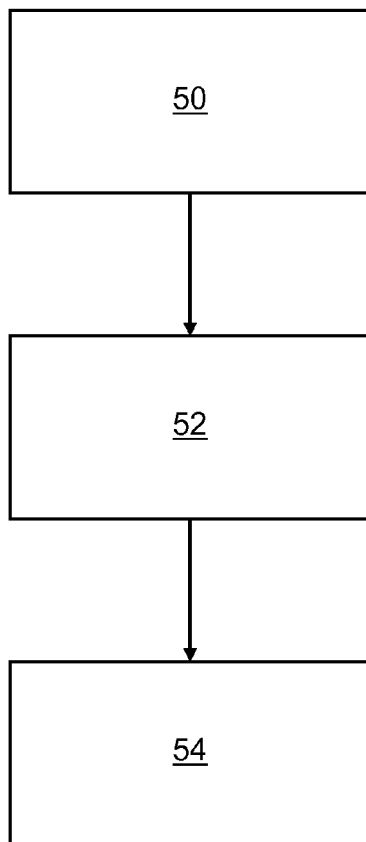


FIG. 7

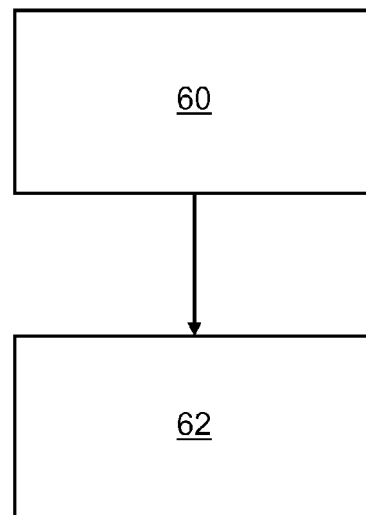


FIG. 8



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Application Number
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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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