

Land-based training device for a submarine crew

The invention relates to a simulator for training a crew, in particular of a submarine, wherein the simulation comprises a simulation space and a virtual simulation environment. It is possible in this case to virtually enter the virtual simulation environment from the simulation space during the training. As a result, training is efficiently possible even for highly complex systems, such as for example a submarine.

Simulators usually comprise a simulation space that reproduces an important area of the vehicle to be simulated. In the case of an aircraft, this is for example the cockpit. This is sufficient for most applications, since the personnel to be trained often do not have to leave the area during normal operation.

In the case of a submarine, however, a quite different problem arises. In this case, it is often necessary to perform training not just on one station, but rather people usually have to be able to access several locations in the submarine. Training is therefore often performed in real submarines. This however leads to the submarine not being available for use during the training time.

The object of the invention is to provide a simulator that allows training for a crew of a submarine without however providing a real submarine for this purpose.

This object is achieved by way of a simulator having the features specified in claim 1. Advantageous developments become apparent from the dependent claims, the following description and the drawings.

The simulator according to the invention serves to simulate a submarine. The simulator has at least one first simulation space, wherein the first simulation space materially emulates a first area of a submarine. By way of example, the first area is the control room, what is known as the bridge, of the submarine. The simulator furthermore has a device for generating and displaying a virtual reality, wherein the virtual reality virtually emulates at least the areas not materially emulated in the simulation space, by way of example and in particular spaces and objects in a submarine, provided that they are accessible to the crew in a submarine. Spaces and objects that have no significance for a simulation may be omitted for the sake of simplification, for example objects that are used for example only for on-board catering. As a result, it becomes possible to supplement the first area present in the first simulation space and thus to make the entire submarine available for the simulation and therefore for the training. The at least one first simulation space has at least one first access device for entering the virtual reality. By virtue of this first access device, it is possible for a person to be trained, during the simulation, to virtually leave the first area that is reproduced in the first

simulation space and to virtually enter other areas of the submarine. Actions are thereby able to be performed in all areas. A simulation is thus not restricted only to a spatially limited area. In comparison with a complete simulation in a virtual reality, the use of a first simulation space containing real components provides for a great improvement in the training due to improved practical experience for the person to be trained leads to significantly improved training results.

Virtual reality within the meaning of the invention is understood to mean a three-dimensional calculated model that reproduces the environment, the inside of the submarine, on the one hand. On the other hand, the virtual reality also comprises the possibility of interacting with this environment, for example of operating switching elements, of opening or of closing hydraulic lines or of actuating mechanical devices. The virtual reality furthermore comprises calculating the effects of these interactions possibly in addition to external influencing variables that are predefined by the scenario given in the simulation, for example simulated system failures, damage and the like.

An access device for entering the virtual reality within the meaning of the invention serves to display the areas, generated in the virtual reality, of the submarine, and has an input device for manipulation purposes. By way of example, the virtual reality may be displayed via a screen or appropriate spectacles. The input for manipulation purposes may be performed for example via keypad, mouse or else gesture recognition. An access device therefore comprises at least one reproduction device and at least one input device. An access device particularly preferably additionally has an acoustic communication device, for example and in particular consisting of a microphone and headphones.

Entering the virtual reality within the meaning of the invention is understood to mean using the access device. In the simplest case, the virtual reality may be entered for example by putting on appropriate spectacles and putting on an appropriate headset.

In a further embodiment of the invention, the simulator has at least one first teaching space, wherein the at least one first teaching space has at least one second access device for entering the virtual reality. It is thereby possible to train both people in the first simulation space and people moving exclusively in the areas that are depicted by way of virtual reality. As a result, it is in particular possible to train the entire ship's crew at the same time.

In a further embodiment of the invention, the simulator has first input means in the at least one first simulation space. The simulator has second input means in the virtual reality. Input means within the

meaning of the invention comprise all possibilities for a person to interact with a submarine. They may for example however not be restricted to computer consoles, levers, valves, switches and the like. By way of example, the trimming may be performed using the corresponding input means on a computer console of the submarine automation system in the first simulation space, but also equally using manual trim pumps. This serves for example to practice behavior in the event of failure of the primary system. The simulator uses inputs via the first input means and inputs via the second input means to simulate the at least one first simulation space. The simulator likewise uses inputs via the first input means and inputs via the second input means to simulate the virtual reality. Precisely the abovementioned example with regard to trimming shows that a complete simulation in the simulator is possible just using the inputs via first input means and second input means.

First input means comprise in particular switchboards and control panels as are used in real submarines. By way of example and in particular, the control room is equipped with real devices that are also suitable for use in a real submarine. The input is thus performed in exactly the same way as the input in a submarine, as a result of which the training result is improved.

Second input means are the devices depicted in the virtual reality, for example switchboards, valves, levers, flaps, doors, computers and the like. The second input means in principle comprise everything that is able to be manipulated by the crew in a submarine. In this case, for the sake of simplifying the simulation, a selection may be made that does not display input means that have no influence on the boat behavior.

Input devices comprise keypad, mouse, gesture recognition, voice recognition, motion capturing and the like.

In a further embodiment of the invention, the virtual reality is designed such that the selection of a second input means is made in two stages, wherein a person initially selects an area containing a plurality of second input means, wherein the simulator displays the selected plurality of second input means in enlarged form, wherein the person is then able to select a particular second input means. This is particularly advantageous if a plurality of second input means are close to one another in the area or these second input means may also be arranged behind one another. This also corresponds to the natural behavior of a person, who initially selects an area in which he/she would like to work and then also focuses his/her attention on said area. This may comprise for example opening a flap or the person bending down to reach a valve.

In a further embodiment of the invention, the simulator is designed to simultaneously train a multiplicity of people. The simulator has communication means. The communication means are designed such that a

person is able to communicate with another person via the communication means only if this is also possible in the submarine. By way of example, people who are situated in the first simulation space are able to talk directly to one another. People who are situated in different spaces in the submarine in the virtual reality are able to talk to one another, for example via a headset, only if they use for example an intercom system, for example in the first simulation space or in the virtual reality, or are situated together in spaces that are not separated by doors or bulkheads, in particular virtual closed soundproof doors or bulkheads, wherein the distance does not exceed the normal possible communication distance in a submarine. This fundamentally distinguishes such a simulator from conventional virtual reality applications in which all of the participants are usually able to communicate constantly with one another. Such a communication possibility would however represent a non-lifelike training situation, which would worsen the training result in the simulator.

In a further embodiment of the invention, the communication means allow communication if the people involved are situated in the same virtual space or use a virtual communication means, for example an intercom system.

In a further embodiment of the invention, the at least one first simulation space is mounted so as to be able to move. The first simulation space may in particular be inclined and/or tilted according to the simulated position of the submarine in space.

In a further embodiment of the invention, the simulator is designed to reproduce people involved in the training in the virtual reality in the form of avatars. An avatar does not in this case have to reproduce a particular person, in particular the appearance of the represented person. For the sake of simplification, generic avatars are preferably used. Due to the spatial confinement in a submarine, precisely the interaction between people involved is highly important. In order for a person to be able to reach a location of an action quickly, it is often necessary to pass other people. In order thereby to achieve a good training result, it is expedient to simulate all of the people involved who are situated in the virtual reality.

In a further embodiment of the invention, the simulator has at least first program elements and second program elements. The first program elements serve to calculate the behavior of the submarine. By way of example, the first program elements serve to calculate the position of the submarine in space depending on the trim position. The second program elements serve to simulate the control of the submarine by way of the installed components. The second program elements are particularly preferably the program elements that are also used in the submarine itself. By way of example, second program elements serve to drive the trim pumps following the inputting of corresponding input values via a data input station.

In a further embodiment of the invention, the simulator has a control room. The control room has control input means, wherein the control input means are designed to intervene in the simulation. By way of example, the failure of individual stations or else an ingress of water may be simulated by way of control input means.

5 Abnormal operating states are thereby also able to be represented easily.

In a further embodiment of the invention, the simulator has at least one second teaching space, wherein the at least one second teaching space materially contains devices that are normally situated in a submarine in the simulator only in the virtual reality. The second teaching space serves for performing training on manual
10 handling procedures using such devices. The devices may for example be connections that need to be for example screwed apart from one another or together. This involves actual manual training on these devices in order to perform simple and efficient training on manual actions by way of practical activity.

The simulator according to the invention is described in more detail below with reference to an exemplary
15 embodiment illustrated in the drawings.

Fig. 1 is a schematic illustration of a simulator

Fig. 1 shows a simulator having a first simulation space 10 and a first teaching space 20. The first simulation
20 space is preferably mounted so as to be able to move, such that the movements of the simulated submarine are reproduced directly and are thus perceptible to people being trained in the first simulation space 10. The first simulation space 10 has first access means 40. These are preferably consoles that are also used on a real submarine. The crew is able to perform control actions via these consoles. A first access device 50 is arranged in the first simulation space 10. A person training in the first simulation space 10 is able to use this
25 first access device 50 to virtually leave the room reproduced in the first simulation space 10. By way of example, the first access device 50 consists of VR spectacles with a headset and motion capturing system.

Three second access devices 52, 54, 56 are arranged in a first teaching space 20. Further people being
trained are able to enter the virtual area of the simulation here.

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List of reference signs

- 10 first simulation space
- 20 first teaching space
- 30 virtual reality

	40	first input means
	50	first access device
	52	second access device
	54	second access device
5	56	second access device

Claims

1. A simulator, wherein the simulator serves to simulate a submarine, wherein the simulator has at least one first simulation space (10), wherein the first simulation space (10) emulates materially with real components a first area of a submarine, wherein the simulator has a device for generating a virtual reality (30), wherein the virtual reality (30) virtually emulates at least the areas not materially emulated in the simulation space (10) that are accessible to the crew when using the submarine, wherein the at least one first simulation space (10) has at least one first access device (50) for entering the virtual reality (30), wherein the real components are suitable for use in a real submarine.
2. The simulator as claimed in claim 1, **characterized in that** the simulator has at least one first teaching space (20), wherein the at least one first teaching space (20) has at least one second access device (52, 54, 56) for entering the virtual reality (30).
3. The simulator as claimed in either of the preceding claims, **characterized in that** the simulator has first input means (40) in the at least one first simulation space (10), wherein the simulator has second input means in the virtual reality (30), wherein the simulator uses inputs via the first input means (40) and inputs via the second input means to simulate the at least one first simulation space (10), wherein the simulator uses inputs via the first input means (40) and inputs via the second input means to simulate the virtual reality (30).
4. The simulator as claimed in claim 3, **characterized in that** the virtual reality (30) is designed such that the selection of a second input means is made in two stages, wherein a person initially selects an area containing a plurality of second input means, wherein the simulator displays the selected plurality of second input means in enlarged form, wherein the person is then able to select a particular second input means.
5. The simulator as claimed in one of the preceding claims, **characterized in that** the simulator is designed to simultaneously train a multiplicity of people, wherein the simulator has communication means, wherein the communication means are designed such that a person is able to communicate with another person via the communication means only if this is also possible in the submarine.

6. The simulator as claimed in claim 5, **characterized in that** the communication means allow communication if the people involved are situated in the same virtual space or use a virtual communication means, for example an intercom system.
7. The simulator as claimed in one of the preceding claims, **characterized in that** the at least one first simulation space (10) is mounted so as to be able to move.
8. The simulator as claimed in one of the preceding claims, **characterized in that** the simulator is designed to reproduce people involved in the training in the virtual reality (30).