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VIRTUAL REALITY TRAINING SYSTEM FOR A SUBMARINE COMMAND CENTER

This application claims the benefit of U.S. Provisional Application No. 60/900,310, filed February 6, 2007 and which is entitled VIRTUAL REALITY TRAINING SYSTEM FOR A SUBMARINE COMMAND CENTER by Douglas B. Maxwell.

STATEMENT OF GOVERNMENT INTEREST

[0001] The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefore.

BACKGROUND OF THE INVENTION

(1) FIELD OF THE INVENTION

[0002] The present invention is directed to training systems. In particular, the present invention is directed to a training system that employs a computer generated virtual reality submarine combat control system.

(2) DESCRIPTION OF THE PRIOR ART

[0003] Currently, concept of operation exercises, where submarine control system physical layouts (such as combat control systems) are tested and where individuals are trained to operate control systems on a submarine, are performed using expensive (both in cost and time) physical model mockups. One physical mock-up prototype must be built for each control room/attack center configuration in order to assess its layout and functionality. It is impractical due to time and cost to continue to build physical mock-ups for future submarines, such as littoral combat vehicles. Virtual models offer the flexibility to assemble and visualize the different configurations of the control room/attack center efficiently and cheaply because they can be reconfigured electronically. What is therefore needed is a system that uses a mixed real and virtual display interaction methodology to generate the visual appearance of control rooms and allow user interaction with mixed real and virtual control panels.

SUMMARY OF THE INVENTION

[0004] It is a general purpose and object of the present invention to create rapid acquisition of expertise in operations and maintenance using simulation and virtual environments, performance measuring and coaching.

[0005] Another general purpose and object of the present invention is to increase training efficiency using distributed training with minimal instructors, exercise monitor resources and authoring tools.

[0006] Another general purpose and object of the present invention is to enhance operational capability using virtual and distributed training aids.

[0007] The above objects are accomplished with the present invention through the use of a system that uses a mixed real and virtual display and interaction methodology to generate the visual appearance of control rooms and the ability to interact with control panels. The tactical environment is modeled using actual design specifications for current combat control systems or proposed design specifications for future/experimental combat control systems. The virtual reality environment is generated through a combination of video clustering, gestural input devices, see-through head mounted displays and head tracking devices. A user is able to operate conceptual virtual displays and work with real tactical data that is located within a virtual submarine attack center. Multiple users, whether students or instructors, are accommodated in the environment, each having the capability to interact with different individual displays pertaining to the user's function in the combat system. Users are able to interact and control the scene using data fed from an actual combat control system trainer in real time. Instructors are able to observe the students performing tasks, take control of their system to guide or tutor, and identify or assess weak points in the different control panel design configurations. The present invention accommodates a team of users, student operators and instructors, each equipped with a head mounted display, head tracker and a communication system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] A more complete understanding of the invention and many of the attendant advantages thereto will be more readily appreciated by referring to the following detailed description when considered in conjunction with the accompanying drawings, wherein like reference numerals refer to like parts and wherein:

[0009] FIG. 1 is a flow diagram of the method of implementing the virtual reality training system for a submarine command center;

DETAILED DESCRIPTION OF THE INVENTION

[0010] Referring to FIG. 1 there is illustrated the method of implementing the virtual reality training system of the present invention. The first step in implementing the training environment is to create a model of the actual environment using design data from existing submarines in operation 10. Multiple virtual models of various attack centers are developed including traditional and conceptual future attack-center versions. Modular design principles are employed to allow the model to be reconfigurable by the training system. Individual displays and consoles are modeled separately 20 and inserted into the environments 30. The displays are overlaid with live tactical streams 40 while in the training environment system as described below. In addition to the model, a scene graph is developed that properly displays the model to scale 50. The scene graph has rules that define the physics of the environment. In a preferred embodiment generating a model and scene graph is accomplished through the use of computer aided design software and a computer cluster having significant graphics capability.

[0011] The next step in implementing the training environment is to develop a training instructor system to allow instructors to network with the students 60. The system hardware consists of a processor, a view and one or more input devices. The processor is a standard desktop personal computer. The view is either a large monitor or wall projector. One of the input devices is a gestural input device that allows the user to navigate the virtual environment in three dimensions. The gestural input device also allows the user to be tracked in the environment. The gestural input device must have proper registration 70, a minimum sensitivity that can detect changes in tracking. Registration of the user in the environment through tracking is a key to creating a realistic three dimensional environment. If the tracking equipment is not accurate enough, then a user may not be able to aim and correctly interact with the environment. For example, if the tracking equipment can only maintain a +/- 6 inch accuracy within the tracking volume, then a 1 inch diameter button would be very difficult to push in a virtual environment. The software gives the instructor the ability to monitor and modify all command center operations 80. The capabilities include view the control center in "God's eye mode," view and take control of any student's view, reconfigure the layout of the control center, and change the live-tactical displays on the control panels.

[0012] The next step in implementing the training environment is to develop a student system using a mixed real and virtual methodology 90. The virtual reality is used to show mock-ups of the submarine attack centers and the locations of other students within the environment. The virtual reality also provides a mix of controls 100 to navigate the space, perform tasks on the control consoles, and interact with other students. The real component of the system is the real interface panel mock ups 110. The students are able to interact with the virtual control panels using the real interface panel mock ups. Each student system consists of a head-mounted display, a mobile computer, keyboard, mouse, head tracker, gestural input device and software. The entire student system is portable and fits within a standard duffle bag. Either a see through or monocle based head mounted display is used so that the student can see the real interface device in front of him or her. The head mounted display supports stereoscopic vision to provide a better sense of depth. The mobile computer can be a laptop, tablet or wearable pc. The head tracker is an inertia based tracker that fits compactly onto the head mounted display. The software shows the training environment and allows the students to move around in virtual space, interact with the control panels, and interact with other students. The software is interactive and distributed, allowing for collaboration with other students at local or remote locations. The real interface device that serves as a model control panel will be populated with real tactical data from simulators as well as live feeds. The feeds become active when the student is positioned in front of the control panes in the virtual attack center. The real interface device is mapped with the same control sequences associated with the virtual control panels. The software will interface with the head tracker to map real head turns to the virtual environment. The software will also generate and display user information about the state of the system and overlay it on the head mounted display screen. When in use the student system can accommodate either all of the students geographically located in the same room, or one student could be in a remote location but they would all see each other in the virtual environment and communicate verbally to each other using voice over internet protocol 120. The instructor may also be in a remote location with complete oversight within the virtual environment.

[0013] The instructor and student systems are integrated through network communication methods and the software has a distributed functionality allowing users from multiple sites to interact within the same model including voice communication 130. The instructor and student systems receive live tactical feeds 140. Some of the tactical feeds are from primary sources or training systems. The feeds are overlaid on the control panels in the virtual environment. The live tactical feeds are part of a curriculum specific to the training goals of the system, primarily the rapid acquisition of expertise in operations and maintenance of combat control systems on submarines 150.

[0014] The advantage of the present invention is that it reduces costs for testing and allows for simulations involving fire and flooding that cannot be done with physical mock ups. The present invention represents a unique combination of several virtual reality technologies in the specific application of combat system training. Unlike conventional 3D walkthrough applications, this application provides the user with the ability to actually interact and control the scene using data fed from an actual combat control system trainer.

[0015] While it is apparent that the illustrative embodiments of the invention disclosed herein fulfill the objectives of the present invention, it is appreciated that numerous modifications and other embodiments may be devised by those skilled in the art. Additionally, feature(s) and/or element(s) from any embodiment may be used singly or in combination with other embodiment(s). Therefore, it will be understood that the appended claims are intended to cover all such modifications and embodiments, which would come within the spirit and scope of the present invention.

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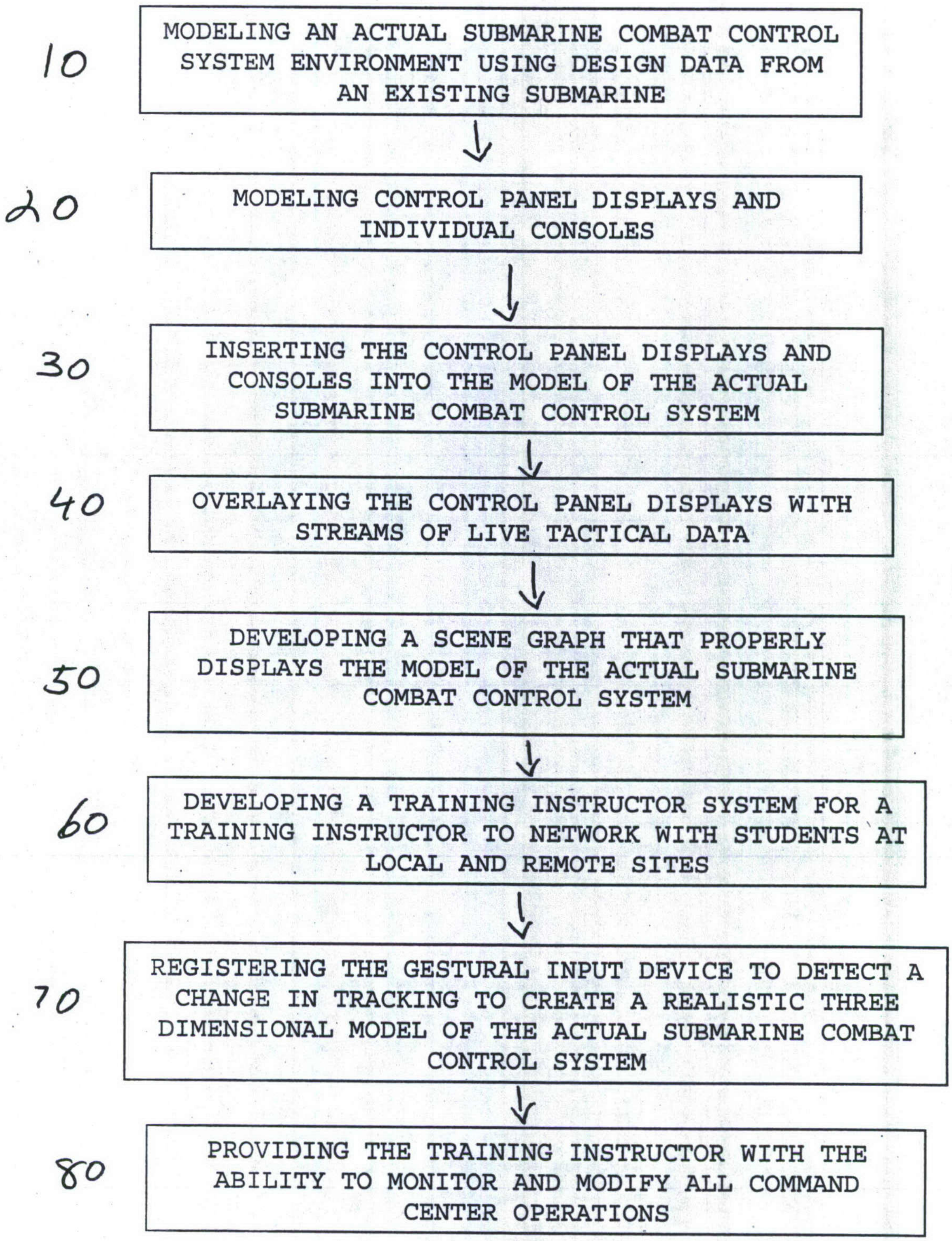
ABSTRACT

The invention as disclosed is a system that uses a combined real and virtual display interaction methodology to generate the visual appearance of submarine combat control rooms and allow interaction with mixed real and virtual control panels for the purposes of training in the operation of submarine combat control systems.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MODELING AN ACTUAL SUBMARINE COMBAT CONTROL SYSTEM ENVIRONMENT USING DESIGN DATA FROM AN EXISTING SUBMARINE
20
MODELING CONTROL PANEL DISPLAYS AND INDIVIDUAL CONSOLES
30
INSERTING THE CONTROL PANEL DISPLAYS AND CONSOLES INTO THE MODEL OF THE ACTUAL SUBMARINE COMBAT CONTROL SYSTEM
40
OVERLAYING THE CONTROL PANEL DISPLAYS WITH STREAMS OF LIVE TACTICAL DATA
50
DEVELOPING A SCENE GRAPH THAT PROPERLY DISPLAYS THE MODEL OF THE ACTUAL SUBMARINE COMBAT CONTROL SYSTEM
60
DEVELOPING A TRAINING INSTRUCTOR SYSTEM FOR A TRAINING INSTRUCTOR TO NETWORK WITH STUDENTS AT LOCAL AND REMOTE SITES
70
REGISTERING THE GESTURAL INPUT DEVICE TO DETECT A CHANGE IN TRACKING TO CREATE A REALISTIC THREE DIMENSIONAL MODEL OF THE ACTUAL SUBMARINE COMBAT CONTROL SYSTEM
80
PROVIDING THE TRAINING INSTRUCTOR WITH THE ABILITY TO MONITOR AND MODIFY ALL COMMAND CENTER OPERATIONS

FIG. 1

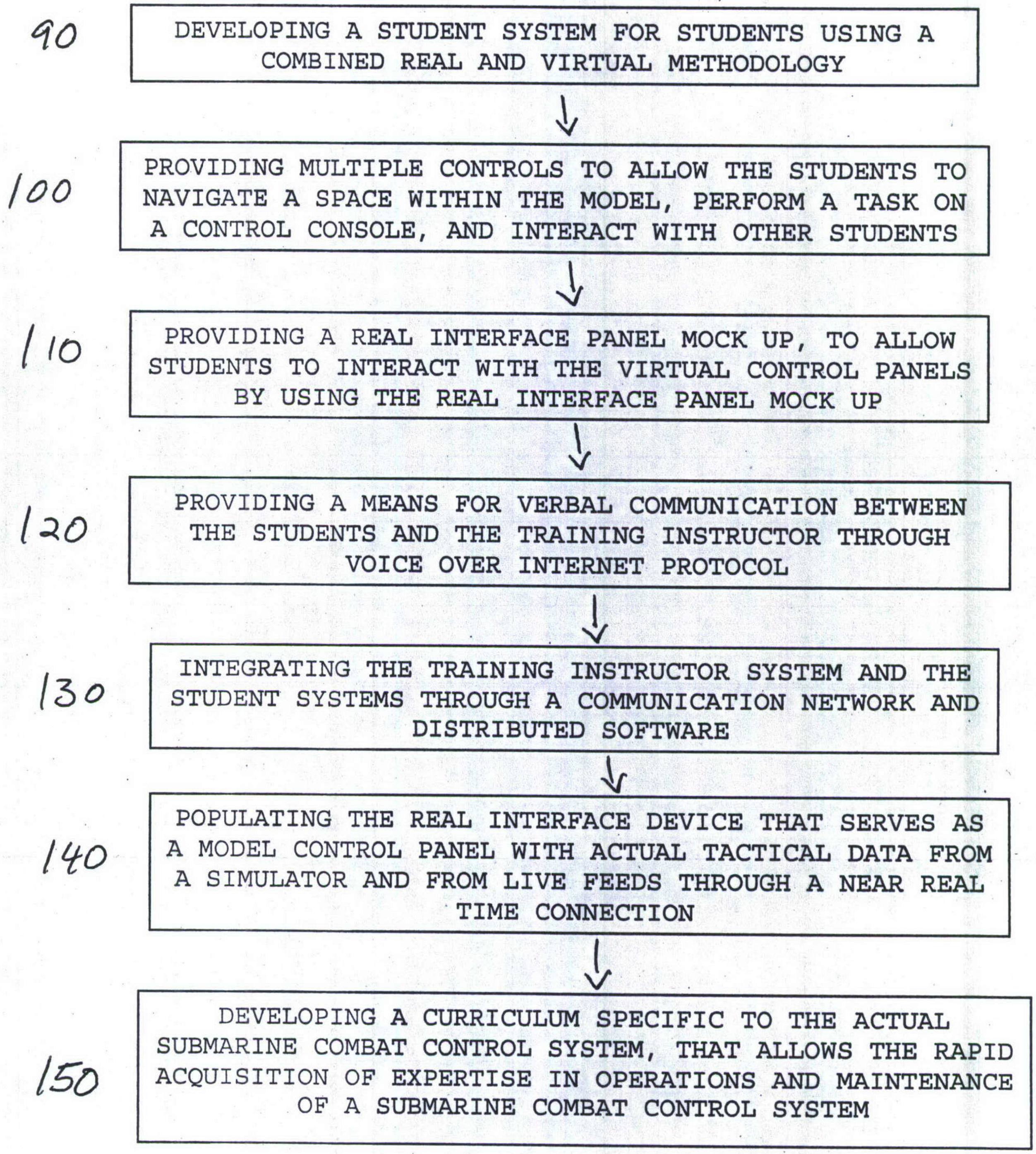

FIG. 1 (continued)