(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 October 2012 (04.10.2012)

(10) International Publication Number
WO 2012/134795 A2

(51) International Patent Classification:
G09B 9/00 (2006.01)

(21) International Application Number:
PCT/US2012/028789

(22) International Filing Date:
12 March 2012 (12.03.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/467,851 25 March 2011 (25.03.2011) US
61/514,769 3 August 2011 (03.08.2011) US

(71) Applicant *(for all designated States except US)*: **EXXONMOBILE UPSTREAM RESEARCH COMPANY** [US/US]; CORP-URC-SW359, P.O. Box 2189, Houston, TX 77252-2189 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **CHEBEN, Joseph, M.** [US/QA]; ASAS Towers, Apt. E404, P.O. Box 22500, Doha (QA). **CAFIERO, Dennis** [US/US]; EON Reality, 39 Parker, Suite 100, Irvine, CA 92618 (US).

(74) Agents: **TIMMINS, Stephen** et al.; Exxonmobil Upstream Research Company, CORP-URC-SW359, P.O. Box 2189, Houston, TX 77252-2189 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

WO 2012/134795 A2

(54) **Title**: IMMERSIVE TRAINING ENVIRONMENT

(57) **Abstract**: A real-time immersive training system is provided. The system includes an immersive visualization room that includes a rendering device configured to provide a three dimensional image of a workspace on a display surface, an operations console configured to provide plant information to the rendering device and obtain operator input from an input device, and a communications system configured to interact with a plant simulator. An operator console includes a control display and input system designed to simulate a plant control board for the workspace. A dynamic process simulator is configured to run a process simulation of the workspace, provide simulated real time data of the workspace to the immersive visualization room and the operator console, accept control inputs from the operator console, and interaction data from the immersive visualization room. An instructor system is configured to interact with the dynamic process simulator, the operator console, or the immersive visualization room, or any combinations thereof, and is configured to activate simulations of events.

IMMERSIVE TRAINING ENVIRONMENT

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from both U.S. Provisional Patent Application No. 61/467,851, filed on March 25, 2011, entitled APPARATUS AND SYSTEMS FOR THREE DIMENSIONAL IMMERSIVE TRAINING AND METHODS RELATED THERETO and U.S. Provisional Patent Application No. 61/514,769, filed on August 3, 2011, entitled IMMERSIVE TRAINING ENVIRONMENT, both of which are incorporated by reference herein in their entirety.

FIELD

[0002] The present techniques relate to apparatus and systems for training. More particularly, the disclosure is related to an immersive environment for training plant operators.

BACKGROUND

[0003] This section is intended to introduce various aspects of the art, which may be associated with exemplary embodiments of the present techniques. This discussion is believed to assist in providing a framework to facilitate a better understanding of particular aspects of the present techniques. Accordingly, it should be understood that this section should be read in this light, and not necessarily as admissions of prior art.

[0004] Hydrocarbon usage is a fundamental aspect of current civilization. Facilities for the production, processing, transportation, and use of hydrocarbons continue to be built in locations around the world. The efficiency of these plants become increasingly important, as even issues can add to cost or create issues for regulatory agencies.

[0005] Training of operators for these facilities can be challenging, as training classes may not engage the operators sufficiently for knowledge retention. Further, training on the active process may be expensive, as an experience operator is often required to continuously monitor the trainee during the training. Training on the actual process may also lead to process upsets, as inexperienced personnel may activate the wrong controls or at the wrong time.

[0006] Virtual reality (VR) simulations are available for training. These simulations provide a training environment that can allow an employee to move about in a virtual plant environment and make changes to the plant environment. However, the simulations do not provide a subjective reality, often merely providing a flat screen environment, through which an operator can move an avatar, or other representation, using a mouse. In some VR simulations, an operator may wear a VR headset, which can provide a stereoscopic view of the plant environment, however, this may not provide a realistic feel of the physical environment, as the visual space may not be in high resolution, and may not include a visualization of the operator.

[0007] Accordingly, new training technologies are needed that accurately reflect the real environment that a trainee is functioning within. These environments should allow an operator to actually see their interactions with the physical environment of the plant.

SUMMARY

[0008] An embodiment provides a real-time immersive training system. The system includes an immersive visualization room. The immersive visualization room includes a rendering device that is configured to provide a three dimensional image of a workspace on a display surface and an operations console that is configured to provide plant information to the rendering device and obtain operator input from an input device. The immersive visualization room also includes a communications system that is configured to interact with a dynamic process simulator, retrieve plant information for the operations console, and pass operator input back to the dynamic process simulator. The system includes an operator console that includes a control board designed to simulate a plant control board for the workspace. The dynamic process simulator is configured to run a process simulation of the workspace, provide simulated real time data of the workspace to the immersive visualization room and the operator console, accept control inputs from the operator console, and interaction data from the immersive visualization room. An instructor system includes a system configured to interact with the dynamic process simulator, the operator console, or the immersive visualization room, or any combinations thereof. The instructor system is configured to activate simulations of events.

[0009] Another embodiment provides a real-time immersive training system that includes a number of immersive visualization rooms. An immersive visualization room includes a display configured to provide a three dimensional image of a workspace, and an input system configured to obtain data representing an interaction with the workspace. In this embodiment, a multi-user server is configured to allow interactions between each of the immersive visualization rooms, wherein trainees in each of the immersive visualization rooms can see representations of trainees in other immersive visualization rooms. The real-time immersive training system includes an operator console that includes a control board

designed to simulate a plant control board for the workspace. A dynamic process simulator is configured to run a process simulation of the workspace and provide simulated real time data of the workspace to each of the plurality of immersive visualization rooms and the operator console. The dynamic process simulator is configured to accept control inputs from the operator console, and accept interaction data from each of the immersive visualization rooms. The real-time immersive training system includes an instructor system that is configured to interact with the dynamic process simulator, the operator console, or the immersive visualization rooms, or any combinations thereof, wherein the instructor system is configured to activate simulations of events.

[0010] Another embodiment provides a method for training workers for a hydrocarbon environment. The method includes placing a field trainee in a real time immersive environment, wherein the real time immersive environment is configured to provide three dimensional images of a workspace to the field trainee, and to accept inputs from the field trainee that represent interactions of the trainee with the environment. An operator trainee is placed at an operations console configured to provide the operator trainee with simulated data representing the workspace. A dynamic process simulator is configured to provide simulated real time data to the field trainee and the operator trainee based, at least in part, on a model of a workplace. A trainer is placed at a training console that is configured to provide control input to the dynamic process simulator to trigger simulations of events, and the trainer is allowed to guide the field trainee and operator trainee through the events.

[0011] Yet another embodiment provides an immersive visualization room, that includes a rendering device configured to provide a three dimensional image of a workspace on a display surface. The immersive visualization room includes an operations console configured to provide plant information to the rendering device and obtain operator input from an input device. A communications device in the immersive visualization room is configured to interact with a plant simulator, retrieve plant information for the operations console, and pass the operator input to the plant simulator.

DESCRIPTION OF THE DRAWINGS

[0012] The advantages of the present techniques are better understood by referring to the following detailed description and the attached drawings, in which:

[0013] Fig. 1 is a block diagram of an immersive training system in which an immersive visualization room is coupled to a dynamic process simulator;

[0014] Fig. 2 is a block diagram of an immersive training system in which a second immersive visualization room is coupled to the dynamic process simulator;

[0015] Fig. 3 is a block diagram of an immersive training system showing different functional units that can work together in an embodiment;

[0016] Fig. 4 is a block diagram of an immersive training system that integrates the functionality of the instructor room into a dynamic process simulator (DPS);

[0017] Fig. 5 is a block diagram of a method for initializing an immersive training system;

[0018] Fig. 6 is a block diagram of a method for interacting with an outside operator in an immersive training system;

[0019] Fig. 7 is a block diagram of a method for interacting with an inside operator in an immersive training system; and

[0020] Fig. 8 is a block diagram of a method for interacting with a trainer in an immersive training system.

DETAILED DESCRIPTION

[0021] In the following detailed description section, specific embodiments of the present techniques are described. However, to the extent that the following description is specific to a particular embodiment or a particular use of the present techniques, this is intended to be for exemplary purposes only and simply provides a description of the exemplary embodiments. Accordingly, the techniques are not limited to the specific embodiments described below, but rather, include all alternatives, modifications, and equivalents falling within the true spirit and scope of the appended claims.

[0022] At the outset, for ease of reference, certain terms used in this application and their meanings as used in this context are set forth. To the extent a term used herein is not defined below, it should be given the broadest definition persons in the pertinent art have given that term as reflected in at least one printed publication or issued patent. Further, the present techniques are not limited by the usage of the terms shown below, as all equivalents, synonyms, new developments, and terms or techniques that serve the same or a similar purpose are considered to be within the scope of the present claims.

[0023] As used herein, a "Facility" is a tangible piece of physical equipment through which hydrocarbon fluids are produced from a reservoir, injected into a reservoir, processed, or transported. In its broadest sense, the term facility is applied to any equipment that may be present along the flow path between a reservoir and its delivery outlets. Facilities may comprise production wells, injection wells, well tubulars, wellhead equipment, gathering lines, manifolds, pumps, compressors, separators, surface flow lines, steam generation plants, processing plants, and delivery outlets. Examples of facilities include LNG plants, LNG tanker vessels, and regasification plants.

[0024] A “hydrocarbon” is an organic compound that primarily includes the elements hydrogen and carbon, although nitrogen, sulphur, oxygen, metals, or any number of other elements may be present in small amounts. As used herein, hydrocarbons generally refer to components found in natural gas, oil, or chemical processing facilities.

[0025] As used herein, the term "natural gas" refers to a multi-component gas obtained from a crude oil well (associated gas) and/or from a subterranean gas-bearing formation (non-associated gas). The composition and pressure of natural gas can vary significantly. A typical natural gas stream contains methane (CH_4) as a major component, i.e. greater than 50 mol% of the natural gas stream is methane. The natural gas stream can also contain ethane (C_2H_6), higher molecular weight hydrocarbons (e.g., C_3-C_{20} hydrocarbons), one or more acid gases (e.g., hydrogen sulfide), or any combination thereof. The natural gas can also contain minor amounts of contaminants such as water, nitrogen, iron sulfide, wax, crude oil, or any combination thereof.

[0026] “Substantial” when used in reference to a quantity or amount of a material, or a specific characteristic thereof, refers to an amount that is sufficient to provide an effect that the material or characteristic was intended to provide. The exact degree of deviation allowable may depend, in some cases, on the specific context.

Overview

[0027] Apparatus and methods are provided herein for an immersive training system that used real-time three-dimensional (3D) graphics and operator interactions. These features allow an outside operator to manipulate valves, press buttons, and the like, as if located in the actual plant environment. Further, both an inside operator of a control board and an outside operator can work together to control the simulation, in which each sees the responses in the simulation that they may see in the actual environment (e.g., a visual indication is displayed or presented as part of the simulation). The inside operator and outside operator can be in radio communications as if they were in the real plant environment. The responses are generated by a dynamic process simulation model of the process.

[0028] The training session can be monitored and controlled by an instructor who also interfaces with the dynamic process simulator. The instructor can trigger events in real-time via this console, to increase the difficulty level and randomness of the training session.

[0029] The system may be expanded to include multiple outside operators in 3D environments in communication with multiple inside operators. Further, the system may be interfaced to other simulation environments, such as ship simulators, to provide a complete training experience for operators and crew. The apparatus and systems make a realistic 3D environment that can make individuals feel as if they are in their actual work environment. This realism makes the training more effective and better equips personnel to perform their jobs quickly and effectively. The simulation is also physically realistic, e.g., using collision detection and avoidance so the trainees cannot navigate through virtual objects. In one or more embodiments, the 3D models are photo-realistic to further enhance the apparent reality.

[0030] Fig. 1 is a block diagram of an immersive training system **100** in which an immersive visualization room **102** is coupled to a dynamic process simulator **104**. In an embodiment, the immersive visualization room **102** is an ICube display available from EON Reality of Irvine, CA, USA. The immersive visualization room **102** provides an immersive display **106** in which a surfaces, such as walls, floor, or ceiling, display a three dimensional image of the workspace, e.g., an offshore platform, a tanker, a chemical plant, a LNG plant, a LNG tanker, a refinery, and the like. In some embodiments, all six walls of an immersive visualization room **102** display the workspace, providing a complete immersion. The immersive visualization room **102** can include any number of other types of simulation rooms, such as rooms that project displays onto a curved or convex surfaces or a dome. A 3D simulation and image generator **108** generates the display of the workspace, and accepts input from an outside operator **110**. The 3D simulation and image generator **108** can include any number of separate systems to obtain data and inputs, and generate the displayed images, as discussed further with respect to Fig. 3. A radio **112**, or other devices, may be used to communicate with other personnel during the simulation.

[0031] The immersive visualization room **102** communicates with the dynamic process simulator **104** to exchange process parameters **114**, which are used to create and adjust the images for the immersive display **106**. Such process parameters include valve positions, plant instrument readings, vessel temperatures, vessel pressures, and other information, such as plant vessel conditions, leaks, and the like.

[0032] The dynamic process simulator **104** models the dynamic processes of the workspace and, thus, can provide the same response as a real workspace. The feedback and reactions of the simulated dynamic process may then be translated back to the virtual 3D world, resulting in status lamps lighting, valves moving, alarms sounding, and the like. Training and operating environments may be made more realistic by adding plant sounds, vibration, smells, and visual effects, such as alarms, machinery noise, and gas smells, among others. Effects may also be utilized to simulate walking, climbing ladders, turning valves, and the like. Further, the output from the dynamic process simulator **104** can be translated into scaled visual entities and elements in the images of the immersive display **106**, such as mapping scalar values to valve positions, mapping scalar values to dial positions, and mapping scalar values to numeric digits on virtual displays, among others. Binary or Boolean values may also be mapped, for example, to open/close states on switches and valves, and to neutral and depressed states on buttons, among others. Boolean values may also be mapped to sounds in the environment, such as providing a hissing sound if a leak is indicated.

[0033] Process parameters can be provided to the dynamic process simulator **104** from the 3D simulation and image generator **108**, allowing the outside operator **110** to affect changes in the environment, such as opening or closing valves, turning equipment on or off, and the like. The process parameters **114** allow the display to reflect the actual responses that the operators may see in the environment.

[0034] In an embodiment, a level-of-detail metric is used to limit the process parameters **114** being updated to those that are within the view of the outside operator **110**. This may increase the speed of the simulation and, thus, the appearance of reality, as it may take a significant amount of time to update all of the process parameters **114** in a large plant.

[0035] In addition to the immersive visualization room **102**, the immersive training system **100** has a control room **116** in which an inside operator **118** operates an operator console **120.** The operator console **120** simulates a plant control board, allowing the inside operator **118** to control valves, motors, and the like, and to monitor plant readings such as vessel pressures, temperatures, levels, and the like. A radio **112**, or other device, can be used by the inside operator **118** to communicate with the outside operator **110**, and other personnel.

[0036] The operator console **120** functions by exchanging inside display parameters **122** with the dynamic process simulator **104**. To further increase the reality of the simulation, the inside display parameters **122** may be signals provided to a DCS controller by a digital/analog simulation of the plant running on the dynamic process simulator **104**. This can allow the inside operator **118** to gain experience with a control console **120** that matches the type used in the real plant environment.

[0037] The immersive training system **100** can be controlled from an instructor room **124** in which a trainer **126** monitors one or more training consoles **128**. The instructor room **124** does not have to be separate from the control room **116**, but may be part of the control room **116**, for example, if the trainer **126** were on an elevated platform overseeing the operations in the control room **116** and immersive visualization room **102**. If the instructor room **124** is separate from the other rooms, the trainer **126** may use a radio **112**, or other device, to communicate with the inside operator **118** and outside operator **110**.

[0038] The training consoles **128** can exchange information **130** with the operator consoles **120**, for example, allowing the trainer **126** to see a screen or make an adjustment to a control. Other functions may also be performed by the training consoles **128**, such as exchanging control information **132** directly with the dynamic process simulator **104**, allowing the trainer **126** to insert conditions and events directly into the plant environment. The immersive training system **100** is not limited to the number of rooms or systems shown, but may be used to link any number of immersive visualization rooms **102** together to form a multiuser environment, as discussed with respect to Fig. 2.

Multiple operator immersive training system

[0039] Fig. 2 is a block diagram of an immersive training system **200** in which a second immersive visualization room **202** is coupled to the dynamic process simulator **104**. Like numbers are as described with respect to Fig. 1. A second outside operator **204** can interact with the second immersive visualization room **202** in a similar manner to the first outside operator **110**. A multi-user server **206** exchanges information **208** with each of the immersive visualization rooms **102** and **202**. The information **208** keeps tracks of users logging in an out of the system and manages the plant elements when multiple users are interacting with elements simultaneously. The multi-user server **206** can also track an image, or avatar, of each of the outside operators **110** and **204** that may be rendered in the other operator's immersive visualization room **202** and **102**, so that each operator can see the other when they are in the other operator's field-of-view. This tracking of the session data for each outside operator **110** and **204** by the multi-user server **206** ensures that movements and control in one visualization room **102** or **202** are correctly rendered in the other visualization room **202** or **102**.

[0040] The immersive visualization rooms **102** and **202** may be proximate to each other or may be located in distant rooms that are linked through a wide area network. Similarly, the trainer **126** and inside operator **118** may be in other geographic locations. For example, such linkages can allow a trainer **126** in Houston, Texas, to interact with an inside operator **118** in Anchorage, Alaska, and outside operators **110** and **204** in Qatar. As described before, the second outside operator **204** can communicate with other personnel using a radio **112**, or other device. In the case of remotely located personnel, a communications link that simulates a radio over a network may be used.

[0041] Fig. 3 is a block diagram of an immersive training system **300** showing different functional units that can work together in an embodiment. The layout of the immersive training system **300** generally matches the arrangement of Fig. 1. As described above, an immersive visualization room **302**, an inside operator room **304**, and an instructor room **306** can communicate with a dynamic process simulator **308** over a network **310**, such as an local area network, a wide area network, or a virtual private network (VPN) hosted across the internet. The network **310** may an Ethernet network, a proprietary plant network, or any other networking protocol.

[0042] The immersive visualization room **302** can include a number of systems that allow the immersive visualization room **302** to function as a modular unit that may be used in concert with any number of process simulators. In the immersive visualization room **302**, a network interface card (NIC) **312** can couple to the network **310**. The NIC **312** is part of a computer system, such as an Open Process Control (OPC) server **314**, which functions as an application programming interface (API) to obtain process parameters for the immersive visualization room **302** from the dynamic process simulator **308**.

[0043] Another computer system may function as the console **316** for the immersive visualization room **302**. The console **316** keeps track of the location of the outside operator **318** in the environment and the operator's position relative to equipment. Using the location information, the console **316** can obtain input from the outside operator **318**, for example, using an input device **320**. In some embodiments, the console **316** may have a NIC **312** and operate to directly obtain tag information, or process parameters, for example, without using the OPC server **314**.

[0044] The input device **320** can include any number of devices, such as a handheld controller used for video games. In an embodiment, the input device **320** can include a laser pointer and camera tracking system to identify the point being selected. In an embodiment, a gyroscopic presentation controller may be used as an input device. In an embodiment, the outside operator **318** may wear gloves and other equipment that has tracking spots affixed to the outside. In this embodiment, the input device **320** can use a light source and a camera to track the motion of the outside operator **318** and interpret the motions to identify command inputs. The input device **320** may include a camera and motion analysis system to interpret motions without further equipment or illumination. The input device **320** can include a treadmill or ball type enclosure to allow realistic movements to control simulated motion. Voice commands may be used with a voice recognition system, for example, saying a phrase such as "select valve," or the like.

[0045] The input device **320** can be used to select devices and enter parameters, such as turning on or off a device, rotating a valve, opening an instrument control panel, moving through the simulated environment, and the like. Any changes to parameter values may then be passed to the OPC server **314** to be transmitted to the dynamic process simulator **308**.

[0046] The console **316** can hold a computer aided design (CAD) model of the environment, which can be used to build the visual model of the plant that is displayed to the outside operator **318**. To perform this function, the console **316** uses the CAD model to communicate equipment views to a series of rendering computers, such as display drivers **322**, each of which may render a different perspective view of the current location. Each of the display drivers **322** may drive a visualization device **324**, which can provide the view for various surfaces **326** of the immersive display. The visualization devices **324** can include single units for each wall **326**, such as a projector, a video display, and the like. In some embodiments, multiple units may be used for a visualization device **324**. In these embodiments, a bank or cluster of video displays may be used for a surface **326**. It can be understood that each of the console **316**, rendering computers **322**, and OPC server **314** may contain multi-core processors or be part of a cluster computing system, to provide the rendering power to make the immersive display operate in a smooth fashion.

[0047] The dynamic process simulator (DPS) **308** provides parameter updates to and accepts parameter inputs from the immersive visualization room **302**, for example, through the OPC server **314**. To perform this function, the DPS **308** is linked to the network **310**, for example, by a network interface card (NIC) **328**. The NIC **328** is linked to a bus **330**, which allows communications and control by a processor **332**. The processor **332** may be a single core processor, a multi-core processor, or a computing cluster. The processor **332** can access code stored in a memory **334** to perform the functions described herein. The memory **334** may include any combination of random access memory (RAM), read only memory (ROM), flash memory, and the like. A storage system **336** can be used to store code for the functions described herein, as well as for the operating system, communications, and the like. In some embodiments, the dynamic process simulator **308** may function as a central server, providing the functional code and rendering information to all of the other units **302**, **304**, and **306**.

[0048] A plant database **338** can contain the plant parameters, for example, in a relational database format. The plant database **338** may be stored in the storage system **336** or may be in a separate storage system. Code modules can be configured to direct the processor **332** of the DPS **308** to adjust output parameters based on input parameters, time, flows, compositions, and the like, i.e., to function as a process simulator. The output parameters can then be provided to the other units **302**, **304**, and **306** for display. In some embodiments, this may be performed automatically, based on a previously determined location or screen. In other embodiments, the other units **302**, **304**, and **306** may track their own location or screens, requesting values from the DPS **308** when needed.

[0049] The control room **304** may communicate process parameters in a number of different ways. A NIC **340** may place the control room **304** in communication with the DPS **308** over the network **310**, allowing the operator console **342** to access and set parameter information as digital values, such as in OPC format or directly into registers on a DCS.

[0050] In some embodiments, the operator console **342** may be a functional distributed control system (DCS) with its own consoles. In this embodiment, the operator console **342** may communicate with the DPS **302** through analog and binary links **344**. Plant equipment interfaces **346**, such as analog-to-digital convertors, digital-to-analog convertors, binary inputs, and binary outputs may be used at each end of the links **344**. The DPS **308** can then function as a simulation of a plant, providing simulated analog values to the DCS.

[0051] The operator console **342** provides display information to screen displays **348** and accepts input from input devices **350**, such as keyboards, mice, trackballs, and the like. Thus, an inside operator **352** can select a screen, which triggers the operator console **342** to build the graphics, access the relevant parameters from the dynamic process simulator **308**, and display the screen on the displays **348**.

[0052] The instructor room **306** can also tie into the network **310** using a network interface card **354**. An instructor console **356** can display information about the system on one or more displays **358**. The trainer **360** can use input devices **362** to access information or enter commands. For example, through the network **310**, the instructor consoles **356** can be used to access screens from the operator consoles **342**, change settings through the operator consoles **342**, view screen shots from the immersive visualization room **303**, or directly modify parameters in the plant database **338** of the dynamic process simulator.

[0053] Additional systems could be added to the network **310**, as described with respect to Fig. 2. These systems could include more immersive visualization rooms, more control rooms or consoles, and more instructor rooms. In an embodiment, for example, a ship simulator may be tied to the system to provide a comprehensive simulation of an LNG tanker. The immersive training system **300** is not limited to the configuration shown above. In other embodiments, some of the functionality may be more integrated, which may lower the total cost of the immersive training system 300.

[0054] Fig. 4 is a block diagram of an immersive training system **400** that integrates the functionality of the instructor room **402** with a dynamic process simulator (DPS) **404**. In this arrangement, the DPS **404** provides the displays **406** and input devices **408** for the trainer **410**, giving the trainer **410** direct control of the DPS **404**. The DPS **404** has a processor **410** that can access code in a storage system **412** to provide the functionality. The code is configured to direct the processor **410** to access parameters in a plant database **414** and change other parameters based on the parameters accessed, e.g., to provide a process simulation. The code can also direct the processor **410** to access parameters in the plant database **414** and provide those parameters to other systems, such as an immersive visualization room **416**. The immersive visualization room **416** functions as described with respect to the previous figures.

[0055] In this embodiment, the DPS **404** acts as a server for two simulator clients **418** in a control room **420**. The simulator clients **418** render information for displays **422** and accept input from inside operators **424** through input devices **426**. However, the simulator clients **418** may not be full operator consoles in this embodiment and may merely display screens and information sent from the DPS **404**.

[0056] Various methods can be used for interacting with the immersive training system described herein, as discussed with respect to Figs. 5-8. It can be understood that the immersive training system is not limited to these methods or functions, as any number of further functions can be performed by the various parts of the system. Further, the methods discussed below are not to be considered all-inclusive. Other actions may be performed in addition to or instead of the actions listed. The methods are to be considered representative methods that can be used for explanatory purposes.

[0057] Fig. 5 is a block diagram of a method **500** for initializing an immersive training system. The method **500** begins at block **502** with the initialization of the dynamic process simulator. Any number of starting conditions may be used, depending on the training sequence desired. For example, the initial condition loaded may have parameters that correspond to the plant being in a pre-startup (empty) condition. In an embodiment, a set of initial variables are loaded in the plant database that correspond to a normal operating condition. After parameter initialization, the dynamic process simulator starts an updating loop that monitors input parameters and changes output parameters accordingly, i.e., the process simulation. At this point, the dynamic process simulator is ready to provide parameters to the other systems. The remaining systems may be initialized in parallel.

[0058] At block **504**, the initialization of the immersive visualization room (or rooms) may be started, for example, by initializing a console and an OPC, or other API, server. The initialization may include loading plant models and relevant parameter lists from a storage system. At block **506**, an initial location is determined for the outside operator. In an embodiment, this location is at an entry to the plant. In another embodiment, the location is the last location before a shutdown. At block **508**, the OPC server obtains the parameters for objects in view of the current location and provides these parameters to the console. The console generates the objects and parameter linkages for the current view and provides these to the rendering computers, which generate the display of the current location.

[0059] Parallel to the initiation of the immersive visualization room, at block **510**, the operator consoles are initialized. These include both the inside operator consoles and the instructor console. The initialization includes determining a start-up screen for the initialization, among others. In an embodiment, the start-up screen is a plant overview screen that allows selection of any of the other process screens. In other embodiments, the start-up screen is the last screen that was accessed before a shutdown. The current parameters for the start-up screen are accessed from the dynamic process simulator. At block **512**, the start-up screen is built and displayed on each of the operator consoles. At block **514**, the immersive training system enters an operations mode. In operations mode, each of the systems loops through an input/updating cycle, as discussed further with respect to Figs. 6-8, below.

[0060] Fig. 6 is a block diagram of a method **600** for interacting with an outside operator in an immersive training system. The method **600** starts at block **602** after the initialization of the immersive training system is finished at block **514** of Fig. 5. The method **600** for interacting with the outside operator can follow any number of paths, depending on the action selected by the outside operator. At any time, at block **604**, the outside operator may communicate with the inside operator, trainer, or other personnel using a radio or other device.

[0061] Referring also to Fig. 3, at block **606**, the immersive training system determines if the outside operator has provided an input, for example, using an input device **320** coupled to a console **316** in an immersive visualization room **302**. If, at block **606**, no input has been provided, the immersive training system performs a screen update. During the screen update, at block **608**, the immersive visualization room accesses simulation parameters from a dynamic process simulator for objects in view of the operator. For example, the immersive visualization room may use a level-of-detail parameter to determine how much information to access for objects that are progressively farther from the outside operator location. At block **610**, a current view of the environment is constructed, for example, by a console that associates the parameters to the graphical elements. At block **612**, the current view is passed to rendering computers that generate the views used for each of the walls and the images on the walls are updated. Process flow then returns to block **606** to check for outside operator input. The screen update and input loop can occur on a time span that can be short enough that the outside operator perceives smooth motion, for example, every 10 milliseconds (ms), every 25 ms, or every 50 ms. It may be clear that as the timeframe gets longer the risk of motion discontinuities leading to a break in the reality of the scene may increase.

[0062] If the immersive visualization room detects an input corresponding to operator motion at block **606**, process flow proceeds to block **614**. At block **614**, the immersive visualization room accepts input that corresponds to an operator motion. The input may be provided by any number of suitable devices, as discussed with respect to block **320**. The input may include turning in place, moving, climbing up a stair or ladder, climbing down a stair or ladder, rotating a view to look up or down, or any number of other motions or combinations of motions. The motions may be combined to form an automated sequence. For example, the outside operator may indicate a desire to climb up a ladder and the console completes the motion and exits the ladder on the next floor. During the motion, at block **616**, the console of the immersive visualization room may determine what objects are currently within the view of the operator. Objects may come into view as they are approached or are no longer hidden behind other objects. Similarly, objects may be hidden or pass out of view as they are left behind.

[0063] Determining which objects are in view prior to obtaining parameters for those objects within view may increase the speed at which the immersive visualization room updates the screens, increasing the apparent reality. However, the immersive visualization room is not limited to obtaining parameters for only the objects in view and may obtain parameters for all objects in the plant simulation. For smaller simulations, this may decrease the overhead of the calculation without affecting the reality of the simulation.

[0064] After block **616**, process control continues at block **608** to perform a screen update, as described above. During automated moves, such as climbing a ladder, going down a staircase, and the like, outside operator inputs may be automatically created to continue the movement until complete. After the screen update is finished at block **612**, process flow returns to block **606** to check for further operator inputs.

[0065] If at block **606**, the console detects an input selecting a control, process flow proceeds to block **618**. The selection may be performed by using a handheld controller to place a cursor on the control, by determining that the operator has placed a hand in proximity to the control, or using any number of other methods. At block **618**, the identity of the control accessed is determined. For example, an outside operator may place a hand proximate to a manual valve, triggering a selection of the valve at block **618**. At block **620**, the console of the immersive visualization room determines the type of control, e.g., manual valve, automatic valve, electrical switch, or manual locks (for lock-out/tag-out operations), among many others. At block **622**, the console determines the action for the control from the control type and operator motion. For example, if the outside operator rotates the hand that is selecting the valve, the valve may open or close in proportion to the hand movement. This same motion may be translated to other types of controllers, for example, if an operator makes a circular motion with a handheld controller, a joystick, or any other type of control device, the valve may be turned a proportional amount. At block **624**, the control position may be changed based on the movement of the valve. At block **626**, the dynamic process simulator is updated with the new control position, for example, using the OPC server **314**. From block **626**, flow proceeds to block **608** to update the screen with the new process parameters. After the screen update is finished at block **612**, process flow returns to block **606** to check for further operator inputs.

[0066] For a control that takes some time to move in the real world, such as a manual valve, intermediate updating of the parameter and display may be performed to increase the reality of the simulation. For example, closing a valve on a line that currently has a liquid flow may slow or divert an increasing amount of the liquid, increasing the upstream pressure. Closing the valve too quickly may lead to a rupture in a vessel feeding the liquid flow, while closing the valve slowly may work without problems. Thus, for increased realism, the valve movement may not be a binary action. In other cases, such as turning on a switch to activate a pump, the action may be binary, and completed prior to updating the dynamic process server and screens.

[0067] Any number of other actions may be included in the possible operator actions for the immersive visualization room. For example, if the immersive visualization room determines at block **606** that the outside operator has selected a more complex object, such as an instrument panel, or other object that needs to be examined more closely, flow proceeds to block **628**. At block **628**, the control type is determined and possible actions for that control are identified. For example at block **630**, a close up view of the controls is displayed, for example, as an expanded illustration on a surface of the immersive display. For an instrument inside a control box, the box can be shown as opened to display the controls. At block **632**, an action for the instrument panel is determined based on an outside operator input. For example, the outside operator may select a particular sub-control within the box and adjust a set point. The actions may depend on the instrument type, allowing any number of field instruments and controls to be manipulated. At block **634**, the outside operator indicates that the display is no longer needed. At that point, the parameters are uploaded to the dynamic process simulator and the display is zoomed back out. Process flow then proceeds to block **608** to update the displays in the immersive visualization room. After the screen update is finished at block **612**, process flow returns to block 606 to check for further operator inputs.

[0068] Fig. 7 is a block diagram of a method **700** for interacting with an inside operator in an immersive training system. The method **700** begins at block **702** after initialization of the immersive training system is complete at block **514** of Fig. 5. At any time during the method **700**, at block **704**, the inside operator can communicate with the outside operator, the trainer, or other personnel, for example, using a radio or simulated radio. Referring also to Fig. 3, at block **706**, an operator console **342** may determine if an inside operator has provided an input. In the immersive training system **400** of Fig. 4, this function may be performed by a simulator client **418**. If no inside operator action is detected at block **706**, process flow proceeds to block **708**. At block **708**, process parameters for the current display screens are obtained from the dynamic process simulator. These parameters are used at block **710** to update the current display screens. In the immersive training system **400** of Fig. 4, the functions of blocks **708** and **710** may be directly performed by the dynamic process simulator **402**. After the screen update is completed at block **710**, process flow can then return to block **706** to check for an inside operator action.

[0069] The actions at blocks **708** and **710** may be considered the basic screen update loop. In a DCS environment, this may take place every 5 seconds, every 10 seconds, every 15 seconds, or longer. Further, different parameters may be updated in different time sequences, for example, with some parameters updating every second and others updating every 15 seconds. This can be based on the time constant of the response of the parameters involved.

[0070] If, at block **706**, it is determined that an inside operator has selected a different screen for display, process flow proceeds to block **712**. At block **712**, the screen selected for display is identified. The identity of the screen selected may be performed by selecting a next screen or previous screen button, by selecting the screen from a catalog or index of screens, by selecting the end of a flow line, by selecting a process vessel, and the like. Once the identity of the new screen is selected, the graphic of the equipment on the screen is built and the screen is displayed. Process flow then proceeds to block **708** for updating the screens, as described above. After the screen update is completed at block **710**, process flow can then return to block **706** to check for an inside operator action.

[0071] If, at block **706**, it is determined that an inside operator has changed a setting or parameter, process flow proceeds to block **716**. At block **716**, the new value for the process parameter is entered. At block **718**, the new value is passed to the dynamic process simulator for storage in the plant database. Process flow then proceeds to block **708** to update the screens. After the screen update is completed at block **710**, process flow can then return to block **706** to check for an inside operator action.

[0072] Fig. 8 is a block diagram of a method **800** for interacting with a trainer in an immersive training system. The method **800** begins at block **802** after initialization of the immersive training system is complete at block **514** of Fig. 5. At any time during the method **800**, at block **804**, the trainer can communicate with the outside operator, the inside operator, or other personnel, for example, using a radio or simulated radio. Referring also to Fig. 3, at block **806**, an instructor console **356** may determine if a trainer has provided an input. In the immersive training system **400** of Fig. 4, this function may be performed directly by the dynamic process simulator **404**. If no inside operator action is detected at block **806**, process flow proceeds to block **808**. At block **808**, process parameters for the current display screens are obtained from the dynamic process simulator. These parameters are used at block **810** to update the current display screens. In the immersive training system **400** of Fig. 4, the functions of blocks **808** and **810** may be directly performed by the dynamic process simulator **402**. Process flow can then return to block **806** to check for an inside operator action.

[0073] The actions in blocks **808** and **810** may be considered the basic screen update. In a DCS environment, this may take place every 5 seconds, every 10 seconds, every 15 seconds, or longer. Further, different parameters may be updated in different time sequences, for example, with some parameters updating every second and others updating every 15 seconds. This can be based on the time constant of the response of the parameters involved.

[0074] If, at block **806**, it is determined that a trainer has selected a different screen for display, process flow proceeds to block **812**. At block **812**, the screen selected for display is identified. The identity of the screen selected may be performed by selecting a next screen or previous screen button, by selecting the screen from a catalog or index of screens, by selecting the end of a flow line, by selecting a process vessel, and the like. In an embodiment, the screen selected is identified by the selection of an inside operator in a control room. Once the identity of the new screen is selected, the graphic of the equipment on the screen is built and the screen is displayed. Process flow then proceeds to block **808** for updating the screens, as described above. After the screen update is completed at block **810**, process flow can then return to block **806** to check for an inside operator action.

[0075] If, at block **806**, it is determined that a trainer has changed a setting or parameter, process flow proceeds to block **816**. At block **816**, the new value for the process parameter is entered. At block **818**, the new value is passed to the dynamic process simulator for storage in the plant database. Process flow then proceeds to block **808** to update the screens. After the screen update is completed at block **810**, process flow can then return to block **806** to check for an inside operator action.

[0076] The trainer has settings available that cannot be directly seen or modified by the operators. For example, if, at block **806**, the trainer indicates that direct access to the plant database and process simulation is desired, flow proceeds to block **820**. At block **820**, the trainer is provided with a display screen showing plant process parameters in the plant database, and providing direct access to the parameter values. At block **822**, the trainer is allowed to make direct changes to parameter values. Such changes may include changing reaction rates or other process simulation information in addition to such values as temperature, pressure, and level, among others. Process flow then proceeds to block 808 for screen updating. The trainer may also have access to environmental variables, as indicated at block **824**. Such variables may include ambient temperature, wind speed, insolation, and the like. Process flow then proceeds to block **808** for updating the screens, as described above. After the screen update is completed at block **810**, process flow can then return to block **806** to check for an inside operator action.

[0077] While the present techniques may be susceptible to various modifications and alternative forms, the embodiments discussed above have been shown only by way of example. However, it should again be understood that the techniques is not intended to be limited to the particular embodiments disclosed herein. Indeed, the present techniques include all alternatives, modifications, and equivalents falling within the true spirit and scope of the appended claims.

Exemplary Embodiments

[0078] An exemplary embodiment described herein includes a real-time immersive training system. The real-time immersive training system can include an immersive visualization room. The immersive visualization room includes a rendering device that is configured to provide a three dimensional image of a workspace on a display surface and an operations console that is configured to provide plant information to the rendering device and obtain operator input from an input device. The immersive visualization room can also include a communications system that is configured to interact with a dynamic process simulator, retrieve plant information for the operations console, and pass operator input back to the dynamic process simulator. The real-time immersive training system can include an operator console that includes a control board designed to simulate a plant control board for the workspace. The dynamic process simulator is configured to run (e.g., execute on a processor) a process simulation of the workspace, provide simulated real time data of the workspace to the immersive visualization room and the operator console, accept control inputs from the operator console, and interaction data from the immersive visualization room. An instructor system includes a system configured to interact with the dynamic process simulator, the operator console, or the immersive visualization room, or any combinations thereof. The instructor system is configured to activate simulations of events. A display surface used in the immersive visualization room may include the surfaces of a square room, a convex surface, a domed surface, or any combinations thereof.

[0079] The real-time immersive training system can include other immersive visualization rooms that are configured to interact with the dynamic process simulator, the operator console, and the instructor system. A multi-user server may be configured to allow interaction of the immersive visualization rooms, so that a trainee in one immersive visualization room can see a representation of a trainee in another immersive visualization room.

[0080] The workspace may include a liquefied natural gas (LNG) plant, an offshore platform, a chemical plant, a tanker, an LNG tanker, or any combinations thereof. The events that are simulated may include standard operations, emergency operations, or any combinations thereof.

[0081] A communication system may be included to let users and trainers communicate as if they were in the workspace. The input system may include a detection system configured to analyze gestures, motions, or combinations thereof to obtain the data representing the interaction with the workspace. A treadmill may be configured to allow a user to input motion data to the workspace.

[0082] The real-time immersive training system may include a three dimensional computer aided drafting (CAD) model of the workspace.

[0083] A distributed control system (DCS) may be included and configured to interact with the dynamic process simulator, provide operational data to the operator console, and accept inputs from the operator console.

[0084] The simulated real time data can include simulated pressure measurements, simulated temperature measurements, simulated flow measurements, simulated level measurements, or any combinations thereof. The simulated real time data can include simulated images of an event determined from the dynamic process simulation.

[0085] The real-time immersive training system can include a bridge simulator for a ship configured to interact with the immersive visualization room, the operator console, the dynamic process simulator, or the instructor system, or any combinations thereof.

[0086] Another exemplary embodiment described herein provides a real-time immersive training system that includes a number of immersive visualization rooms. An immersive visualization room includes a display configured to provide a three dimensional image of a workspace, and an input system configured to obtain data representing an interaction with the workspace. In this embodiment, a multi-user server is configured to allow interactions between each of the immersive visualization rooms, wherein trainees in each of the immersive visualization rooms can see representations of trainees in other immersive visualization rooms. The real-time immersive training system includes an operator console that includes a control board designed to simulate a plant control board for the workspace. A dynamic process simulator is configured to run a process simulation of the workspace and provide simulated real time data of the workspace to each of the plurality of immersive visualization rooms and the operator console. The dynamic process simulator is configured to accept control inputs from the operator console, and accept interaction data from each of the immersive visualization rooms. The real-time immersive training system includes an instructor system that is configured to interact with the dynamic process simulator, the operator console, or the immersive visualization rooms, or any combinations thereof, wherein the instructor system is configured to activate simulations of events.

[0087] The real-time immersive training system can include a workspace radio system configured to allow communications between a plurality of trainers, a plurality of trainees, a plant operator, or any combinations thereof.

[0088] Another exemplary embodiment described herein provides a method for training workers for a hydrocarbon environment. The method includes placing a field trainee in a real time immersive environment, wherein the real time immersive environment is configured to provide three dimensional images of a workspace to the field trainee, and to accept inputs from the field trainee that represent interactions of the trainee with the environment. An operator trainee is placed at an operations console configured to provide the operator trainee with simulated data representing the workspace. A dynamic process simulator is configured to provide simulated real time data to the field trainee and the operator trainee based, at least in part, on a model of a workplace. A trainer is placed at a training console that is configured to provide control input to the dynamic process simulator to trigger simulations of events, and the trainer is allowed to guide the field trainee and operator trainee through the events.

[0089] The method can include providing a ship simulator configured to interact with the dynamic process simulator and simulating events in marine operations.

[0090] The method can include providing simulated image data of the events to the real time immersive environment for display to the field trainee.

[0091] The method can include placing a plurality of field trainees in individual real time immersive environments, and allowing the plurality of field trainees to interact with each other, the operator trainee, a trainer, the workspace, or any combinations thereof.

[0092] The method can include analyzing motions made by the field trainee to determine data representing interaction with the workspace.

[0093] Yet another exemplary embodiment described herein provides an immersive visualization room, that includes a rendering device configured to provide a three dimensional image of a workspace on a display surface. The immersive visualization room includes an operations console configured to provide plant information to the rendering device and obtain operator input from an input device. A communications device in the immersive visualization room is configured to interact with a plant simulator, retrieve plant information for the operations console, and pass the operator input to the plant simulator.

[0094] The communications device used in the immersive visualization room can include an Open Process Control (OPC) server.

In these embodiments above, run may refer to the execution of a set of instructions on a processor to perform various functions. Also, real-time may mean a task, process or response occurs substantially immediately. That is, real-time is taken to mean generation of data at a rate that is useful or adequate for making decisions during or concurrent with the simulation processes for interaction with a user or operator. One non-limiting example includes information that is collected and provided at a rate that is adequate to aid in appropriately communicating and displaying it for interaction in a simulation. Accordingly, it includes dataflow that occurs without any delay added beyond the minimum required for generation of the dataflow components

CLAIMS

What is claimed is:

1. A real-time immersive training system, comprising:

an immersive visualization room, comprising:

a rendering device configured to provide a three dimensional image of a workspace on a display surface;

an operations console configured to:

provide plant information to the rendering device; and

obtain operator input from an input device; and

a communications system configured to:

interact with a dynamic process simulator;

retrieve plant information for the operations console; and

pass operator input back to the dynamic process simulator;

an operator console, comprising a control board designed to simulate a plant control board for the workspace;

the dynamic process simulator configured to:

run a process simulation of the workspace;

provide simulated real time data of the workspace to the immersive visualization room and the operator console;

accept control inputs from the operator console; and

interaction data from the immersive visualization room; and

an instructor system, comprising a system configured to interact with the dynamic process simulator, the operator console, or the immersive visualization room, or any combinations thereof, and wherein the instructor system is configured to activate simulations of events.

2. The real-time immersive training system of claim 1, wherein the workspace comprises a liquefied natural gas (LNG) plant, an off-shore platform, a chemical plant, a tanker, an LNG tanker, or any combinations thereof.

3. The real-time immersive training system of claim 1, comprising at least one other immersive visualization room, wherein the at least one other immersive visualization room is

configured to interact with the dynamic process simulator, the operator console, and the instructor system.

4. The real-time immersive training system of claim 3, comprising a multi-user server configured to allow interaction of the immersive visualization room and the at least one other immersive visualization room, wherein a trainee in the immersive visualization room can see a representation of a trainee in another immersive visualization room.

5. The real-time immersive training system of claim 1, wherein the display surface comprises surfaces of a square room, a convex surface, a domed surface, or any combinations thereof.

6. The real-time immersive training system of claim 1, wherein the events comprise standard operations, emergency operations, or any combinations thereof.

7. The real-time immersive training system of claim 1, comprising a communication system, configured to let users and trainers communicate as if they were in the workspace.

8. The real-time immersive training system of claim 1, wherein the input system comprises a detection system configured to analyze gestures, motions, or combinations thereof to obtain the data representing the interaction with the workspace.

9. The real-time immersive training system of claim 1, comprising a treadmill configured to allow a user to input motion data to the workspace.

10. The real-time immersive training system of claim 1, comprising a three dimensional computer aided drafting (CAD) model of the workspace.

11. The real-time immersive training system of claim 1, comprising a distributed control system (DCS) configured to:

interact with the dynamic process simulator;

provide operational data to the operator console; and

accept inputs from the operator console.

12. The real-time immersive training system of claim 1, wherein the simulated real time data comprises simulated pressure measurements, simulated temperature measurements, simulated flow measurements, simulated level measurements, or any combinations thereof.

13. The real-time immersive training system of claim 1, wherein the simulated real time data comprises simulated images of an event determined from the dynamic process simulation.

14. The real-time immersive training system of claim 1, comprising a bridge simulator for a ship configured to interact with the immersive visualization room, the operator console, the dynamic process simulator, or the instructor system, or any combinations thereof.

15. A real-time immersive training system, comprising:

a plurality of immersive visualization rooms, wherein an immersive visualization room comprises a display configured to provide a three dimensional image of a workspace, and an input system configured to obtain data representing an interaction with the workspace;

a multi-user server configured to allow interactions between each of the plurality of immersive visualization rooms, wherein trainees in each of the plurality of immersive visualization rooms can see representations of trainees in other immersive visualization rooms;

an operator console, comprising a control board designed to simulate a plant control board for the workspace;

a dynamic process simulator configured to:

run a process simulation of the workspace;

provide simulated real time data of the workspace to each of the plurality of immersive visualization rooms and the operator console;

accept control inputs from the operator console; and

interaction data from each of the plurality of immersive visualization rooms; and

an instructor system, comprising a system configured to interact with the dynamic process simulator, the operator console, or the plurality of immersive visualization rooms, or any combinations thereof, and wherein the instructor system is configured to activate simulations of events.

16. The real-time immersive training system of claim 15, comprising a workspace radio system configured to allow communications between a plurality of trainers, a plurality of trainees, a plant operator, or any combinations thereof.

17. A method for training workers for a hydrocarbon environment, comprising:

placing a field trainee in a real time immersive environment, wherein the real time immersive environment is configured to provide three dimensional images of a workspace to the field trainee, and to accept inputs from the field trainee that represent interactions of the trainee with the environment;

placing an operator trainee at an operations console configured to provide the operator trainee with simulated data representing the workspace;

providing a dynamic process simulator configured to provide simulated real time data to the field trainee and the operator trainee based, at least in part, on a model of a workplace; and

placing a trainer at a training console configured to provide control input to the dynamic process simulator to trigger simulations of events, and allowing the trainer to guide the field trainee and operator trainee through the events.

18. The method of claim 17, comprising:

providing a ship simulator configured to interact with the dynamic process simulator and the real time immersive environment; and

simulating events in marine operations.

19. The method of claim 17, comprising providing simulated image data of the events to the real time immersive environment for display to the field trainee.

20. The method of claim 17, comprising placing a plurality of field trainees in individual real time immersive environments, and allowing the plurality of field trainees to interact with each other, the operator trainee, a trainer, the workspace, or any combinations thereof.

21. The method of claim 17, comprising analyzing motions made by the field trainee to determine data representing interaction with the workspace.

22. An immersive visualization room, comprising:

a rendering device configured to provide a three dimensional image of a workspace on a display surface;

an operations console configured to:

provide plant information to the rendering device; and

obtain operator input from an input device; and

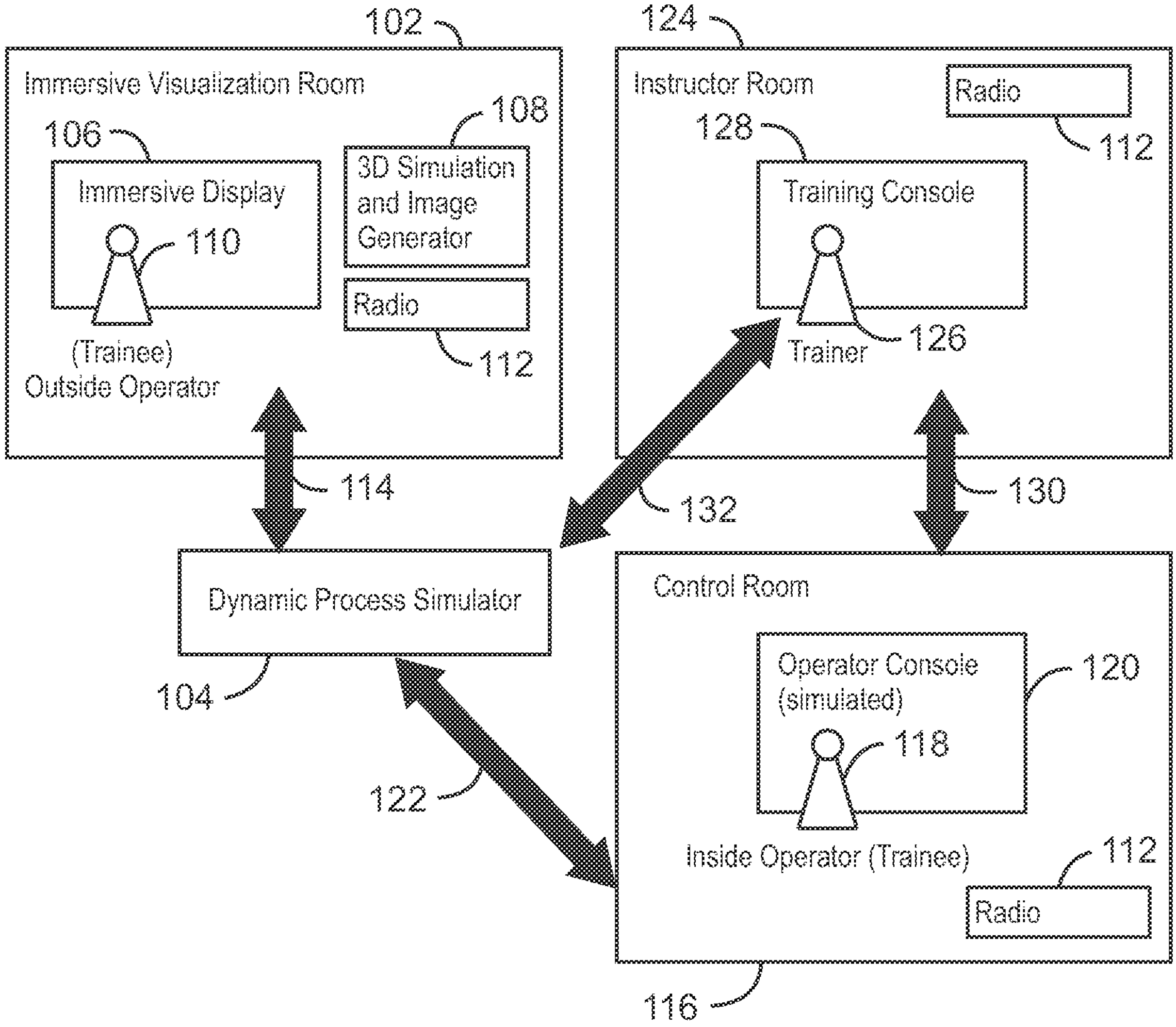
a communications device configured to:

interact with a plant simulator;

retrieve plant information for the operations console; and

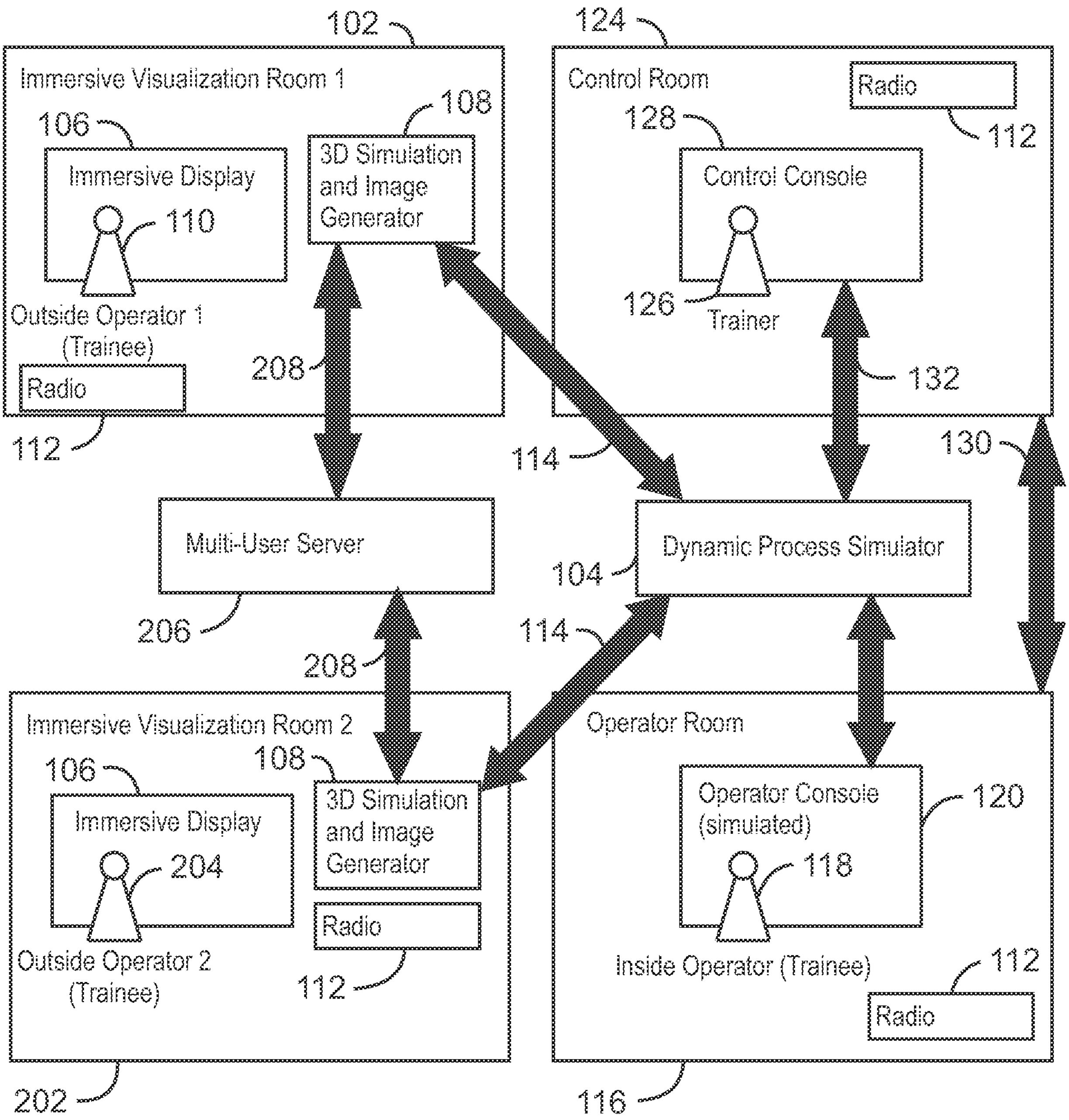
pass the operator input to the plant simulator.

23. The immersive visualization room of claim 22, wherein the communications device comprises an Open Process Control (OPC) server.

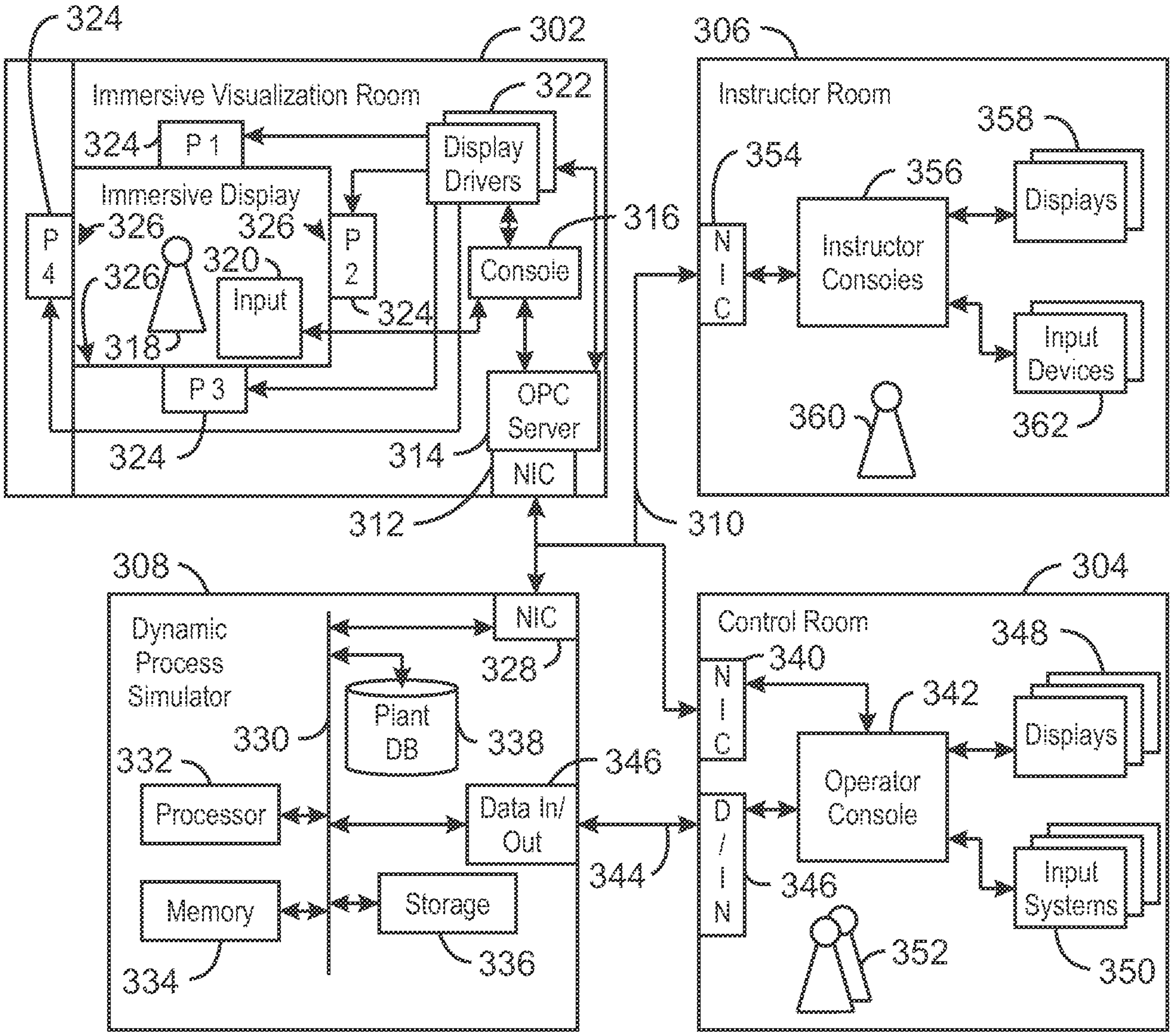

102
Immersive Visualization Room
106
Immersive Display
110
(Trainee)
Outside Operator
108
3D Simulation and Image Generator
Radio
112
114
124
Instructor Room
Radio
112
128
Training Console
Trainer
126
132
130
Dynamic Process Simulator
104
Control Room
Operator Console (simulated)
120
118
Inside Operator (Trainee)
112
Radio
122
116

100

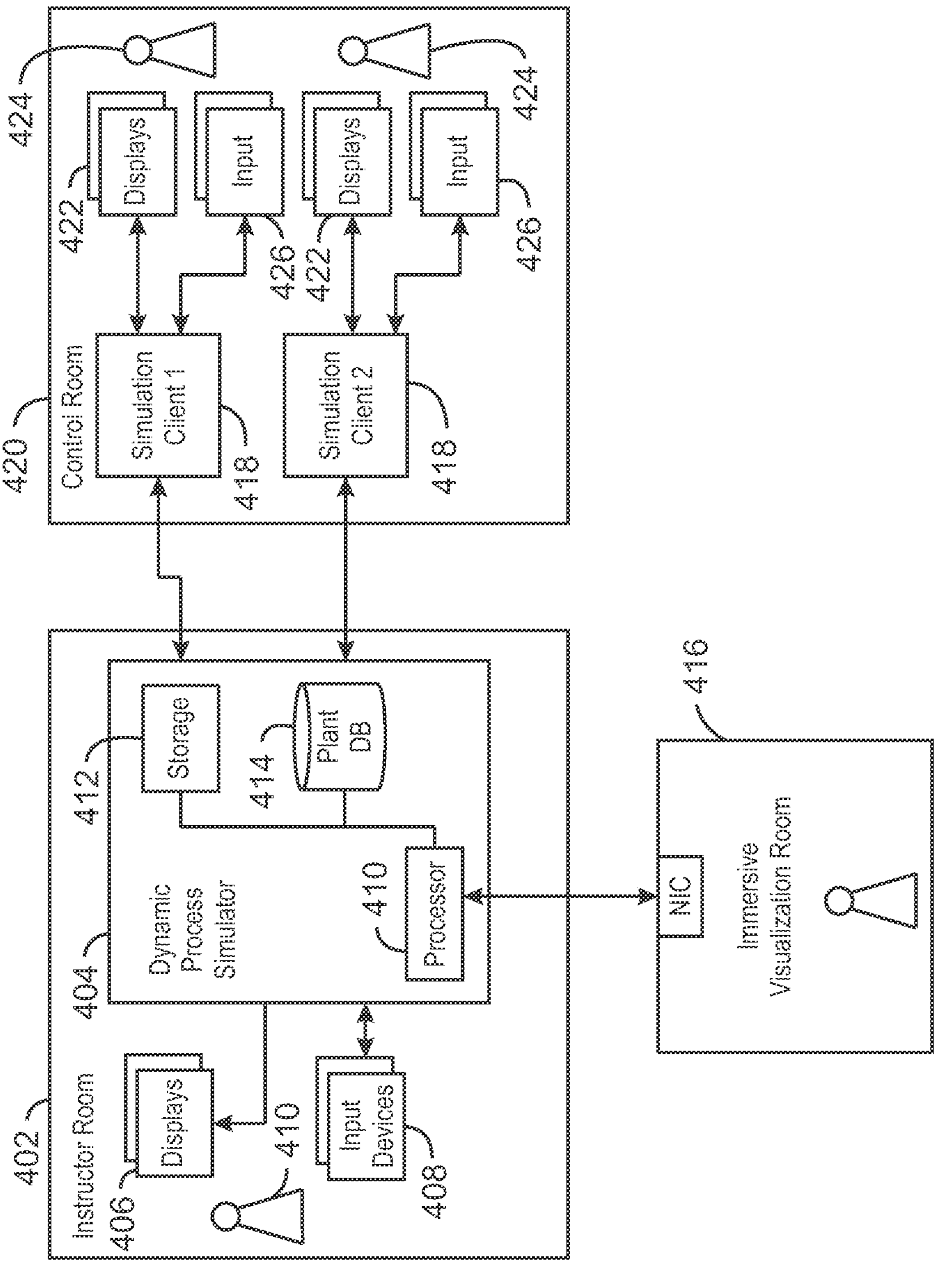
FIG. 1


102
Immersive Visualization Room 1
106
Immersive Display
110
108
3D Simulation and Image Generator
Outside Operator 1 (Trainee)
Radio
112
208
124
Control Room
Radio
112
128
Control Console
126
Trainer
132
130
114
Multi-User Server
206
Dynamic Process Simulator
104
114
208
Immersive Visualization Room 2
106
Immersive Display
204
108
3D Simulation and Image Generator
Radio
112
Outside Operator 2 (Trainee)
202
Operator Room
Operator Console (simulated)
120
118
Inside Operator (Trainee)
112
Radio
116

200
FIG. 2

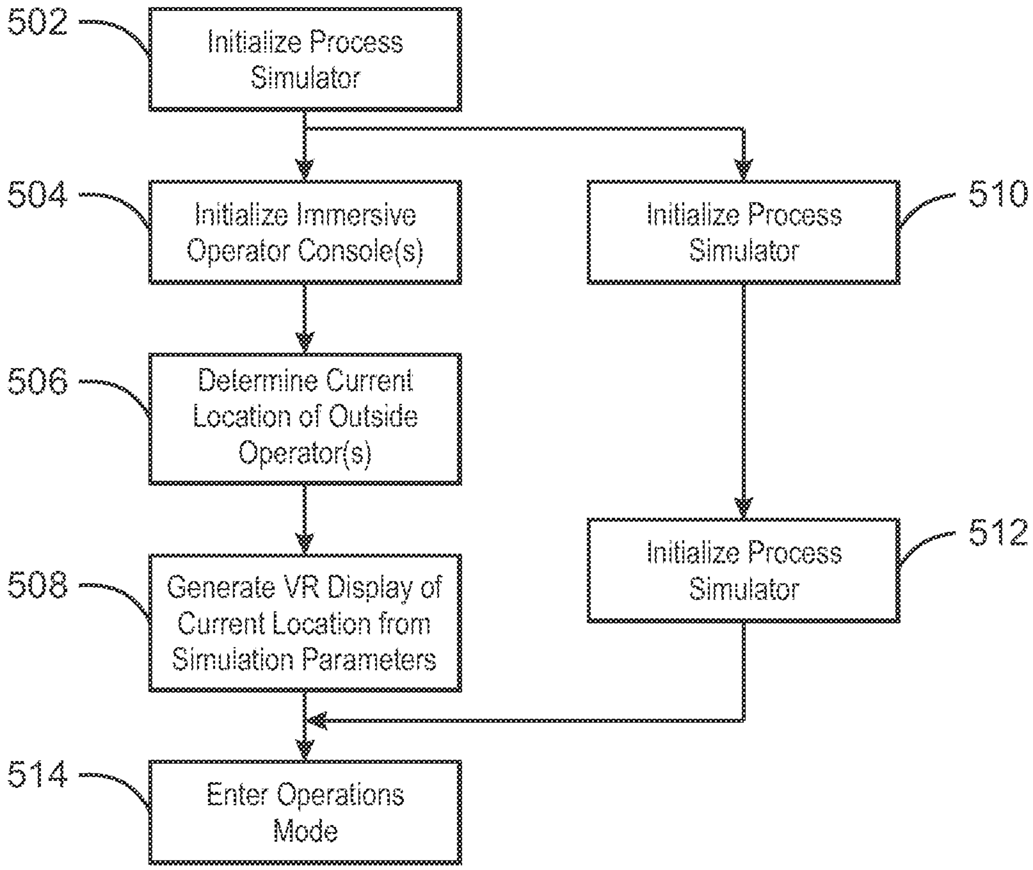

324
302
306
Immersive Visualization Room
322
Instructor Room
358
324
P 1
Display Drivers
354
356
Immersive Display
Displays
326
326
316
P 4
P 2
320
Console
Instructor Consoles
326
Input
324
318
Input Devices
P 3
OPC Server
360
362
324
314
NIC
312
310
308
304
Dynamic Process Simulator
NIC
Control Room
348
328
340
Plant DB
342
330
338
NIC
Displays
332
346
Processor
Data In/ Out
Operator Console
D/IN
344
346
Input Systems
Memory
Storage
352
334
336
350

300
FIG. 3

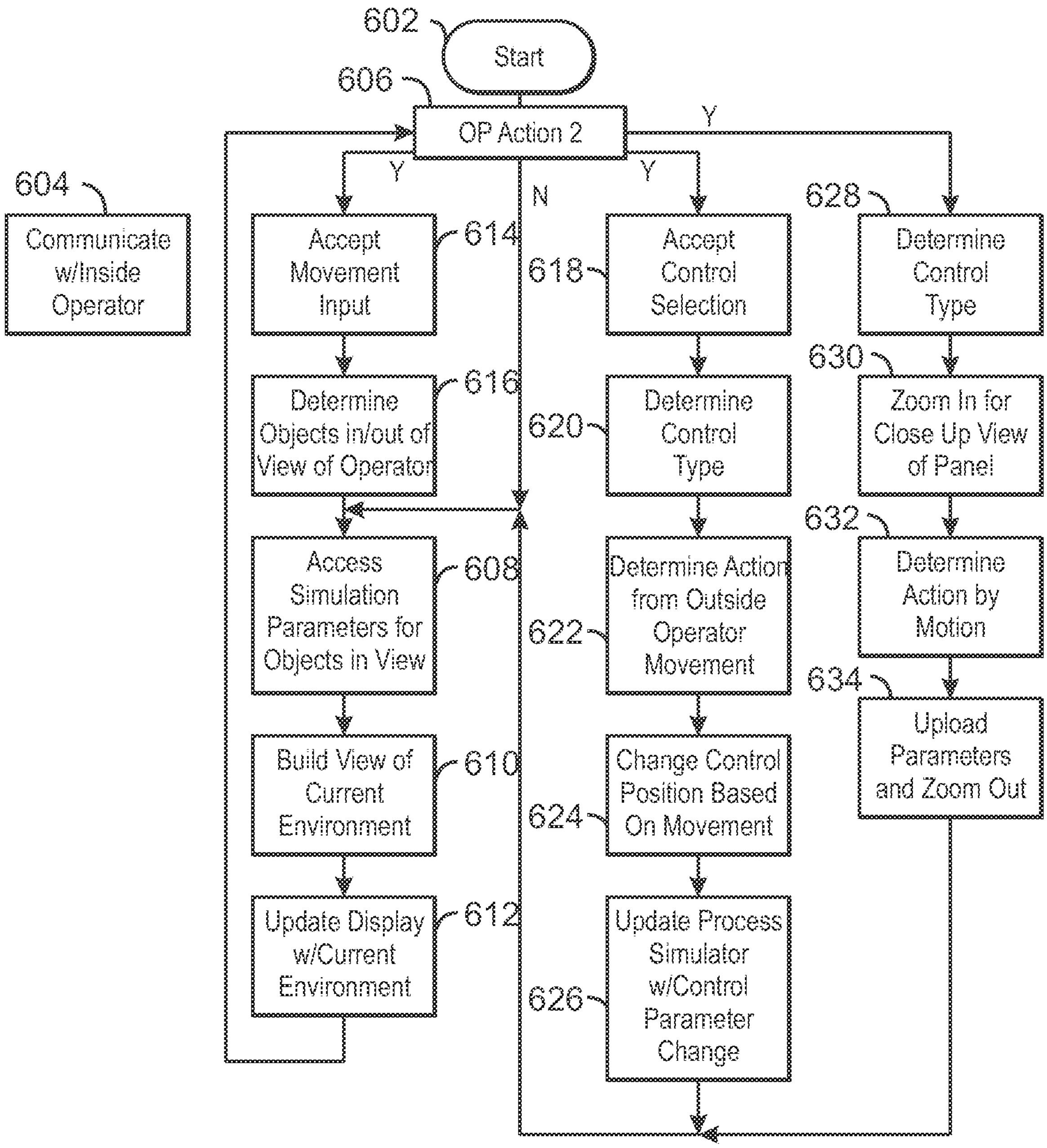

420
Control Room
Simulation Client 1
418
Simulation Client 2
418
422
Displays
426
Input
424
402
Instructor Room
406
Displays
410
Input Devices
408
404
Dynamic Process Simulator
410
Processor
412
Storage
414
Plant DB
416
NIC
Immersive Visualization Room

400

FIG. 4

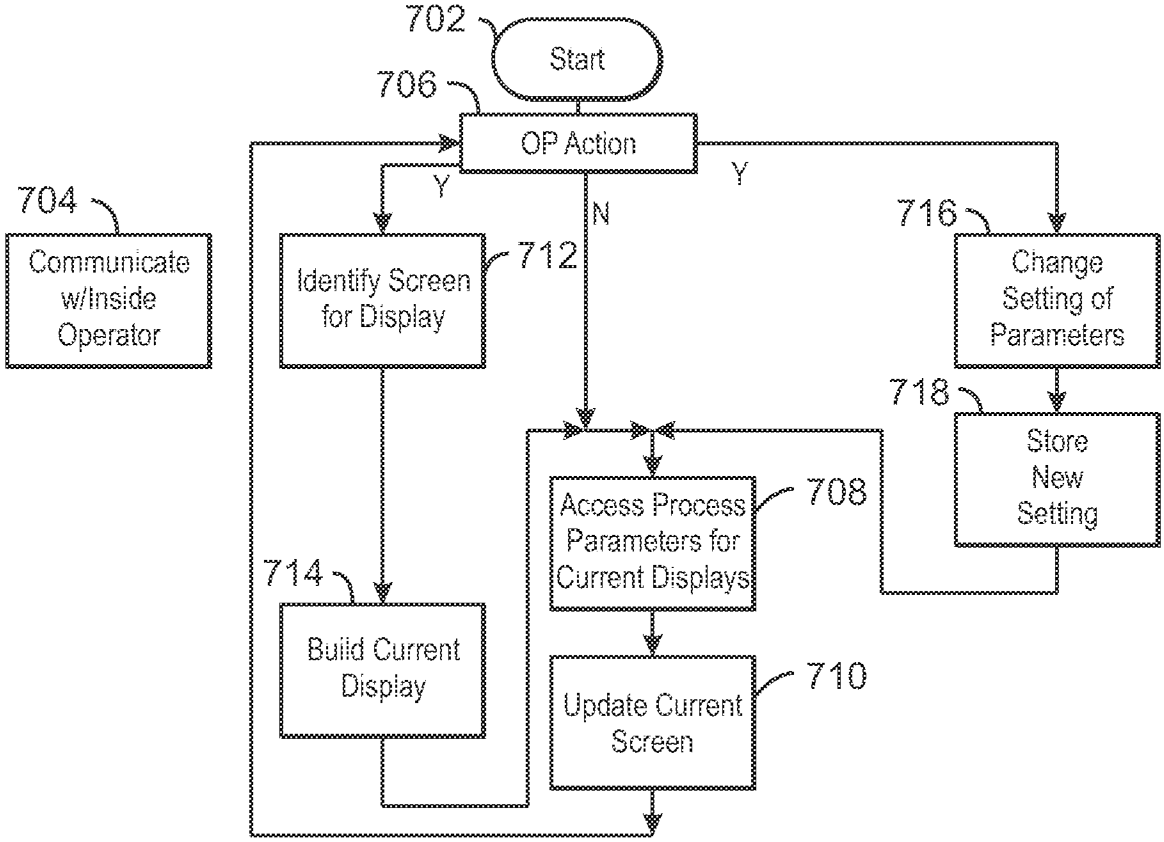

502
Initialize Process Simulator
504
Initialize Immersive Operator Console(s)
506
Determine Current Location of Outside Operator(s)
508
Generate VR Display of Current Location from Simulation Parameters
510
Initialize Process Simulator
512
Initialize Process Simulator
514
Enter Operations Mode

500
FIG. 5


602
Start
606
OP Action 2
Y
Y
Y
N
604
Communicate w/Inside Operator
Accept Movement Input
614
Determine Objects in/out of View of Operator
616
Access Simulation Parameters for Objects in View
608
Build View of Current Environment
610
Update Display w/Current Environment
612
618
Accept Control Selection
620
Determine Control Type
622
Determine Action from Outside Operator Movement
624
Change Control Position Based On Movement
626
Update Process Simulator w/Control Parameter Change
628
Determine Control Type
630
Zoom In for Close Up View of Panel
632
Determine Action by Motion
634
Upload Parameters and Zoom Out

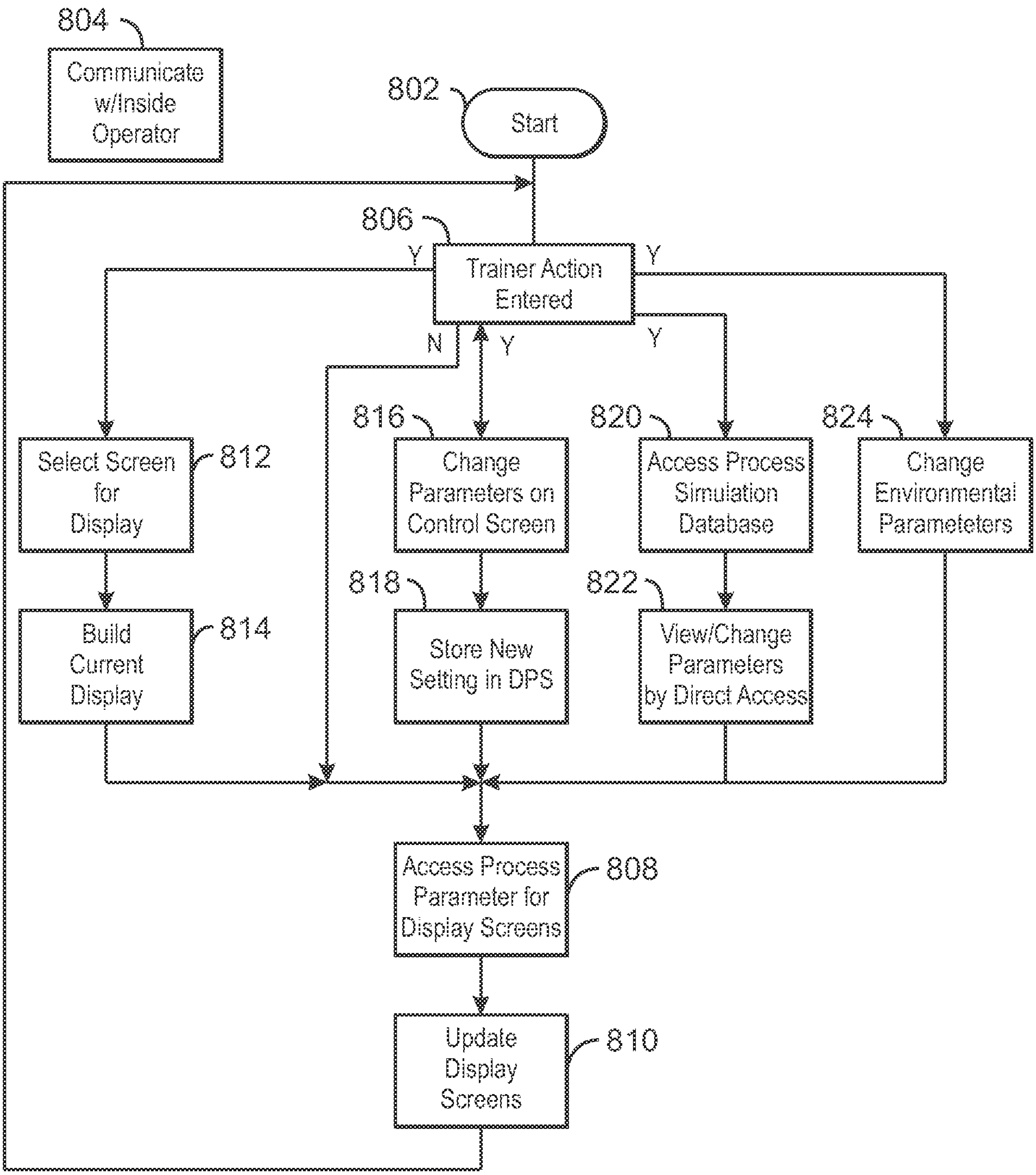
600

FIG. 6


702
Start
706
OP Action
Y
N
Y
704
Communicate w/Inside Operator
Identify Screen for Display
712
716
Change Setting of Parameters
718
Store New Setting
Access Process Parameters for Current Displays
708
714
Build Current Display
Update Current Screen
710

700

FIG. 7


804
Communicate w/Inside Operator
802
Start
806
Trainer Action Entered
Y
Y
N
Y
Y
816
Change Parameters on Control Screen
820
Access Process Simulation Database
824
Change Environmental Parameteters
Select Screen for Display
812
818
Store New Setting in DPS
822
View/Change Parameters by Direct Access
Build Current Display
814
Access Process Parameter for Display Screens
808
Update Display Screens
810

800

FIG. 8