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SYSTEMS AND METHODS FOR USING ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TO MONITOR WORK TASKS

Abstract

One embodiment sets forth a method for monitoring work tasks. According to some embodiments, the method can be implemented by a computing device, and includes the steps of (1) interfacing with a plurality of sensor groups, where each sensor group of the plurality of sensor groups gathers respective information about a respective at least one work task that is being monitored by the sensor group, (2) for each sensor group of the plurality of sensor groups: obtaining the respective information about the respective at least one work task, and providing the respective information to at least one machine learning model to output a respective performance score that corresponds to the respective at least one work task, and (3) outputting a user interface (UI) that includes, for each performance score, a respective sub-UI that is ordered within the UI relative to other sub-UIs based on their respective performance scores.

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Background/Summary

CROSS-REFERENCES TO RELATED APPLICATIONS [0001] This application is a continuation-in-part of and claims the benefit of and priority to U.S. patent application Ser. No. 18/394,298 filed Dec. 22, 2023, titled "SYSTEMS AND METHODS FOR USING A VOCATIONAL MASK WITH A HYPER-ENABLED WORKER," which claims priority to U.S. Application Patent Ser. No. 63/607,354 filed Dec. 7, 2023, titled "SYSTEMS AND METHODS FOR USING A VOCATIONAL MASK WITH A HYPER-ENABLED WORKER," the entire disclosure of which is hereby incorporated by reference for all purposes. [0002] This application also claims priority to U.S. Patent Application Ser. No. 63/633,315, filed Apr. 12, 2024, titled "SYSTEMS AND METHODS FOR using ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TO MONITOR WORK TASKS," the entire disclosure of which is hereby incorporated by reference for all purposes.

TECHNICAL FIELD
[0003] This disclosure relates to enabling workers to perform vocations. More specifically, this disclosure relates to systems and methods for using artificial intelligence and machine learning to monitor work tasks.
BACKGROUND
[0004] People use various tools and/or equipment to perform various vocations. For example, a welder may use a welding mask and/or a welding gun to weld an object. The welder may participate in training courses prior to welding the object. A master welder may lead the training courses to train the welder how to properly weld. In some instances, the master welder may be located at a physical location that is remote from where a student welder is physically located.
SUMMARY
[0005] One embodiment sets forth a method for monitoring work tasks. According to some embodiments, the method can be implemented by a computing device, and includes the steps of (1) interfacing with a plurality of sensor groups, where each sensor group of the plurality of sensor groups gathers respective information about a respective at least one work task that is being monitored by the sensor group, (2) for each sensor group of the plurality of sensor groups: (i) obtaining the respective information about the respective at least one work task that is being monitored by the sensor group, and (ii) providing the respective information to at least one machine learning model to cause the at least one machine learning model to output a respective performance score that corresponds to the respective at least one work task, (3) outputting a user interface (UI) to at least one display device, where the UI includes, for each performance score, a respective sub-UI that is ordered within the UI relative to other sub-UIs based on their respective performance scores.
[0006] In one embodiment, a tangible, non-transitory computer-readable medium stores instructions that, when executed, cause a processing device to perform any operation of any method

disclosed herein.
[0007] In one embodiment, a system includes a memory device storing instructions and a processing device communicatively coupled to the memory device. The processing device executes the instructions to perform any operation of any method disclosed herein.
[0008] Other technical features may be readily apparent to one skilled in the art from the following figures, descriptions, and claims.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0009] For a detailed description of example embodiments, reference will now be made to the accompanying drawings in which:
[0010] FIG. **1** illustrates a system architecture according to certain embodiments of this disclosure;
[0011] FIG. **2** illustrates a component diagram for a vocational mask according to certain embodiments of this disclosure;
[0012] FIG. **3** illustrates bidirectional communication between communicatively coupled vocational masks according to certain embodiments of this disclosure;
[0013] FIG. **4** illustrates an example of projecting an image onto a user's retina via a virtual retinal display of a vocational mask according to certain embodiments of this disclosure;
[0014] FIG. **5** illustrates an example of an image including instructions projected via a virtual retinal display of a vocational mask according to certain embodiments of this disclosure;
[0015] FIG. **6** illustrates an example of an image including a warning projected via a virtual retinal display of a vocational mask according to certain embodiments of this disclosure;
[0016] FIG. **7** illustrates an example of a method for executing an artificial intelligence agent to determine certain information projected via a vocational mask of a user according to certain embodiments of this disclosure;
[0017] FIG. **8** illustrates an example of a method for transmitting instructions for performing a task via bidirectional communication between a vocational mask and a computing device according to certain embodiments of this disclosure;
[0018] FIG. **9** illustrates an example of a method for implementing instructions for performing a task using a peripheral haptic device according to certain embodiments of this disclosure;
[0019] FIG. **10** illustrates an example computer system according to embodiments of this disclosure;
[0020] FIGS. **11**A-**11**B illustrate conceptual diagrams of different environments in which artificial intelligence and machine learning can be utilized to monitor work tasks, according to certain embodiments of this disclosure;
[0021] FIGS. **12**A-**12**H illustrate conceptual diagrams of user interfaces that can be implemented to monitor work tasks under an example workflow that occurs within a work environment, according to certain embodiments of this disclosure; and
[0022] FIG. **13** illustrates steps of an example method for monitoring work tasks, according to certain embodiments of this disclosure.
NOTATION AND NOMENCLATURE
[0023] Various terms are used to refer to particular system components. Different entities may refer to a component by different names—this document does not intend to distinguish between components that differ in name but not function. In the following discussion and in the claims, the terms “including” and “comprising” are used in an open-ended fashion, and thus should be interpreted to mean “including, but not limited to . . . ” Also, the term “couple” or “couples” is intended to mean either an indirect or a direct connection. Thus, if a first device couples to a second device, that connection may be through a direct connection or through an indirect connection via

other devices and connections.

[0024] The terminology used herein is for the purpose of describing particular example embodiments only, and is not intended to be limiting. As used herein, the singular forms “a,” “an,” and “the” may be intended to include the plural forms as well, unless the context clearly indicates otherwise. The method steps, processes, and operations described herein are not to be construed as necessarily requiring their performance in the particular order discussed or illustrated, unless specifically identified as an order of performance. It is also to be understood that additional or alternative steps may be employed.

[0025] The terms first, second, third, etc. may be used herein to describe various elements, components, regions, layers and/or sections; however, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms may be only used to distinguish one element, component, region, layer or section from another region, layer or section. Terms such as “first,” “second,” and other numerical terms, when used herein, do not imply a sequence or order unless clearly indicated by the context. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the example embodiments. The phrase “at least one of,” when used with a list of items, means that different combinations of one or more of the listed items may be used, and only one item in the list may be needed. For example, “at least one of: A, B, and C” includes any of the following combinations: A, B, C, A and B, A and C, B and C, and A and B and C. In another example, the phrase “one or more” when used with a list of items means there may be one item or any suitable number of items exceeding one.

[0026] Moreover, various functions described below can be implemented or supported by one or more computer programs, each of which is formed from computer readable program code and embodied in a computer readable medium. The terms “application” and “program” refer to one or more computer programs, software components, sets of instructions, procedures, functions, objects, classes, instances, related data, or a portion thereof adapted for implementation in a suitable computer readable program code. The phrase “computer readable program code” includes any type of computer code, including source code, object code, and executable code. The phrase “computer readable medium” includes any type of medium capable of being accessed by a computer, such as read only memory (ROM), random access memory (RAM), a hard disk drive, a compact disc (CD), a digital video disc (DVD), solid state drives (SSDs), flash memory, or any other type of memory. A “non-transitory” computer readable medium excludes wired, wireless, optical, or other communication links that transport transitory electrical or other signals. A non-transitory computer readable medium includes media where data can be permanently stored and media where data can be stored and later overwritten, such as a rewritable optical disc or an erasable memory device.

[0027] Definitions for other certain words and phrases are provided throughout this patent document. Those of ordinary skill in the art should understand that in many if not most instances, such definitions apply to prior as well as future uses of such defined words and phrases.

DETAILED DESCRIPTION

[0028] The following discussion is directed to various embodiments of the disclosed subject matter. Although one or more of these embodiments may be preferred, the embodiments disclosed should not be interpreted, or otherwise used, as limiting the scope of the disclosure, including the claims. In addition, one skilled in the art will understand that the following description has broad application, and the discussion of any embodiment is meant only to be exemplary of that embodiment, and not intended to intimate that the scope of the disclosure, including the claims, is limited to that embodiment.

[0029] FIGS. **1** through **13** discussed below, and the various embodiments used to describe the principles of this disclosure in this patent document are by way of illustration only and should not be construed in any way to limit the scope of the disclosure.

[0030] Some of the disclosed embodiments relate to one or more artificial intelligent enhanced vocational tools for workers to use to perform a job, task, and/or vocation. In some embodiments, the vocational tools may be in the form of a vocational mask that projects work instructions using imagery, animation, video, text, audio, and the like. The vocational tools may be used by workers to enhance the efficiency and proficiency of performing professional and vocational tasks, such as but not limited to supply chain operations, manufacturing and warehousing processes, product inspection, coworker and master-apprentice bidirectional collaboration and communication with or without haptic sensory feedback, other telepresence, and the like.

[0031] Some of the disclosed embodiments may be used to collect data, metadata, and multiband video to aid in product acceptance, qualification, and full lifecycle product management. Further, some of the disclosed embodiments may aid a failure reporting, analysis, and corrective action system, a failure mode, effects, and criticality analysis system, other sustainment and support activities and tasks to accommodate worker dislocation and multi-decade lifecycle of some products.

[0032] In one embodiment, a vocational mask is disclosed that employs bidirectional communication to include voice and imagery and still and audio video imagery recording with other colleagues over a distance. The vocational mask may provide virtual images of objects to a person wearing the vocational mask via a display (e.g., virtual retinal display). The vocational mask may enable bidirectional communications with collaborators and/or students. Further, the vocational mask may enable bidirectional audio, visual, and haptic communication to provide a master-apprentice relationship. The vocational mask may include multiple electromagnetic spectrum and acoustic sensors/imagers. The vocational mask may also provide multiband audio and video sensed imagery to a wearer of the vocational mask.

[0033] The vocational mask may be configured to provide display capabilities to project images onto one or more irises of the wearer to display alphanumeric data and graphic/animated work instructions, for example. The vocational mask may also include one or more speakers to emit audio related to work instructions, such as those provided by a master trained user, supervisor, collaborator, teacher, etc.

[0034] The vocational mask may include an edge-based processor that executes an artificial intelligence agent. The artificial intelligence agent may be implemented in computer instructions stored on one or more memory devices and executed by one or more processing devices. The artificial intelligence agent may be trained to perform one or more functions, such as but not limited to (i) perception-based object and feature identification, (ii) cognition-based scenery understanding, to identify material and assembly defects versus acceptable features, and (iii) decision making to aid the wearer and to provide relevant advice and instruction in real-time or near real-time to the wearer of the vocational mask. The data that is collected may be used for inspection and future analyses of product quality, product design, and the like. Further, the collected data may be stored for instructional analyses and providing lessons, mentoring, collaboration, and the like.

[0035] The vocational mask may include one or more components (e.g., processing device, memory device, display, etc.), interfaces, and/or sensors configured to provide sensing capabilities to understand hand motions and use of a virtual user interface (e.g., keyboards) and other haptic instructions. The vocational mask may include a haptic interface to allow physical bidirectional haptic sensing and stimulation via the bidirectional communications to other users and/or collaborators using a peripheral haptic device (e.g., a welding gun).

[0036] In some embodiments, the vocational mask may be in the form of binocular goggles, monocular goggles, finishing process glasses (e.g., grind, chamfer, debur, sand polish, coat, etc.), or the like. The vocational mask may be attached to a welding helmet. The vocational mask may include an optical bench that aligns a virtual retinal display to one or more eyes of a user. The vocational mask may include a liquid crystal display welding helmet, a welding camera, an augmented reality/virtual reality headset, etc.

[0037] The vocational mask may augment projections by providing augmented reality cues and information to assist a worker (e.g., welder) with contextual information, which may include setup, quality control, procedures, training, and the like. Further, the vocational mask may provide a continuum of visibility from visible spectrum (arc off) through high-intensity/ultraviolet (arc on). Further, some embodiments include remote feedback and recording of images and bidirectional communications to a trainer, supervisor, mentor, master user, teacher, collaborator, etc. who can provide visual, auditory, and/or haptic feedback to the wearer of the vocational mask in real-time or near real-time.

[0038] In some embodiments, the vocational mask may be integrated with a welding helmet. In some embodiments, the vocational mask may be a set of augmented reality/virtual reality goggles worn under a welding helmet (e.g., with external devices, sensors, cameras, etc. appended for image/data gathering). In some embodiments, the vocational mask may be a set of binocular welding goggles or a monocular welding goggle to be worn under or in lieu of a welding helmet (e.g., with external devices, sensors, cameras, etc. appended to the goggles for image/data gathering). In some embodiments, the vocational mask may include a mid-band or long wave context camera displayed to the user and monitor.

[0039] In some embodiments, information may be superpositioned or superimposed onto a display without the user (e.g., worker, student, etc.) wearing a vocational mask. The information may include work instructions in the form of text, images, alphanumeric characters, video, etc. The vocational mask may function across both visible light (arc off) and high intensity ultraviolet light (arc on) conditions. The vocational mask may natively or in conjunction with other personal protective equipment provide protection against welding flash. The vocational mask may enable real-time or near real-time two-way communication with a remote instructor or supervisor. The vocational mask may provide one or more video, audio, and data feeds to a remote instructor or supervisor. The vocational mask and/or other components in a system may enable recording of all data and communications. The system may provide a mechanism for replaying the data and communications, via a media player, for training purposes, quality control purposes, inspection purposes, and the like. The vocational mask and/or other components in a system may provide a mechanism for visual feedback from a remote instructor or supervisor. The vocational mask and/or other components in a system may provide a bidirectional mechanism for haptic feedback from a remote instructor or supervisor.

[0040] Further, the system may include an artificial intelligence simulation generator that generates task simulations to be transmitted to and presented via the vocational mask. The simulation of a task may be transmitted as virtual reality data to the vocational mask which includes a virtual reality headset and/or display to playback the virtual reality data. The virtual reality data may be configured based on parameters of a physical space in which the vocational mask is located, based on parameters of an object to be worked on, based on parameters of a tool to be used, and the like.

[0041] Turning now to the figures, FIG. **1** depicts a system architecture **10** according to some embodiments. The system architecture **10** may include one or more computing devices **140**, one or more vocational masks **130**, one or more peripheral haptic devices **134**, and/or one or more tools **136** communicatively coupled to a cloud-based computing system **116**. Each of the computing devices **140**, vocational masks **130**, peripheral haptic devices **134**, tools **136**, and components included in the cloud-based computing system **116** may include one or more processing devices, memory devices, and/or network interface cards. The network interface cards may enable communication via a wireless protocol for transmitting data over short distances, such as Bluetooth, ZigBee, NFC, etc. Additionally, the network interface cards may enable communicating data over long distances, and in one example, the computing devices **140**, the vocational masks **130**, the peripheral haptic devices **134**, the tools **136**, and the cloud-based computing system **116** may communicate with a network **20**. Network **20** may be a public network (e.g., connected to the Internet via wired (Ethernet) or wireless (WiFi)), a private network (e.g., a local area network

(LAN) or wide area network (WAN)), or a combination thereof. Network **20** may also include a node or nodes on the Internet of Things (IoT). The network **20** may be a cellular network.
[0042] The computing devices **140** may be any suitable computing device, such as a laptop, tablet, smartphone, smartwatch, ear buds, server, or computer. In some embodiments, the computing device **140** may be a vocational mask. The computing devices **140** may include a display capable of presenting a user interface **142** of an application. In some embodiments, the display may be a laptop display, smartphone display, computer display, tablet display, a virtual retinal display, etc. The application may be implemented in computer instructions stored on the one or more memory devices of the computing devices **140** and executable by the one or more processing devices of the computing device **140**. The application may present various screens to a user. For example, the user interface **142** may present a screen that plays video received from the vocational mask **130**. The video may present real-time or near real-time footage of what the vocational mask **130** is viewing, and in some instances, that may include a user's hands holding the tool **136** to perform a task (e.g., weld, sand, polish, chamfer, debur, paint, play a video game, etc.). Additional screens may be presented via the user interface **142**.
[0043] In some embodiments, the application (e.g., website) executes within another application (e.g., web browser). The computing device **140** may also include instructions stored on the one or more memory devices that, when executed by the one or more processing devices of the computing devices **140** perform operations of any of the methods described herein.
[0044] In some embodiments, the computing devices **140** may include an edge processor **132.1** that performs one or more operations of any of the methods described herein. The edge processor **132.1** may execute an artificial intelligence agent to perform various operations described herein. The artificial intelligence agent may include one or more machine learning models that are trained via the cloud-based computing system **116** as described herein. The edge processor **132.1** may represent one or more general-purpose processing devices such as a microprocessor, central processing unit, or the like. More particularly, the edge processor **132.1** may be a complex instruction set computing (CISC) microprocessor, reduced instruction set computing (RISC) microprocessor, very long instruction word (VLIW) microprocessor, or a processor implementing other instruction sets or processors implementing a combination of instruction sets. The edge processor **132.1** may also be one or more special-purpose processing devices such as an application specific integrated circuit (ASIC), a field programmable gate array (FPGA), a digital signal processor (DSP), network processor, or the like.
[0045] In some embodiments, the vocational mask **130** may be attached to or integrated with a welding helmet, binocular goggles, a monocular goggle, glasses, a hat, a helmet, a virtual reality headset, a headset, a facemask, or the like. The vocational mask **130** may include various components as described herein, such as an edge processor **132.2**. In some embodiments, the edge processor **132.2** may be located separately from the vocational mask **130** and may be included in another computing device, such as a server, laptop, desktop, tablet, smartphone, etc. The edge processor **132.2** may represent one or more general-purpose processing devices such as a microprocessor, central processing unit, or the like. More particularly, the edge processor **132.2** may be a complex instruction set computing (CISC) microprocessor, reduced instruction set computing (RISC) microprocessor, very long instruction word (VLIW) microprocessor, or a processor implementing other instruction sets or processors implementing a combination of instruction sets. The edge processor **132.2** may also be one or more special-purpose processing devices such as an application specific integrated circuit (ASIC), a field programmable gate array (FPGA), a digital signal processor (DSP), network processor, or the like.
[0046] The edge processor **132.2** may perform one or more operations of any of the methods described herein. The edge processor **132.2** may execute an artificial intelligence agent to perform various operations described herein. The artificial intelligence agent may include one or more machine learning models that are trained via the cloud-based computing system **116** as described

herein. For example, the cloud-based computing system **116** may train one or more machine learning models **154** via a training engine **152**, and may transmit the parameters used to train the machine learning model to the edge processor **132.2** such that the edge processor **132.2** can implement the parameters in the machine learning models executing locally on the vocational mask **130** or computing device **140**.

[0047] The edge processor **132.2** may include a data concentrator that collects data from multiple vocational masks **130** and transmits the data to the cloud-based computing system **116**. The data concentrator may map information to reduce bandwidth transmission costs of transmitting data. In some embodiments, a network connection may not be needed for the edge processor **132.2** to collect data from vocational masks and to perform various functions using the trained machine learning models **154**.

[0048] The vocational mask **130** may also include a network interface card that enables bidirectional communication with any other computing device **140**, such as other vocational masks **130**, smartphones, laptops, desktops, servers, wearable devices, tablets, etc. The vocational mask **130** may also be communicatively coupled to the cloud-based computing system **116** and may transmit and receive information and/or data to and from the cloud-based computing system **116**. The vocational mask **130** may include various sensors, such as position sensors, acoustic sensors, haptic sensors, microphones, temperature sensors, accelerometers, and the like. The vocational mask **130** may include various cameras configured to capture audio and video. The vocational mask **130** may include a speaker to emit audio. The vocational mask **130** may include a haptic interface configured to transmit and receive haptic data to and from the peripheral haptic device **134**. The haptic interface may be communicatively coupled to a processing device (e.g., edge processor **132.2**) of the vocational mask **130**.

[0049] In some embodiments, the peripheral haptic device **134** may be attached to or integrated with the tool **136**. In some embodiments, the peripheral haptic device **134** may be separate from the tool **136**. The peripheral haptic device **134** may include one or more haptic sensors that provide force, vibration, touch, and/or motion sensations to the user, among other things. The peripheral haptic device **134** may be used to enable a person remote from a user of the peripheral haptic device **134** to provide haptic instructions to perform a task (e.g., weld, shine, polish, paint, control a video game controller, grind, chamfer, debur, etc.). The peripheral haptic device **134** may include one or more processing devices, memory devices, network interface cards, haptic interfaces, etc. In some embodiments, the peripheral haptic device **134** may be communicatively coupled to the vocational mask **130**, the computing device **140**, and/or the cloud-based computing system **116**.

[0050] The tool **136** may be any suitable tool, such as a welding gun, a video game controller, a paint brush, a pen, a utensil, a grinder, a sander, a polisher, a gardening tool, a yard tool, a glove, or the like. The tool **136** may be handheld such that the peripheral haptic device **134** is enabled to provide haptic instructions for performing a task to the user holding the tool **136**. In some embodiments, the tool **136** may be wearable by the user. The tool **136** may be used to perform a task. In some embodiments, the tool **136** may be located in a physical proximity to the user in a physical space.

[0051] In some embodiments, the cloud-based computing system **116** may include one or more servers **128** that form a distributed computing architecture. The servers **128** may be a rackmount server, a router computer, a personal computer, a portable digital assistant, a mobile phone, a laptop computer, a tablet computer, a camera, a video camera, a netbook, a desktop computer, a media center, any other device capable of functioning as a server, or any combination of the above. Each of the servers **128** may include one or more processing devices, memory devices, data storage, and/or network interface cards. The servers **128** may be in communication with one another via any suitable communication protocol. The servers **128** may execute an artificial intelligence (AI) engine and/or an AI agent that uses one or more machine learning models **154** to perform at least one of the embodiments disclosed herein. The cloud-based computing system **116** may also include a database **129** that stores data, knowledge, and data structures used to perform various embodiments. For example, the database **129** may store multimedia data of users performing tasks using tools, communications between vocational masks **130** and/or computing devices **140**, virtual reality simulations, augmented reality information, recommendations, instructions, and the like. The database **129** may also store user profiles including characteristics particular to each user. In some embodiments, the database **129** may be hosted on one or more of the servers **128**.

[0052] In some embodiments the cloud-based computing system **116** may include a training engine **152** capable of generating the one or more machine learning models **154**. The machine learning models **154** may be trained to identify perception-based objects and features using training data that includes labeled inputs of images including certain objects and features mapped to labeled outputs of identities or characterizations of those objects and features. The machine learning models **154** may be trained determine cognition-based scenery to identify one or more material defects, one or more assembly defects, one or more acceptable features, or some combination thereof using training data that includes labeled input of scenery images of objects including material defects, assembly defects, and/or acceptable features mapped to labeled outputs that characterize and/or identify the material defects, assembly defects, and/or acceptable features. The machine learning models **154** may be trained to determine one or more recommendations, instructions, or both using training data including labeled input of images (e.g., objects, products, tools, actions, etc.) and tasks to be performed (e.g., weld, grind, chamfer, debur, sand, polish, coat, etc.) mapped to labeled outputs including recommendations, instructions, or both.

[0053] The one or more machine learning models **154** may be generated by the training engine **152** and may be implemented in computer instructions executable by one or more processing devices of the training engine **152** and/or the servers **128**. To generate the one or more machine learning models **154**, the training engine **152** may train the one or more machine learning models **154**. The one or more machine learning models **154** may also be executed by the edge processor **132** (**132.1**, **132.2**). The parameters used to train the one or more machine learning models **154** by the training engine **152** at the cloud-based computing system **116** may be transmitted to the edge processor **132** (**132.1**, **132.2**) to be implemented locally at the vocational mask **130** and/or the computing device **140**.

[0054] The training engine **152** may be a rackmount server, a router computer, a personal computer, a portable digital assistant, a smartphone, a laptop computer, a tablet computer, a netbook, a desktop computer, an Internet of Things (IoT) device, any other desired computing device, or any combination of the above. The training engine **152** may be cloud-based, be a real-time software platform, include privacy software or protocols, and/or include security software or protocols. To generate the one or more machine learning models **154**, the training engine **152** may train the one or more machine learning models **154**.

[0055] The one or more machine learning models **154** may refer to model artifacts created by the training engine **152** using training data that includes training inputs and corresponding target outputs. The training engine **152** may find patterns in the training data wherein such patterns map the training input to the target output and generate the machine learning models **154** that capture these patterns. Although depicted separately from the server **128**, in some embodiments, the training engine **152** may reside on server **128**. Further, in some embodiments, the database **129**, and/or the training engine **152** may reside on the computing devices **140**.

[0056] As described in more detail below, the one or more machine learning models **154** may comprise, e.g., a single level of linear or non-linear operations (e.g., a support vector machine [SVM]) or the machine learning models **154** may be a deep network, i.e., a machine learning model comprising multiple levels of non-linear operations. Examples of deep networks are neural networks, including generative adversarial networks, convolutional neural networks, recurrent neural networks with one or more hidden layers, and fully connected neural networks (e.g., each neuron may transmit its output signal to the input of the remaining neurons, as well as to itself). For example, the machine learning model may include numerous layers and/or hidden layers that perform calculations (e.g., dot products) using various neurons.

[0057] FIG. **2** illustrates a component diagram for a vocational mask **130** according to certain embodiments of this disclosure. The edge processor **132.2** is also depicted. In some embodiments, the edge processor **132.2** may be included in a computing device separate from the vocational mask **130**, and in some embodiments, the edge processor **132.2** may be included in the vocational mask **130**.

[0058] The vocational mask **130** may include various position, navigation, and time (PNT) components, sensors, and/or devices that enable determining the geographical positon (latitude, longitude, altitude, time), pose (length (ground to sensor), elevation, time), translation (delta in latitude, delta in longitude, delta in altitude, time), the rotational rate of pose (ω_r,ω_p,ω_y (northing),t), and the like, where ω_r represents the roll rate, which is the angular velocity about the longitudinal axis of the vocational mask **130**, ω_p represents the pitch rate, which is the angular velocity about the lateral axis of the vocational mask **130**, ω_y (northing) represents the yaw rate, which is the angular velocity about the vertical axis of the vocational mask **130**, referenced with respect to the northing direction, and t represents the time at which these rotational rates are measured. In some embodiments, the vocational mask **130** may include one or more sensors, such as vocation imaging band specific cameras, visual band cameras, microphones, and the like.

[0059] In some embodiments, the vocational mask **130** may include an audio visual display, such as a stereo speaker, a virtual retinal display, a liquid crystal display, a virtual reality headset, and the like. A virtual retinal display may be a retinal scan display or retinal projector that draws a raster display directly onto the retina of the eye. In some embodiments, the virtual retinal display may include drive electronics that transmit data to a photon generator and/or intensity modulator. These components may process the data (e.g., video, audio, haptic, etc.) and transmit the processed data to a beam scanning component that further transmits data to an optical projector that projects an image and/or video to a retina of a user.

[0060] In some embodiments, the vocational mask **130** may include a network interface card that enables bidirectional communication (digital communication) with other vocational masks and/or computing device **140**.

[0061] In some embodiments, the vocational mask **130** may provide a user interface to the user via the display described herein.

[0062] In some embodiments, the edge processor **132.2** may include a network interface card that enables digital communication with the vocational mask **130**, the computing device **140**, the cloud-based computing system **116**, or the like.

[0063] FIG. **3** illustrates bidirectional communication between communicatively coupled vocational masks **130** and **302** according to certain embodiments of this disclosure. As depicted, a user **306** is wearing a vocational mask **130**. In the depicted example, the vocational mask **130** is attached to or integrated with a welding helmet **308**. The user is viewing an object **300** (e.g., a workpiece). The vocational mask **130** may include multiple electromagnetic spectrum and/or acoustic sensors/imagers **304** to enable obtaining audio, video, acoustic, etc. data while observing the object **300** and/or performing a task (e.g., welding).

[0064] Further, as depicted, the vocational mask **130** may be communicatively coupled to one or more other vocational masks **302** worn by other users and may communicate data in real-time or near real-time such that bidirectional audio visual and haptic communications fosters a master-apprentice relationship. In some embodiments, the bidirectional communication enabled by the vocational masks **130** may enable collaboration between a teacher or collaborator and students. Each of the users wearing the vocational mask **130** may be enabled to visualize the object **300** that the user is viewing in real-time or near real-time.

[0065] FIG. **4** illustrates an example of projecting an image onto a user's retina **400** via a virtual retinal display of a vocational mask **130** according to certain embodiments of this disclosure. As depicted, the imagers and/or cameras of the vocational mask **130** receive data pertaining to the object and the vocational mask **130** processes the data and projects an image representing the object **300** using a virtual retinal display onto the user's retina **400**. The bidirectional communication with other users (e.g., students, master user, collaborator, teacher, supervisor, etc.) may enable projecting the image onto their retinas if they are wearing a vocational mask, as well. In some embodiments, the image may be displayed via a computing device **140** if the other users are not wearing vocational masks.

[0066] FIG. **5** illustrates an example of an image including instructions projected via a virtual retinal display of a vocational mask **130** according to certain embodiments of this disclosure. The example user interface **500** depicts actual things the user is looking at, such as a tool **136** and an object **300** (e.g., a workpiece), through the vocational mask **130**. Further, the user interface depicts instructions **502** pertaining to performing a task. The instructions **502** may be generated by one or more machine learning models **154** of the AI agent, or may be provided via a computing device **140** and/or other vocational mask being used by another user (e.g., master user, collaborator, teacher, supervisor, etc.). In the depicted example, the instructions **502** instruct the user to “1. Turn on welder; 2. Adjust wire speed and voltage”. The instructions **502** may be projected on the user's retina via the virtual retinal display and/or presented on a display of the vocational mask **130**.

[0067] FIG. **6** illustrates an example of an image including a warning projected via a virtual retinal display of a vocational mask according to certain embodiments of this disclosure. The example user interface **600** depicts actual things the user is looking at, such as a tool **136** and an object **300**, through the vocational mask **130**. Further, the user interface depicts a warning **602** pertaining to performing a task. The warning **602** may be generated by one or more machine learning models **154** of the AI agent, or may be provided via a computing device **140** and/or other vocational mask being used by another user (e.g., master user, collaborator, teacher, supervisor, etc.). In the depicted example, the warning **602** indicates “Caution: Material defect detected! Cease welding to avoid burn through”. The warning **602** may be projected on the user's retina via the virtual retinal display and/or presented on a display of the vocational mask **130**.

[0068] FIG. **7** illustrates an example of a method **700** for executing an artificial intelligence agent to determine certain information projected via a vocational mask of a user according to certain embodiments of this disclosure. The method **700** may be performed by processing logic that may include hardware (circuitry, dedicated logic, etc.), software, or a combination of both. The method **700** and/or each of their individual functions, subroutines, or operations may be performed by one or more processing devices of a computing device (e.g., any component (server **128**, training engine **152**, machine learning models **154**, etc.) of cloud-based computing system **116**, vocational mask **130**, edge processor **132** (**132.1**, **132.2**), peripheral haptic device **134**, tool **136**, and/or computing device **140** of FIG. **1**) implementing the method **700**. The method **700** may be implemented as computer instructions stored on a memory device and executable by the one or more processors. In certain implementations, the method **700** may be performed by a single processing thread. Alternatively, the method **700** may be performed by two or more processing threads, each thread implementing one or more individual functions, routines, subroutines, or operations of the methods.

[0069] For simplicity of explanation, the method **700** is depicted and described as a series of operations. However, operations in accordance with this disclosure can occur in various orders or concurrently, and with other operations not presented and described herein. For example, the operations depicted in the method **700** may occur in combination with any other operation of any other method disclosed herein. Furthermore, not all illustrated operations may be required to implement the method **700** in accordance with the disclosed subject matter. In addition, those skilled in the art will understand and appreciate that the method **700** could alternatively be represented as a series of interrelated states via a state diagram or events.

[0070] In some embodiments, one or more machine learning models may be generated and trained by the artificial intelligence engine and/or the training engine to perform one or more of the operations of the methods described herein. For example, to perform the one or more operations, the processing device may execute the one or more machine learning models. In some embodiments, the one or more machine learning models may be iteratively retrained to select different features capable of enabling optimization of output. The features that may be modified may include a number of nodes included in each layer of the machine learning models, an objective function executed at each node, a number of layers, various weights associated with outputs of each node, and the like.

[0071] In some embodiments, a system may include the vocational mask **130**, which may include one or more virtual retinal displays, memory devices, processing devices, and other components as described herein. The processing devices may be communicatively coupled to the memory devices that store computer instructions, and the processing devices may execute the computer instructions to perform one or more of the steps of the method **700**. In some embodiments, the system may include a welding helmet and the vocational mask may be coupled to the welding helmet. In some embodiments, the vocational mask may be configured to operate across both visible light and high intensity ultraviolet light conditions. In some embodiments, the vocational mask may provide protection against welding flash. In some embodiments, the vocational mask may be integrated with goggles. In some embodiments, the vocational mask may be integrated with binoculars or a monocular.

[0072] At block **702**, the processing device may execute an artificial intelligence agent trained to perform at least one or more functions to determine certain information. The functions may include (i) identifying perception-based objects and features, (ii) determining cognition-based scenery to identify one or more material defects, one or more assembly defects, one or more acceptable features, or some combination thereof, and (iii) determining one or more recommendations, instructions, or both.

[0073] At block **704**, the artificial intelligence agent may include one or more machine learning models **154** trained to perform the functions. For example, one or more machine learning models **154** may be trained to (i) identify perception-based objects and features using training data that includes labeled inputs of images including certain objects and features mapped to labeled outputs of identities or characterizations of those objects and features. The machine learning models may be trained to analyze aspects of the objects and features to compare the aspects to known aspects associated with known objects and features, and the machine learning models may perceive the identity of the analyzed objects and features.

[0074] At block **706**, the one or more machine learning models **154** may be trained to (ii) determine cognition-based scenery to identify one or more material defects, one or more assembly defects, one or more acceptable features, or some combination thereof using training data that includes labeled input of scenery images of objects including material defects, assembly defects, and/or acceptable features mapped to labeled outputs that characterize and/or identify the material defects, assembly defects, and/or acceptable features. For example, one scenery image may include a portion of a submarine that includes parts that are welded together, and the machine learning models may be trained to cognitively analyze the scenery image to identify one or more portions of the scenery image that includes a welded part with a material welding defect, a part assembly defect, and/or acceptable welded feature.

[0075] At block **708**, the one or more machine learning models **154** may be trained to (iii) determine one or more recommendations, instructions, or both using training data including labeled input of images (e.g., objects, products, tools, actions, etc.) and tasks to be performed (e.g., weld, grind, chamfer, debur, sand, polish, coat, etc.) mapped to labeled outputs including recommendations, instructions, or both. The processing device may provide (e.g., via the virtual retinal display, a speaker, etc.) images, video, and/or audio that points out the defects and provides instructions, drawings, and/or information pertaining to how to fix the defects.

[0076] In addition, the output from performing one of the functions (i), (ii), and/or (iii) may be used as input to the other functions to enable the machine learning models **154** to generate a combined output. For example, the machine learning models **154** may identify a defect (a gouge) and provide welding instructions on how to fix the defect by filling the gouge properly via the vocational mask **130**. Further, in some instances, the machine learning models **154** may identify several potential actions that the user can perform to complete the task and may aid the user's decision making by providing the actions in a ranked order of most preferred action to least preferred action or a ranked order of the action with the highest probability of success to the action with the lowest probability of success. In some embodiments, the machine learning models **154** may identify an acceptable feature (e.g., properly welded parts) and may output a recommendation to do nothing.
[0077] At block **710**, the processing device may cause the certain information to be presented via the virtual retinal display. In some embodiments, the virtual retinal display may project an image onto at least one iris of the user to display alphanumeric data, graphic instructions, animated instructions, video instructions, or some combination thereof. In some embodiments, the vocational mask may include a stereo speaker to emit audio pertaining the information. In some embodiments, the processing device may superposition the certain information on a display (e.g., virtual retinal display).
[0078] In some embodiments, the vocational mask may include a network interface configured to enable bidirectional communication with a second network interface of a second vocational mask. The bidirectional communication may enable transmission of real-time or near real-time audio and video data, recorded audio and video data, or some combination thereof. “Real-time” may refer to less than 2 seconds and “near real-time” may refer to between 2 and 20 seconds.
[0079] In some embodiments, in addition to the vocational mask, a system may include a peripheral haptic device. The vocational mask may include a haptic interface, and the haptic interface may be configured to perform bidirectional haptic sensing and stimulation using the peripheral haptic device and the bidirectional communication. The stimulation may include precise mimicking, vibration, and the like. For example, the stimulation may include performing mimicked gestures via the peripheral haptic device. In other words, a master user may be using a peripheral haptic device to perform a task and the gestures performed by the master user using the peripheral haptic device may be mimicked by the peripheral haptic device being used by an apprentice user. In such a way, the master user may train and/or guide the apprentice user how to properly perform a task (e.g., weld) using the peripheral haptic devices.
[0080] The haptic interface may be communicatively coupled to the processing device. The haptic interface may be configured to sense, from the peripheral haptic device, hand motions, texture, temperature, vibration, slipperiness, friction, wetness, pulsation, stiction, friction, and the like. For example, the haptic interface may detect keystrokes when a user uses a virtual keyboard presented via the vocational mask using a display (e.g., virtual retinal display).
[0081] Further, the bidirectional communication provided by the vocational mask(s) and/or computing devices may enable a master user of a vocational mask and/or computing device to view and/or listen to the real-time or near real-time audio and video data, recorded audio and video data, or some combination thereof, and to provide instructions to the user via the vocational mask being worn by the user. In some embodiments, the bidirectional communication provided by the vocational mask(s) and/or computing devices may enable the user of a vocational mask and/or computing device to provide instructions to a set of students and/or apprentices via multiple vocational masks being worn by the students and/or apprentices. This technique may be beneficial for a teacher, collaborator, master user, and/or supervisor that is training the set of students.
[0082] In some embodiments, the user wearing a vocational mask may communicate with one or more users who are not wearing a vocational mask. For example, a teacher and/or collaborator may be using a computing device (e.g., smartphone) to see what a student is viewing and hear what the

student is hearing using the bidirectional communication provided by the vocational mask worn by the student. The bidirectional communication provided by the vocational mask may enable a teacher or collaborator to receive, using a computing device, audio data, video data, haptic data, or some combination thereof, from the vocational mask being used by the user.

[0083] Additionally, the teacher and/or collaborator may receive haptic data, via the computing device, from the vocational mask worn by the student. The teacher and/or collaborator may transmit instructions (e.g., audio, video, haptic, etc.), via the computing device, to the vocational mask to guide and/or teach the student how to perform the task (e.g., weld) in real-time or near real-time.

[0084] In another example, the bidirectional communication may enable a user wearing a vocational mask to provide instructions to a set of students via a set of computing devices (e.g., smartphones). In this example, the user may be a teacher or collaborator and may be teaching a class or lesson on how to perform a task (e.g., weld) while wearing the vocational mask.

[0085] In some embodiments, the vocational mask may include one or more sensors to provide information related to geographical position, pose of the user, rotational rate of the user, or some combination thereof. In some embodiments, a position sensor may be used to determine a location of the vocational mask, an object, a peripheral haptic device, a tool, etc. in a physical space. The position sensor may determine an absolute position in relation to an established reference point. In some embodiments, the processing device may perform physical registration of the vocational mask, an object being worked on, a peripheral haptic device, a tool (e.g., welding gun, sander, grinder, etc.), etc. to map out the device in an environment (e.g., warehouse, room, underwater, etc.) in which the vocational mask, the object, the peripheral haptic device, etc. is located.

[0086] In some embodiments, the vocational mask may include one or more sensors including vocation imaging band specific cameras, visual band cameras, stereo microphones, acoustic sensors, or some combination thereof. The acoustic sensors may sense welding clues based on audio signatures associated with certain defects or issues, such as burn through. Machine learning models **154** may be trained using inputs of labeled audio signatures, labeled images, and/or labeled videos mapped to labeled outputs of defects. The artificial intelligence agent may process received sensor data, such as images, audio, video, haptics, etc., identify an issue (e.g., defect), and provide a recommendation (e.g., stop welding due to detected potential burn through) via the vocational mask.

[0087] In some embodiments, the vocational mask may include an optical bench that aligns the virtual retinal display to one or more eyes of the user.

[0088] In some embodiments, the processing device is configured to record the certain information, communications with other devices (e.g., vocational masks, computing devices), or both. The processing device may store certain information and/or communications as data in the memory device communicatively coupled to the processing device, and/or the processing device may transmit the certain information and/or communications as data feeds to the cloud-based computing system **116** for storage.

[0089] FIG. **8** illustrates an example of a method **800** for transmitting instructions for performing a task via bidirectional communication between a vocational mask and a computing device according to certain embodiments of this disclosure. The method **800** may be performed by processing logic that may include hardware (circuitry, dedicated logic, etc.), software, or a combination of both. The method **800** and/or each of their individual functions, subroutines, or operations may be performed by one or more processing devices of a computing device (e.g., any component (server **128**, training engine **152**, machine learning models **154**, etc.) of cloud-based computing system **116**, vocational mask **130**, edge processor **132** (**132.1**, **132.2**), peripheral haptic device **134**, tool **136**, and/or computing device **140** of FIG. **1**) implementing the method **700**. The method **800** may be implemented as computer instructions stored on a memory device and executable by the one or more processors. In certain implementations, the method **800** may be performed by a single processing thread. Alternatively, the method **800** may be performed by two or more processing threads, each thread implementing one or more individual functions, routines, subroutines, or operations of the methods.

[0090] For simplicity of explanation, the method **800** is depicted and described as a series of operations. However, operations in accordance with this disclosure can occur in various orders or concurrently, and with other operations not presented and described herein. For example, the operations depicted in the method **800** may occur in combination with any other operation of any other method disclosed herein. Furthermore, not all illustrated operations may be required to implement the method **800** in accordance with the disclosed subject matter. In addition, those skilled in the art will understand and appreciate that the method **800** could alternatively be represented as a series of interrelated states via a state diagram or events.

[0091] In some embodiments, one or more machine learning models may be generated and trained by the artificial intelligence engine and/or the training engine to perform one or more of the operations of the methods described herein. For example, to perform the one or more operations, the processing device may execute the one or more machine learning models. In some embodiments, the one or more machine learning models may be iteratively retrained to select different features capable of enabling optimization of output. The features that may be modified may include a number of nodes included in each layer of the machine learning models, an objective function executed at each node, a number of layers, various weights associated with outputs of each node, and the like.

[0092] At block **802**, while a first user wears a vocational mask **130** to perform a task, the processing device may receive, at one or more processing devices of the vocational mask **130**, one or more first data feeds from one or more cameras of the vocational mask **130**, sensors of the vocational mask **130**, peripheral haptic devices associated with the vocational mask **130**, microphones of the vocational mask **130**, or some combination thereof. In some embodiments, the vocational mask **130** may be attached to or integrated with a welding helmet and the task may be welding. In some embodiments, the task may be sanding, grinding, polishing, deburring, chamfering, coating, etc. The vocational mask **130** may be attached to or integrated with a helmet, a hat, goggles, binoculars, a monocular, or the like.

[0093] In some embodiments, the one or more first data feeds may include information related to video, images, audio, hand motions, haptics, texture, temperature, vibration, slipperiness, friction, wetness, pulsation, or some combination thereof. In some embodiments, the one or more first data feeds may include geographical position of the vocational mask **130**, and the processing device may map, based on the geographical positon, the vocational mask **130** in an environment or a physical space in which the vocational mask **130** is located.

[0094] At block **804**, the processing device may transmit, via one or more network interfaces of the vocational mask **130**, the one or more first data feeds to one or more processing devices of the computing device **140** of a second user. In some embodiments, the computing device **140** of the second user may include one or more vocational masks, one or more smartphones, one or more tablets, one or more laptop computers, one or more desktop computers, one or more servers, or some combination thereof. The computing device **140** may be separate from the vocational mask **130**, and the one or more first data feeds are at least one of presented via a display of the computing device **140**, emitted by an audio device of the computing device **140**, or produced or reproduced via a peripheral haptic device coupled to the computing device **140**. In some embodiments, the first user may be an apprentice, student, trainee, or the like, and the second user may be a master user, a trainer, a teacher, a collaborator, a supervisor, or the like.

[0095] At block **806**, the processing device may receive, from the computing device, one or more second data feeds pertaining to at least instructions for performing the task. The one or more second data feeds are received by the one or more processing devices of the vocational mask **130**, and the one or more second data feeds are at least one of presented via a virtual retinal display of the vocational mask **130**, emitted by an audio device (e.g., speaker) of the vocational mask **130**, or produced or reproduced via a peripheral haptic device **134** coupled to the vocational mask **130**.

[0096] In some embodiments, the instructions are presented, by the virtual retinal display of the vocational mask **130**, via augmented reality. In some embodiments, the instructions are presented, by the virtual retinal display of the vocational mask, via virtual reality during a simulation associated with the task. In some embodiments, the processing device may cause the virtual retinal display to project an image onto at least one iris of the first user to display alphanumeric data associated with the instructions, graphics associated with the instructions, animations associated with the instructions, video associated with the instructions, or some combination thereof.

[0097] At block **808**, the processing device may store, via one or more memory devices communicatively coupled to the one or more processing devices of the vocational mask **130**, the one or more first data feeds and/or the one or more second data feeds.

[0098] In some embodiments, the processing device may cause the peripheral haptic device **134** to vibrate based on the instructions received from the computing device **140**.

[0099] In some embodiments, the processing device may execute an artificial intelligence agent trained to perform at least one or more functions to determine certain information. The one or more functions may include (i) identifying perception-based objects and features, (ii) determining cognition-based scenery to identify one or more material defects, one or more assembly defects, one or more acceptable features, or some combination thereof, and (iii) determining one or more recommendations, instructions, or both.

[0100] FIG. **9** illustrates an example of a method **900** for implementing instructions for performing a task using a peripheral haptic device according to certain embodiments of this disclosure. The method **900** may be performed by processing logic that may include hardware (circuitry, dedicated logic, etc.), software, or a combination of both. The method **900** and/or each of their individual functions, subroutines, or operations may be performed by one or more processing devices of a computing device (e.g., any component (server **128**, training engine **152**, machine learning models **154**, etc.) of cloud-based computing system **116**, vocational mask **130**, edge processor **132** (**132.1**, **132.2**), peripheral haptic device **134**, tool **136**, and/or computing device **140** of FIG. **1**) implementing the method **900**. The method **900** may be implemented as computer instructions stored on a memory device and executable by the one or more processors. In certain implementations, the method **900** may be performed by a single processing thread. Alternatively, the method **900** may be performed by two or more processing threads, each thread implementing one or more individual functions, routines, subroutines, or operations of the methods.

[0101] For simplicity of explanation, the method **900** is depicted and described as a series of operations. However, operations in accordance with this disclosure can occur in various orders or concurrently, and with other operations not presented and described herein. For example, the operations depicted in the method **900** may occur in combination with any other operation of any other method disclosed herein. Furthermore, not all illustrated operations may be required to implement the method **900** in accordance with the disclosed subject matter. In addition, those skilled in the art will understand and appreciate that the method **900** could alternatively be represented as a series of interrelated states via a state diagram or events.

[0102] In some embodiments, one or more machine learning models may be generated and trained by the artificial intelligence engine and/or the training engine to perform one or more of the operations of the methods described herein. For example, to perform the one or more operations, the processing device may execute the one or more machine learning models. In some embodiments, the one or more machine learning models may be iteratively retrained to select different features capable of enabling optimization of output. The features that may be modified may include a number of nodes included in each layer of the machine learning models, an objective function executed at each node, a number of layers, various weights associated with outputs of each node, and the like.

[0103] At block **902**, the processing device may receive, at one or more processing devices of a vocational mask **130**, first data pertaining to instructions for performing a task using a tool **136**. The first data may be received from a computing device **140** separate from the vocational mask **130**. In some embodiments, the computing device may include one or more peripheral haptic devices, one or more vocational masks, one or more smartphones, one or more tablets, one or more laptop computers, one or more desktop computers, one or more servers, or some combination thereof. In some embodiments, the task includes welding and the tool **136** is a welding gun.

[0104] At block **904**, the processing device may transmit, via a haptic interface communicatively coupled to the one or more processing devices of the vocational mask **130**, the first data to one or more peripheral haptic devices **134** associated with the tool **136** to cause the one or more peripheral haptic devices **134** to implement the instructions by at least vibrating in accordance with the instructions to guide a user to perform the task using the tool **136**.

[0105] At block **906**, responsive to the one or more peripheral haptic devices **134** implementing the instructions, the processing device may receive, from a haptic interface, feedback data pertaining to one or more gestures, motions, surfaces, temperatures, or some combination thereof. The feedback data may be received from the one or more peripheral haptic devices **134**, and the feedback data may include information pertaining to the user's compliance with the instructions for performing the task.

[0106] At block **908**, the processing device may transmit, to the computing device **140**, the feedback data. In some embodiments, transmitting the feedback data may cause the computing device **140** to produce an indication of whether the user complied with the instructions for performing the task. The indication may be produced or generated via a display, a speaker, a different peripheral haptic device, or some combination thereof.

[0107] In some embodiments, in addition to the first data being received, video data may be received at the processing device of the vocational mask **130**, and the video data may include video pertaining to the instructions for performing the task using the tool **136**. In some embodiments, the processing device may display, via a virtual retinal display of the vocational mask **130**, the video data. In some embodiments, the video data may be displayed concurrently with the instructions being implemented by the one or more peripheral haptic devices **134**.

[0108] In some embodiments, in addition to the first data and/or video data being received, audio data may be received at the processing device of the vocational mask **130**, and the audio data may include audio pertaining to the instructions for performing the task using the tool **136**. In some embodiments, the processing device may emit, via a speaker of the vocational mask **130**, the audio data. In some embodiments, the audio data may be emitted concurrently with the instructions being by the one or more peripheral haptic devices **134** and/or with the video data being displayed by the virtual retinal display. That is, one or more of video, audio, and/or haptic data pertaining to the instructions may be used concurrently to guide or instruct a user how to perform a task.

[0109] In some embodiments, in addition to the first data, video data, and/or audio data being received, virtual reality data may be received at the processing device of the vocational mask **130**, and the virtual reality data may include virtual reality multimedia representing a simulation of a task. The processing device may execute, via at least a display of the vocational mask **130**, playback of the virtual reality multimedia. For example, an artificial intelligent simulation generator may be configured to generate a virtual reality simulation for performing a task, such as welding an object using a welding gun. The virtual reality simulation may take into consideration various attributes, characteristics, parameters, and the like of the welding scenario, such as type of object being welded, type of welding, current amperage, length of arc, angle, manipulation, speed, and the like. The virtual reality simulation may be generated as multimedia that is presented via the vocational mask to a user to enable a user to practice, visualize, and experience performing certain welding tasks without actually welding anything.

[0110] In some embodiments, in addition to the first data, video data, audio data, and/or virtual reality data being received, augmented reality data may be received at the processing device of the vocational mask **130**, and the augmented reality data may include augmented reality multimedia representing at least the instructions (e.g., via text, graphics, images, video, animation, audio). The processing device may execute, via at least a display of the vocational mask **130**, playback of the augmented reality multimedia.

[0111] In some embodiments, the processing device may execute an artificial intelligence agent trained to perform at least one or more functions to determine certain information. The one or more functions may include (i) identifying perception-based objects and features, (ii) determining cognition-based scenery to identify one or more material defects, one or more assembly defects, one or more acceptable features, or some combination thereof, and/or (iii) determining one or more recommendations, instructions, or both. In some embodiments, the processing device may display, via a display (e.g., virtual retinal display or other display), the objects and features, the one or more material defects, the one or more assembly defects, the one or more acceptable features, the one or more recommendations, the instructions, or some combination thereof.

[0112] FIG. **10** illustrates an example computer system **1000**, which can perform any one or more of the methods described herein. In one example, computer system **1000** may include one or more components that correspond to the vocational mask **130**, the computing device **140**, the peripheral haptic device **134**, the tool **136**, one or more servers **128** of the cloud-based computing system **116**, or one or more training engines **152** of the cloud-based computing system **116** of FIG. **1**. The computer system **1000** may be connected (e.g., networked) to other computer systems in a LAN, an intranet, an extranet, or the Internet. The computer system **1000** may operate in the capacity of a server in a client-server network environment. The computer system **1000** may be a personal computer (PC), a tablet computer, a laptop, a wearable (e.g., wristband), a set-top box (STB), a personal Digital Assistant (PDA), a smartphone, a smartwatch, a camera, a video camera, or any device capable of executing a set of instructions (sequential or otherwise) that specify actions to be taken by that device. Further, while only a single computer system is illustrated, the term “computer” shall also be taken to include any collection of computers that individually or jointly execute a set (or multiple sets) of instructions to perform any one or more of the methods discussed herein.

[0113] The computer system **1000** includes a processing device **1002**, a main memory **1004** (e.g., read-only memory (ROM), solid state drive (SSD), flash memory, dynamic random access memory (DRAM) such as synchronous DRAM (SDRAM)), a static memory **1006** (e.g., solid state drive (SSD), flash memory, static random access memory (SRAM)), and a data storage device **1008**, which communicate with each other via a bus **1010**.

[0114] Processing device **1002** represents one or more general-purpose processing devices such as a microprocessor, central processing unit, or the like. More particularly, the processing device **1002** may be a complex instruction set computing (CISC) microprocessor, reduced instruction set computing (RISC) microprocessor, very long instruction word (VLIW) microprocessor, or a processor implementing other instruction sets or processors implementing a combination of instruction sets. The processing device **1002** may also be one or more special-purpose processing devices such as an application specific integrated circuit (ASIC), a field programmable gate array (FPGA), a digital signal processor (DSP), network processor, or the like. The processing device **1002** is configured to execute instructions for performing any of the operations and steps of any of the methods discussed herein.

[0115] The computer system **1000** may further include a network interface device **1012**. The computer system **1000** also may include a video display **1014** (e.g., a liquid crystal display (LCD) or a cathode ray tube (CRT)), one or more input devices **1016** (e.g., a keyboard and/or a mouse), and one or more speakers **1018** (e.g., a speaker). In one illustrative example, the video display **1014** and the input device(s) **1016** may be combined into a single component or device (e.g., an LCD touch screen).

[0116] The data storage device **1008** may include a computer-readable medium **1020** on which the instructions **1022** embodying any one or more of the methodologies or functions described herein are stored. The instructions **1022** may also reside, completely or at least partially, within the main memory **1004** and/or within the processing device **1002** during execution thereof by the computer system **1000**. As such, the main memory **1004** and the processing device **1002** also constitute computer-readable media. The instructions **1022** may further be transmitted or received over a network **20** via the network interface device **1012**.
[0117] While the computer-readable storage medium **1020** is shown in the illustrative examples to be a single medium, the term "computer-readable storage medium" should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, and/or associated caches and servers) that store the one or more sets of instructions. The term "computer-readable storage medium" shall also be taken to include any medium that is capable of storing, encoding or carrying a set of instructions for execution by the machine and that cause the machine to perform any one or more of the methodologies of the present disclosure. The term "computer-readable storage medium" shall accordingly be taken to include, but not be limited to, solid-state memories, optical media, and magnetic media.
[0118] Systems and methods of the present disclosure can also implement artificial intelligence and machine learning to monitor work tasks. According to some embodiments, two or more of the same (or similar) work tasks can be performed in a given environment (e.g., by humans, by robots, or some combination thereof), where each work task is monitored by a respective group of sensors. For example, given group of sensors can correspond to a vocational mask **130** being worn by a practician, one or more sensors that are located in proximity to the area where the work task is being performed, or some combination thereof. As a given work task is performed, the respective group of sensors collects information about how the work task is being performed, and provides the information as input(s) to at least one machine learning model to cause the model to output a respective performance score associated with the work task.
[0119] According to some embodiments, a user interface (UI) can include a respective sub-UI for each work task, where each sub-UI includes information that pertains to the work task (e.g., the respective performance score, one or more video feeds, etc.), UI controls that enable a manager to remotely interface relative to the work task, and so on. The sub-UIs can be dynamically re-ordered based on the performance scores (and/or other information) as they are output by the at least one machine learning model so that work tasks that are being properly performed—or, conversely, improperly performed—are prominently displayed within the UI. In this manner, one or more managers can utilize the UI to help mitigate issues that arise.
[0120] FIGS. **11**A-**11**B illustrate conceptual diagrams of different environments in which artificial intelligence and machine learning can be utilized to monitor work tasks, according to some embodiments. In particular, FIG. **11**A illustrates a conceptual diagram of an example work environment **1100** where four individuals are operating in respective areas of the work environment **1100** and are performing the same (or similar) welding task. As another example, FIG. **11**B illustrates an example work environment **1150** where four robots are operating in respective areas of the work environment **1150** and are performing the same (or similar) welding task. In this regard, various aspects of the work environment **1100** described herein can be applied in the same or similar manner to the work environment **1150**, consistent with the scope of this disclosure.
[0121] As shown in FIG. **11**A, each individual is operating a welding gun that can include one or more sensors that collect information about the welding task as it is being performed. The welding gun sensors can include, for example, arc sensors, temperature sensors, force sensors, distance sensors, gas flow sensors, wire feed sensors, weld pool monitoring sensors, weld seam tracking sensors, weld penetration sensors, vision sensors, and the like. It is noted that the welding gun, machine(s) to which the welding gun is attached, etc., can also provide information about configuration settings that are currently implemented. For example, when the welding gun is used

to perform gas metal arc welding, the information can include a voltage setting, an amperage setting, a wire feed rate setting, a gas flow rate setting, and so on.

[0122] As shown in FIG. **11**A, each area of the work environment **1100** can include oversight sensors that collect information about the individual, the equipment, the materials, etc., as the welding task is being performed. For example, each area of the work environment **1100** can include one or more camera sensors (e.g., visible light cameras, infrared cameras, 3d cameras, multispectral cameras, hyperspectral cameras, x-ray cameras, gamma-ray cameras, ultraviolet cameras, underwater cameras, panoramic cameras, microscopic cameras, high-speed cameras, etc.). As also shown in FIG. **11**A, each area of the work environment **1100** can include localized sensors that collect information about the individual, the equipment, the materials, etc., as the welding task is being performed. For example, each area of the work environment **1100** can include temperature sensors, strain gauges, ultrasonic sensors, acoustic emission sensors, displacement sensors, infrared sensors, pressure sensors, moisture sensors, conductivity sensors, surface roughness sensors, and the like.

[0123] It is noted that the sensors described herein are not meant to be limiting, and that any amount, type, form, etc., of sensor(s), groups of sensors, etc., can be included within each area of the work environment **1100**, and can be configured to collect any amount, type, form, etc., of information, at any level of granularity, consistent with the scope of this disclosure. It is also noted that other sensors can be included in the work environment **1100** to gather information about one or more of the areas of the work environment **1100**, consistent with the scope of this disclosure.

[0124] According to some embodiments, and as shown in FIG. **11**A, information gathered by the sensors can be transmitted to the cloud-based computing system **116** (e.g., via the Internet). Additional information (e.g., metadata) can accompany the information to enable the cloud-based computing system **116** to effectively organize and analyze the information to implement the techniques described herein. The additional information can include, for example, a unique identifier (UID) associated with the work environment **1100**, UIDs associated with different areas of the work environment **1100**, UIDs of individuals working within the areas of the work environment **1100**, UIDs of equipment being utilized within different areas of the work environment **1100**, UIDs of sensors being used to gather information within different areas of the work environment **1100**, and so on. It is noted that the foregoing examples are not meant to be limiting, and that the additional information (e.g., metadata) can include any amount, type, form, etc., of information, at any level of granularity, consistent with the scope of this disclosure. It should also be appreciated that the work environment **1100** can include one or more localized computing devices that can be configured to interact with and collect information from the sensors, optionally analyze, modify, etc., the information, and then transmit the information to the cloud-based computing system **116**, to thereby reduce or eliminate procedures performed by the cloud-based computing system **116**.

[0125] According to some embodiments, the cloud-based computing system **116** can receive information associated with the work environment **1100** and output respective performance scores for the different areas of the work environment **1100**. According to some embodiments, for a given area of the work environment **1100**, the respective performance score can be based on any number of sub-scores that are calculated for the area of the work environment **1100**. For example, a progress score can indicate a rate at which a work task is being performed within the area of the work environment **1100**. In another example, a quality score can indicate a quality of the work task being performed. In yet another example, an adherence score can represent an overall adherence to how the work task should be performed. It is noted that the foregoing examples are not meant to be limiting, and that the sub-scores can include any amount, type, form, etc., of sub-score(s), at any level of granularity, consistent with the scope of this disclosure.

[0126] As a general example, the performance score for a given area of the work environment **1100** may be based on a comparison between a performance of the current work task and a baseline, reference, or target performance level of the work task, a comparison between the performance of the current work task and previous performances of the work task by the same user or other users, and so on. In an example, the performance score can based on one or more performance values, which may correspond to measured or sensed values, calculated values, modeled or estimated values, and the like. As one example, a performance score may be based on a calculation of an overall amount of variation of performance values from one or more target values (e.g., a running average of performance values), a number of times respective performance values varied (e.g., by at least a predetermined amount) from one or more target values, and so on.

[0127] In one example, the performance score is calculated (e.g., using one or more of the ML models **154**) based on a combination of performance values each corresponding to one or more of a plurality of measured, sensed, calculated, estimated, etc., values. For example, the performance score may be a numerical value, such as an integer or non-integer value (e.g., a value on a scale from 1 to 10, from 1 to 100, etc.) or a percentage. Each individual performance value may be calculated in accordance with a variation from a target value, where a maximum performance value (e.g., 100) is assigned for measurements within a minimum threshold of a target or baseline value and a minimum performance value (e.g., 0) is assigned for measurements greater than or equal to a maximum threshold of the target or baseline value. The target or baseline value may be a predetermined value (e.g., a predetermined target temperature), a dynamic value based on historical performance data (e.g., an average or other combination of temperatures measured during previous performances of the current task by the same or different users), or combinations thereof.

[0128] According to some embodiments, the performance score is an average or weighted average of the individual performance values. For example, one or more of the ML models **154** may be trained to obtain weights for each of the performance values based on assessments of overall weld quality (i.e., for a completed weld by the user and/or other users) and the various performance values calculated during performance of the respective welds. In other words, an ML model **154** may be trained to identify performance values that have the greatest effect on overall weld quality and assign weights accordingly. The weights may correspond to percentages or decimal values between 0 and 1, a ranking of the performance values (e.g., from 1 to n or from n to 1, where n is an integer greater than one), etc. In this manner, the performance score may be continuously calculated and updated as the user performs the welding task.

[0129] FIGS. **12**A-**12**H illustrate conceptual diagrams of user interfaces that can be implemented to monitor work tasks under an example workflow that occurs within a work environment **1100**, according to some embodiments. As shown in FIG. **12**A, a user interface **1210** can include six sub-UIs **1211-1216**, where each sub-UI is dynamically updated, throughout the example workflow, and corresponds to a respective area of the work environment **1100**.

[0130] For example, FIG. **12**A represents a first point in time during the example workflow, where sub-UI **1211** displays information about an Operator 4, who is an individual that is currently achieving a performance score of 92. Similarly, sub-UI **1212** displays information about an Operator 1, who is an individual that is currently achieving a performance score of 87. Similarly, sub-UI **1213** displays information about an Operator 6, who is an individual that is currently achieving a performance score of 83. Similarly, sub-UI **1214** displays information about an Operator 3, who is an individual that is currently achieving a performance score of 72. Similarly, sub-UI **1215** displays information about an Operator 5, who is an individual that is currently achieving a performance score of 65. Finally, sub-UI **1216** displays information about an Operator 2, who is an individual that is currently achieving a performance score of 47. Each of the performance scores can be calculated, for example, in accordance with the techniques described above in conjunction with FIGS. **11**A-**11**B.

[0131] As shown in FIG. **12**A, each of the sub-UIs **1211-1216** can include an active video feed of the respective work task that is being performed in the area of the work environment **1100** to which the sub-UI corresponds. It should be appreciated that any number, type, form, etc., of video feed(s) can be displayed within the sub-UIs **1211-1216**, consistent with the scope of this disclosure. Additionally, as shown in FIG. **12**A, each of the sub-UIs **1211-1216** can include user interface controls that enable one or more operators who interface with the user interface **1210** to interact with the area of the work environment **1100**, the individuals working within the area of the work environment **1100**, the equipment being utilized within the area of the work environment **1100**, etc., to which the sub-UI corresponds. In particular, and as shown in FIG. **12**A, each sub-UI can include user interface controls that provide options to remotely interact with the individual, the equipment (e.g., tools, robots, etc.), etc., operating in the respective area of the work environment **1100**, an option to toggle between camera feeds of the respective area of the work environment **1100**, and so on. It should be appreciated that any number, type, form, etc., of user interface control(s), configured to enable any of the features described herein to be accessed, utilized, etc., at any level of granularity, can be included in the sub-UIs **1211-1216**, consistent with the scope of this disclosure.

[0132] As shown in FIG. **12**A, the sub-UIs **1211-1216** are ordered, in a left to right, and top to bottom fashion, based on respective performance scores of the operator. It should be appreciated, however, that other ordering paradigms can be implemented, consistent with the scope of this disclosure. It should also be appreciated that the layout, style, etc., of the user interface **1210** illustrated in FIG. **12**A should not be construed as limiting, and that the user interfaces illustrated throughout FIGS. **12**A-**12**H can incorporate any number, type, form, etc., of sub-UIs, configured to display any amount, type, form, etc., of information, at any level of granularity, consistent with the scope of this disclosure. In any case, and as described herein, the user interfaces illustrated in FIG. **12**A-**12**H can beneficially enable one or more managers to effortlessly identify overall performances of operators relative to the work tasks they have been assigned, as well as enable the managers to implement remedial measures when appropriate.

[0133] Accordingly, at the first point in time illustrated in FIG. **12**A, Operator 4 is the top-performing operator among the six different operators, and Operator 2 is the lowest-performing operator among the six different operators. FIG. **12**B illustrates a user interface **1220** that reflects a second point in time during the example workflow, where the operators have continued working on their respective work tasks, and their respective performance scores have changed based on their rate of progress, their quality of work, and so on. In the example illustrated in FIG. **12**B, Operator 1 and Operator 4 switch positions in the user interface **1220** due to their changes in performance scores.

[0134] Additionally, within the sub-UI **1216**, the option the toggle the camera view is selected, which causes an overlay UI, that includes additional user interface elements, to be displayed within the sub-UI **1216**. As shown in FIG. **12**B, the overlay UI lists out various camera views that are available, including an option to view a camera feed directed at materials that are being welded, a camera feed directed at the welding gun (or a camera feed from the perspective of the welding gun directed at the materials being welded), a camera feed directed at the operator (or a camera feed from the perspective of the operator), and so on. It should be appreciated that the camera feeds illustrated in FIG. **12**B and described herein are merely exemplary, and that any number, type, form, etc., of camera feed(s) can be accessible through the overlay UI, consistent with the scope of this disclosure.

[0135] According to some embodiments, the cloud-based computing system **116** can analyze information associated with the area of the work environment **1100** to which the sub-UI **1216** corresponds, to automatically identify the camera feed that would be most helpful to the manager when overseeing the work task that is being performed. For example, if the cloud-based computing system **116** determines that operator technique is a primary cause of a performance score deficiency, then the option to view the Operator View camera feed can be displayed at the top of the list of camera feeds within the overlay UI. In another example, if the cloud-based computing system **116** determines that the welding gun settings are a primary cause of a performance score deficiency, then the option to the Welding Gun View camera feed can be displayed at the top of the list of camera feeds within the overlay UI. Alternatively (or additionally), the optimal camera feed can be dynamically identified and selected/displayed within the sub-UIs **1211-1216** so that the manager is able to efficiently identify problems that are occurring as well as how to mitigate them. It should be appreciated that the foregoing approaches can be conversely applied to identify factors that are contributing to high/satisfactory performance scores, so that such factors can be utilized as a basis for mitigating performance score deficiencies.

[0136] In any case, as shown in FIG. **12**B, the manager selects the Welding Gun View option within the sub-UI **1216**. FIG. **12**C illustrates a user interface **1230** that reflects a third point in time during the example workflow, where the operators have continued working on their respective work tasks, and their respective performance scores have changed based on their rate of progress, their quality of work, and so on. As shown in FIG. **12**C, the camera feed displayed within the sub-UI **1216** has been updated to an up-close view of the welding gun being utilized by Operator 2, so that the manager can get a closer look at what might be contributing to the low performance score of 38 that Operator 2 is achieving. Additionally, as shown in FIG. **12**C, Operator 3 and Operator 6 have switched positions within the user interface **1230** as a result of their performance scores changing.

[0137] FIG. **12**D illustrates a user interface **1240** that reflects a fourth point in time during the example workflow, where the operators have continued working on their respective work tasks, and their respective performance scores have changed based on their rate of progress, their quality of work, and so on. As shown in FIG. **12**D, the performance score of Operator 2 continues to decline, which prompts the manager to select the Remote Access option. When the Remote Access option is selected, an overlay UI is displayed that provides options to perform welding gun adjustments, to engage in a live control/intercom session with Operator 2 and/or the equipment being utilized by Operator 2, and to summon a manager (that is local/onsite relative to the area of the work environment **1100** to which the sub-UI **1216** corresponds). As shown in FIG. **12**D, the manager selects the Welding Gun Adjustments option, which causes the user interface **1250** illustrated in FIG. **12**E to be displayed.

[0138] As shown in FIG. **12**E, the user interface **1250** provides an expanded view of information associated with Operator 2, including their name (“Roy Smith”), the type of welding gun being used (“Gas Metal Arc Welder”), and their current performance score. The user interface **1250** also displays various configuration settings currently applied on the welding gun, e.g., voltage, amperage, wire feed rate, gas flow rate, and so on. As shown in FIG. **12**E, a respective range is provided for each configuration setting, as well as a slider to conveniently adjust the configuration setting. According to some embodiments, the cloud-based computing system **116** can also provide recommendations for each of the configuration settings, which can be dynamically generated based on information received in association with the work task being performed in the area of the work environment **1100** to which the sub-UI **1216** corresponds.

[0139] Additionally, and as shown in FIG. **12**E, a larger video feed of the work task is displayed within the sub-UI **1216**, as well as user interface controls that enable the manager to speak directly with Operator 2, to take live control of the welding gun (e.g., consistent with the techniques described herein) or other equipment, to toggle the camera view, and so on. Again, it is noted that the manner in which the user interface **1250** is organized—as well as the information, options, etc., displayed therein—is merely exemplary, and that any amount, type, form, etc., of information, as well as any number, type, form, of option(s) to perform different tasks, at any level of granularity, can be included in the user interface **1250**, consistent with the scope of this disclosure.

[0140] As shown in FIG. **12**F, the manager opts to adjust the configuration settings described above in conjunction with FIG. **12**E, which yields a drastic improvement in the performance score (**62**) achieved by Operator 2 (as illustrated in the user interface **1260**). FIG. **12**G illustrates a user interface **1270** that reflects a later point in time during the example workflow, where the operators have continued working on their respective work tasks, and their respective performance scores have changed based on their rate of progress, their quality of work, and so on.

[0141] Finally, FIG. **12**H illustrates a user interface **1280** that reflects a final point in time of the example workflow, where the operators have continued working on their respective work tasks, and their respective performance scores have changed based on their rate of progress, their quality of work, and so on. As shown in FIG. **12**H, Operator 4 and Operator 1 have switched positions based on their performance scores, and Operator 5 and Operator 6 have switched positions based on their respective performance scores. Additionally, the cloud-based computing system **116** identifies that Operator 2 has manually adjusted the configuration settings that were applied by the manager (as described above in conjunction with FIG. **12**F). In turn, an overlay UI can be displayed within the sub-UI **1216**, where the overlay UI includes information that indicates, to the manager, the nature of the problem. The overlay UI can also enable the manager to summon an on-site manager to address the problem (or take other remedial actions that are available).

[0142] FIG. **13** illustrates steps of an example method **1300** for monitoring work tasks, according to some embodiments. One or more computing systems, computing devices, processors or processing devices, AI/ML models, etc. as described herein may be configured to perform various steps of the method **1300** (e.g., the cloud-based computing system **116**). While the method **1300** may be implemented for performing different types of tasks, the steps of the method **1300** are described with respect to a welding task for illustration purposes only.

[0143] As shown in FIG. **13**, the method **1300** begins at step **1302**, where the cloud-based computing system **116** interfaces with a plurality of sensor groups, where each sensor group of the plurality of sensor groups gathers respective information about a respective at least one work task that is being monitored by the sensor group (e.g., as described above in conjunction with FIGS. **11**A-**11**B and **12**A-**12**H).

[0144] At step **1304**, the cloud-based computing system **116** performs the following steps for each sensor group of the plurality of sensor groups: (1) obtains the respective information about the respective at least one work task that is being monitored by the sensor group, and (2) provides the respective information to at least one machine learning model to cause the at least one machine learning model to output a respective performance score that corresponds to the respective at least one work task (e.g., as described above in conjunction with FIGS. **11**A-**11**B and **12**A-**12**H).

[0145] At step **1306**, the cloud-based computing system **116** outputs a user interface (UI) to at least one display device, where the UI includes, for each performance score, a respective sub-UI that is ordered within the UI relative to other sub-UIs based on their respective performance scores (e.g., as described above in conjunction with FIGS. **11**A-**11**B and **12**A-**12**H).

CLAUSES

[0146] 1. A system, comprising: [0147] a plurality of sensor groups, wherein each sensor group of the plurality of sensor groups gathers respective information about a respective at least one work task that is being monitored by the sensor group; and [0148] at least one computing device configured to: [0149] for each sensor group of the plurality of sensor groups: [0150] obtain the respective information about the respective at least one work task that is being monitored by the sensor group, and [0151] provide the respective information to at least one machine learning model to cause the at least one machine learning model to output a respective performance score that corresponds to the respective at least one work task; and [0152] output a user interface (UI) to at least one display device, wherein the UI includes, for each performance score, a respective sub-UI that is ordered within the UI relative to other sub-UIs based on their respective performance scores.

[0153] The system of any clause herein, wherein, for a given sensor group of the plurality of sensor groups, the respective information includes a plurality of performance values, and the respective performance score is based on the plurality of performance values.

[0154] The system of any clause herein, wherein respective weights are assigned to the plurality of performance values, and the respective performance score is calculated based on a weighted

average of the plurality of performance values.
[0155] The system of any clause herein, wherein the at least one machine learning model is trained and fine-tuned to output the performance scores based on the respective information.
[0156] The system of any clause herein, wherein, for a given sensor group of the plurality of sensor groups, the respective at least one work task comprises at least one welding task.
[0157] The system of any clause herein, wherein the respective information indicates, for a weld associated with the at least one welding task, a straightness of the weld, a thickness of the weld, a temperature of the weld, a travel speed of the weld, a gas presence of the weld, an amount of welding material used, a porosity of the weld, a penetration of the weld, or some combination thereof.
[0158] The system of any clause herein, wherein, for a given at least one work task, the respective sub-UI includes: [0159] first information based at least in part on the respective performance score; and [0160] second information based at least in part on the respective information on which the respective performance score is based, [0161] a first option to adjust at least one aspect of the respective at least one work task, [0162] a second option to view at least one camera feed of the given at least one work task as it is being performed, and [0163] a third option to summon at least one manager individual who is in proximity to the given at least one work task as it is being performed.
[0164] A method for monitoring work tasks, the method comprising, by a computing device: [0165] interfacing with a plurality of sensor groups, wherein each sensor group of the plurality of sensor groups gathers respective information about a respective at least one work task that is being monitored by the sensor group; [0166] for each sensor group of the plurality of sensor groups: [0167] obtaining the respective information about the respective at least one work task that is being monitored by the sensor group, and [0168] providing the respective information to at least one machine learning model to cause the at least one machine learning model to output a respective performance score that corresponds to the respective at least one work task; and [0169] outputting a user interface (UI) to at least one display device, wherein the UI includes, for each performance score, a respective sub-UI that is ordered within the UI relative to other sub-UIs based on their respective performance scores.
[0170] The method of any clause herein, wherein, for a given sensor group of the plurality of sensor groups, the respective information includes a plurality of performance values, and the respective performance score is based on the plurality of performance values.
[0171] The method of any clause herein, wherein respective weights are assigned to the plurality of performance values, and the respective performance score is calculated based on a weighted average of the plurality of performance values.
[0172] The method of any clause herein, wherein the at least one machine learning model is trained and fine-tuned to output the performance scores based on the respective information.
[0173] The method of any clause herein, wherein, for a given sensor group of the plurality of sensor groups, the respective at least one work task comprises at least one welding task.
[0174] The method of any clause herein, wherein the respective information indicates, for a weld associated with the at least one welding task, a straightness of the weld, a thickness of the weld, a temperature of the weld, a travel speed of the weld, a gas presence of the weld, an amount of welding material used, a porosity of the weld, a penetration of the weld, or some combination thereof.
[0175] The method of any clause herein, wherein, for a given at least one work task, the respective sub-UI includes: [0176] first information based at least in part on the respective performance score; and [0177] second information based at least in part on the respective information on which the respective performance score is based, a first option to adjust at least one aspect of the respective at least one work task, [0178] a second option to view at least one camera feed of the given at least one work task as it is being performed, and [0179] a third option to summon at least one manager

individual who is in proximity to the given at least one work task as it is being performed.
[0180] A non-transitory computer readable storage medium configured to store instructions that, when executed by at least one processor included in a computing device, cause the computing device to monitor work tasks, by carrying out steps that include: [0181] interfacing with a plurality of sensor groups, wherein each sensor group of the plurality of sensor groups gathers respective information about a respective at least one work task that is being monitored by the sensor group; [0182] for each sensor group of the plurality of sensor groups: [0183] obtaining the respective information about the respective at least one work task that is being monitored by the sensor group, and [0184] providing the respective information to at least one machine learning model to cause the at least one machine learning model to output a respective performance score that corresponds to the respective at least one work task; and [0185] outputting a user interface (UI) to at least one display device, wherein the UI includes, for each performance score, a respective sub-UI that is ordered within the UI relative to other sub-UIs based on their respective performance scores.
[0186] The non-transitory computer readable storage medium of any clause herein, wherein, for a given sensor group of the plurality of sensor groups, the respective information includes a plurality of performance values, and the respective performance score is based on the plurality of performance values.
[0187] The non-transitory computer readable storage medium of any clause herein, wherein respective weights are assigned to the plurality of performance values, and the respective performance score is calculated based on a weighted average of the plurality of performance values.
[0188] The non-transitory computer readable storage medium of any clause herein, wherein the at least one machine learning model is trained and fine-tuned to output the performance scores based on the respective information.
[0189] The non-transitory computer readable storage medium of any clause herein, wherein, for a given sensor group of the plurality of sensor groups, the respective at least one work task comprises at least one welding task.
[0190] The non-transitory computer readable storage medium of any clause herein, wherein the respective information indicates, for a weld associated with the at least one welding task, a straightness of the weld, a thickness of the weld, a temperature of the weld, a travel speed of the weld, a gas presence of the weld, an amount of welding material used, a porosity of the weld, a penetration of the weld, or some combination thereof.
[0191] The above discussion is meant to be illustrative of the principles and various embodiments of the present disclosure. Numerous variations and modifications will become apparent to those skilled in the art once the above disclosure is fully appreciated. It is intended that the following claims be interpreted to embrace all such variations and modifications.

Claims

1. A system, comprising: a plurality of sensor groups, wherein each sensor group of the plurality of sensor groups gathers respective information about a respective at least one work task that is being monitored by the sensor group; and at least one computing device configured to: for each sensor group of the plurality of sensor groups: obtain the respective information about the respective at least one work task that is being monitored by the sensor group, and provide the respective information to at least one machine learning model to cause the at least one machine learning model to output a respective performance score that corresponds to the respective at least one work task; and output a user interface (UI) to at least one display device, wherein the UI includes, for each performance score, a respective sub-UI that is ordered within the UI relative to other sub-UIs based on their respective performance scores.
2. The system of claim 1, wherein, for a given sensor group of the plurality of sensor groups, the

respective information includes a plurality of performance values, and the respective performance score is based on the plurality of performance values.
3. The system of claim 2, wherein respective weights are assigned to the plurality of performance values, and the respective performance score is calculated based on a weighted average of the plurality of performance values.
4. The system of claim 1, wherein the at least one machine learning model is trained and fine-tuned to output the performance scores based on the respective information.
5. The system of claim 1, wherein, for a given sensor group of the plurality of sensor groups, the respective at least one work task comprises at least one welding task.
6. The system of claim 5, wherein the respective information indicates, for a weld associated with the at least one welding task, a straightness of the weld, a thickness of the weld, a temperature of the weld, a travel speed of the weld, a gas presence of the weld, an amount of welding material used, a porosity of the weld, a penetration of the weld, or some combination thereof.
7. The system of claim 1, wherein, for a given at least one work task, the respective sub-UI includes: first information based at least in part on the respective performance score, and second information based at least in part on the respective information on which the respective performance score is based, a first option to adjust at least one aspect of the respective at least one work task, a second option to view at least one camera feed of the given at least one work task as it is being performed, and a third option to summon at least one manager individual who is in proximity to the given at least one work task as it is being performed.
8. A method for monitoring work tasks, the method comprising, by a computing device: interfacing with a plurality of sensor groups, wherein each sensor group of the plurality of sensor groups gathers respective information about a respective at least one work task that is being monitored by the sensor group; for each sensor group of the plurality of sensor groups: obtaining the respective information about the respective at least one work task that is being monitored by the sensor group, and providing the respective information to at least one machine learning model to cause the at least one machine learning model to output a respective performance score that corresponds to the respective at least one work task; and outputting a user interface (UI) to at least one display device, wherein the UI includes, for each performance score, a respective sub-UI that is ordered within the UI relative to other sub-UIs based on their respective performance scores.
9. The method of claim 8, wherein, for a given sensor group of the plurality of sensor groups, the respective information includes a plurality of performance values, and the respective performance score is based on the plurality of performance values.
10. The method of claim 9, wherein respective weights are assigned to the plurality of performance values, and the respective performance score is calculated based on a weighted average of the plurality of performance values.
11. The method of claim 8, wherein the at least one machine learning model is trained and fine-tuned to output the performance scores based on the respective information.
12. The method of claim 8, wherein, for a given sensor group of the plurality of sensor groups, the respective at least one work task comprises at least one welding task.
13. The method of claim 12, wherein the respective information indicates, for a weld associated with the at least one welding task, a straightness of the weld, a thickness of the weld, a temperature of the weld, a travel speed of the weld, a gas presence of the weld, an amount of welding material used, a porosity of the weld, a penetration of the weld, or some combination thereof.
14. The method of claim 8, wherein, for a given at least one work task, the respective sub-UI includes: first information based at least in part on the respective performance score, second information based at least in part on the respective information on which the respective performance score is based, a first option to adjust at least one aspect of the respective at least one work task, a second option to view at least one camera feed of the given at least one work task as it is being performed, and a third option to summon at least one manager individual who is in

proximity to the given at least one work task as it is being performed.

15. A non-transitory computer readable storage medium configured to store instructions that, when executed by at least one processor included in a computing device, cause the computing device to monitor work tasks, by carrying out steps that include: interfacing with a plurality of sensor groups, wherein each sensor group of the plurality of sensor groups gathers respective information about a respective at least one work task that is being monitored by the sensor group; for each sensor group of the plurality of sensor groups: obtaining the respective information about the respective at least one work task that is being monitored by the sensor group, and providing the respective information to at least one machine learning model to cause the at least one machine learning model to output a respective performance score that corresponds to the respective at least one work task; and outputting a user interface (UI) to at least one display device, wherein the UI includes, for each performance score, a respective sub-UI that is ordered within the UI relative to other sub-UIs based on their respective performance scores.

16. The non-transitory computer readable storage medium of claim 15, wherein, for a given sensor group of the plurality of sensor groups, the respective information includes a plurality of performance values, and the respective performance score is based on the plurality of performance values.

17. The non-transitory computer readable storage medium of claim 16, wherein respective weights are assigned to the plurality of performance values, and the respective performance score is calculated based on a weighted average of the plurality of performance values.

18. The non-transitory computer readable storage medium of claim 15, wherein the at least one machine learning model is trained and fine-tuned to output the performance scores based on the respective information.

19. The non-transitory computer readable storage medium of claim 15, wherein, for a given sensor group of the plurality of sensor groups, the respective at least one work task comprises at least one welding task.

20. The non-transitory computer readable storage medium of claim 19, wherein the respective information indicates, for a weld associated with the at least one welding task, a straightness of the weld, a thickness of the weld, a temperature of the weld, a travel speed of the weld, a gas presence of the weld, an amount of welding material used, a porosity of the weld, a penetration of the weld, or some combination thereof.