INTELLECTUAL PROPERTY

Tienovix is building a world-class intellectual property (IP) portfolio to protect and market its proprietary technology and brands. Tienovix is actively pursuing U.S. and international Patent and Trademark protection for its innovative products and ideas. Tienovix is very active in developing its IP, including filing applications for Patents and Trademarks across various categories.

Well beyond the state-of-the-art, among Tienovix' patent pending technology is augmented reality systems that are capable of guiding a remote user in performing various tasks. These tasks may include industrial procedures, medical procedures, manufacturing procedures, quality control procedures, etc. The user may be prompted by texts, graphics, and/or virtual objects within the user's field of vision while the user is performing a procedure.

For example, an augmented reality (A/R) display device may be used to guide a user to perform an industrial procedure, such as assembling a wellhead stack in an oil field. Displayed in the A/R display device may be one or more objects, such as text windows, graphics, virtual objects, etc., which all appear in the user's field of view. These objects guide the user in performing one or more tasks, such as selecting one of several parts in strategic order for assembly. The user may be able to select particular graphics, text windows, and/or virtual objects in an interactive fashion to navigate through various tasks. In some cases, particular manufacturing parts within the user's field of vision may be identified and virtually highlighted for ease of recognition. The user may then engage the identified manufacturing part for performing a step in the assembly task.

This process may be performed in a remote location, such as an off-site oil well platform or a medical center, while being monitored and supervised by a remote skilled practitioner, artificial intelligence (AI) system, and/or an expert system. Retina sensing features associated with the A/R display device may track the user's eye movements in order to determine exactly what the user is viewing. Further, the user's hand movements may be also be tracked. Based on multiple inputs, such as the user's vision, the user's hand movements, machine-recognition of contents in the user's field of view, etc., an expert system may provide instructions to the user to perform, move, collect and assemble various parts. In this matter, accuracy of the user's performance, as well as safety features, are enhanced. That is, using Tienovix' systems, a novice user may instantly become competent with respect to a particular task, and an experienced user may instantly become an expert. Moreover, Tienovix' system may be deployed to perform a quality control check for any process, enhancing the accuracy of critical tasks.

Tienovix' innovative mixed-reality technology may be used for various commercial and medical tasks, such as industrial, manufacturing, testing, training, medical procedure, data acquisition, and many other applications. This cutting-edge technology can be found in the Tienovix Technology Series™. The Tienovix Technology Series™ includes Tienovix' Pro-G™ System and its Vulcan™ System, which includes the Vulcan-Training System™, the Vulcan-Diagnostic System™ and the Vulcan Automated-Diagnostic System™.

As a simplified illustration of a part of one of Tienovix' systems, as shown in Figure 1, an A/R Controller is capable of displaying text windows, graphics, and/or virtual objects in an A/R Reality Display Device utilized by a user. A Task Controller is capable of interacting with the A/R Reality Display via the A/R Controller. The user may perform a task that is monitored and supervised by the Task Controller. Using guidance provided by the Task Controller, the user may perform a task on or with any appropriate equipment/patient/tool in a mixed-reality scenario. That is, while the user is performing a task on a real-world object or person, an augmented-reality object may be displayed in the user's field of vision, interacting with the user as she performs the task.

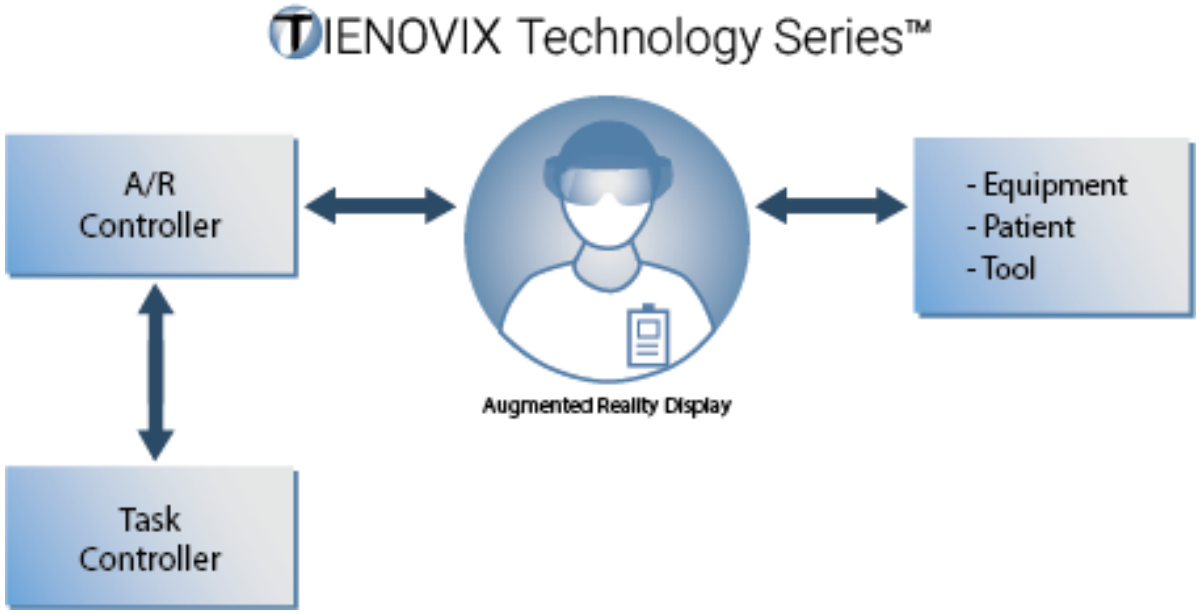

Figure 1

Further, as shown in Figure 2, an expert system, such as an artificial intelligence (AI) System may monitor the user's field of vision and identify various items in this field of vision. The expert system may monitor the user's actions and make multiple determinations as to any instructions or prompts that should be provided to the user to guide the user's actions. This guidance may be performed via the Task Controller and

the A/R Controller. The AI System may perform evaluation, recognition, generate modification instructions, and provide interactive instructions to the user. In some cases, the expert system's interaction with the user may be performed from a remote location, using wireless communications.

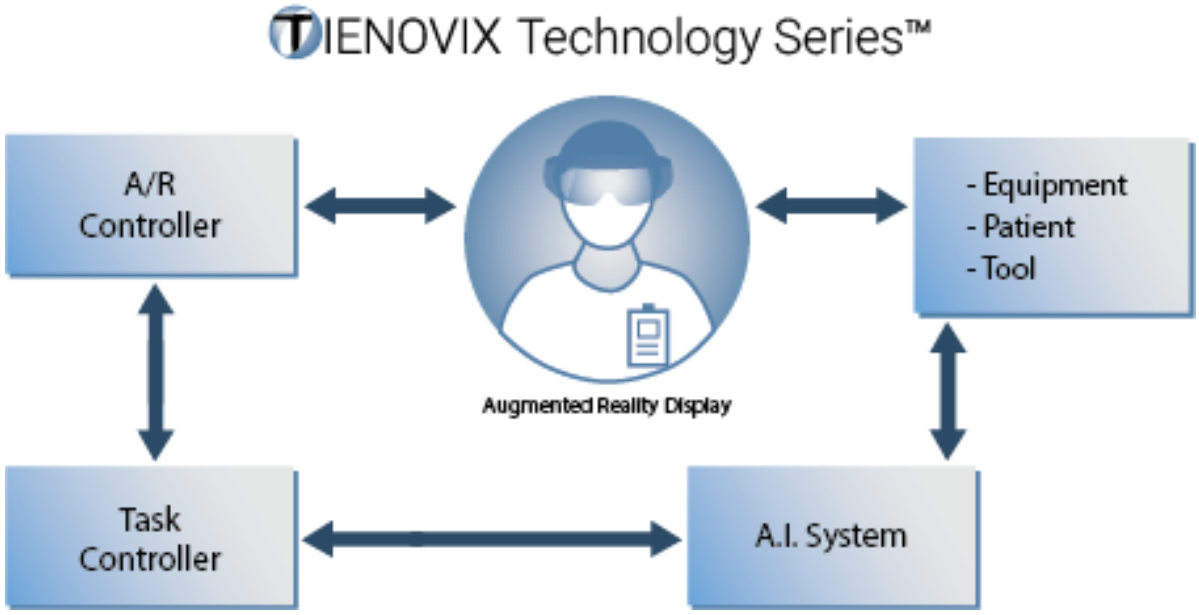

Figure 2

As shown in Figure 3, a slightly more detailed, exemplary block diagram of one of Tienovix' systems, is presented. Figure 4 depicts the controller of Figure 3 in more detail. The controller that may be any combination of computer hardware, computer software, and/or firmware that is configurable and/or programmable to perform one or more data processing, evaluation, calculation, and/or AI functions. Generally, the controller includes at least one input device; a memory in which is stored operating instructions (e.g., a program) and data used by and/or generated by the operating instructions; at least one core which performs computing operations according to the operating instructions on the data; and at least one output device.

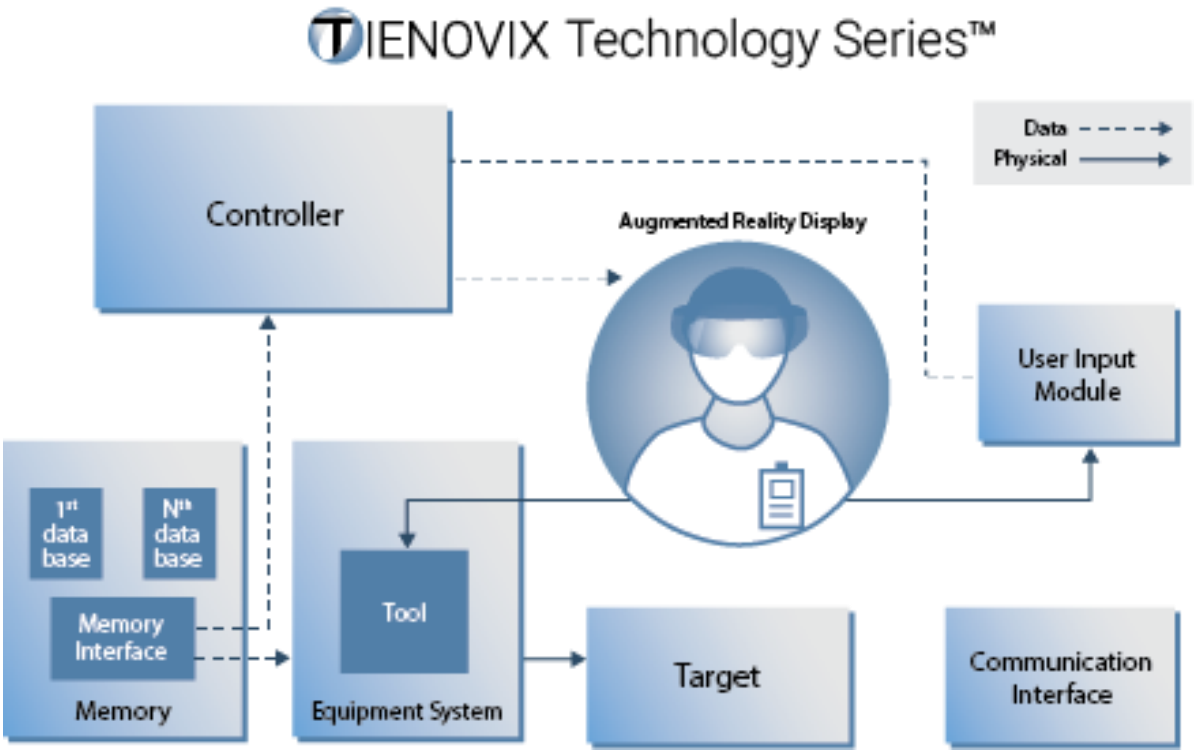

Figure 3

In some cases, the controller may also include a library containing stored reference positioning-data relating to one or more of a movement, position, and orientation of at least a portion of an equipment system (e.g. a tool) during a reference procedure. The library may also include stored reference outcome data relating to an outcome of a reference procedure. Further, the controller may also include a machine learning module (MLM) for providing various data. For example, the MLM may provide position-based 3D A/R feedback to a user based on sensed user data and the reference positioning-data. The MLM may also provide outcome-based 3-D A/R feedback to the user based on data received from the equipment system (e.g., from the tool) during the procedure performed by the user and reference outcome data. At least one presentation element of the position-based 3-D A/R feedback and the outcome-based 3-D A/R feedback may be based at least in part on user condition data, e.g., environment in which the user is working, user's physical state, etc.

The system depicted in Figure 3 also includes an equipment system that is configured for a user to perform a procedure. The equipment system includes at least one tool that is manipulable by the user in the performance of the procedure.

A "procedure" refers to any process in which, by use of an equipment system or by body members of the user, an action may be performed on a target. This may include

performing a manufacturing procedure, a medical procedure, a testing procedure, a training procedure, etc.

In some cases, such as is shown in Figure 4, the controller may include an AI system. The controller may include an input processing module that is capable of processing data gathered and relayed by various sensors and/or input modules, e.g., as described below. The input processing module is capable of performing one or more preprocessing tasks, such as any necessary or suitable amplifying, filtering, and analog-to-digital (A/D) converting tasks, to prepare for downstream processing the data received from the sensors and/or input modules.

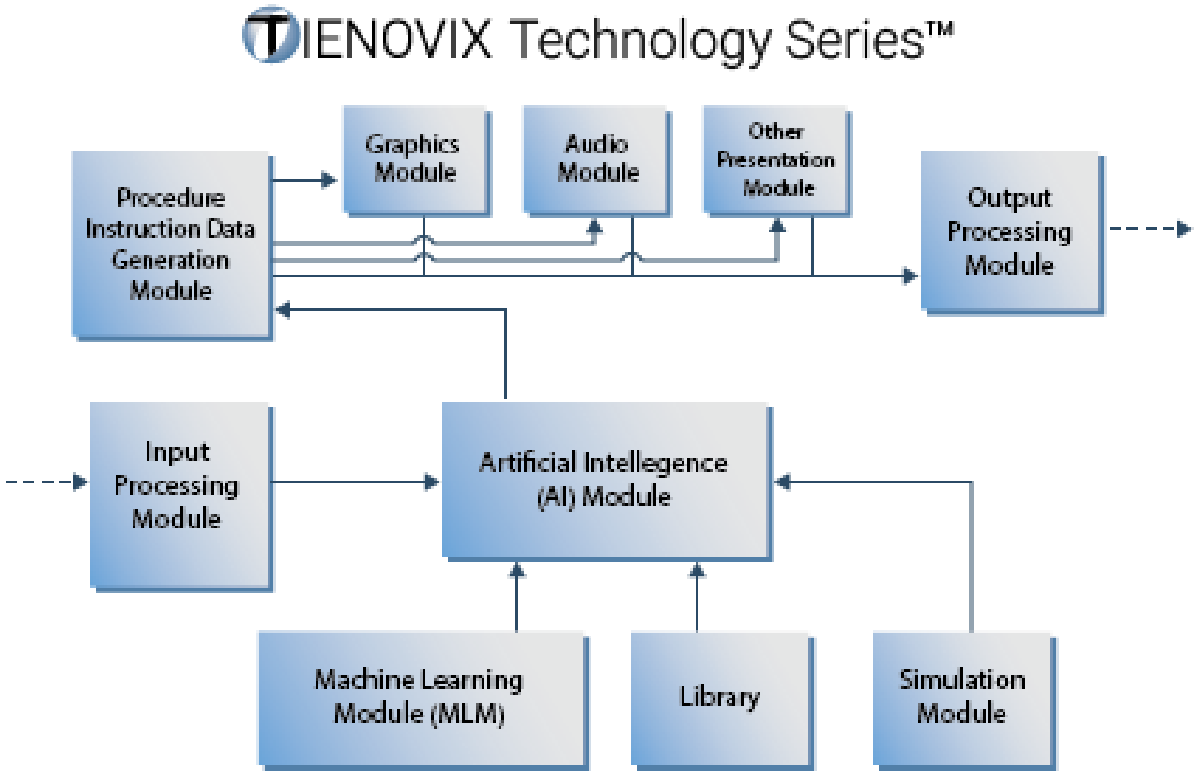

Figure 4

The controller of Figure 4 may also include a machine learning module (MLM) that is capable of performing various machine learning processes. The controller may further include described in further details below.

The controller may additionally comprise a simulation module that is capable of generating data relating to simulation of a task to be performed by a user. The data generated by the simulation module may be used by other modules of the Figure 4 to perform one or more functions.

The controller may comprise an artificial intelligence (AI) module that is capable of processing data received from one or more of the input processing module, the MLM module, the library, and/or the simulation module, in view of the nature of the equipment system, the tool, the target, and the user, as further described below. The processing may lead to generation of data relating to a procedure being performed by the user using the equipment system to affect a change or perform another action on the target. The term “artificial intelligence” may encompasses neural networks, expert systems, and other data structures and algorithms.

The controller may also include a procedure instruction data generation module that is capable of processing data received from the AI module in order to generate procedure instruction data. However, at this juncture, procedure instruction data may not yet be in condition for presentation to the user of the system. Accordingly, the procedure instruction data generation module may send its results to one or more of a graphics module, the audio module, and/or other presentation (e.g., tactile, haptic, olfactory, gustatory, etc.) module. The modules may process the procedure instruction data in order to generate one or more human-apprehensible elements suitable for presentation to the user during the performance of a procedure using the equipment system. For example, the graphics module may generate one or more text, icon, interactive or visual cue elements, etc. The audio module may generate one or more voice narration or auditory cue elements. The other presentation module may generate one or more tactile, haptic, olfactory, gustatory, or other cues to the user.

The output processing module of the controller then receives the generated elements of the procedure instruction data and transfers them to an augmented reality user interface (ARUI), such as the augmented reality display depicted in Figure 3.

In some examples, the procedure described above may be a training or operations procedure, in which thee equipment system may be a car, truck, construction vehicle, combat vehicle, boat, ship, aircraft, spacecraft, space extravehicular activity (EVA) suit, weapon, power tool, manufacturing facility, assembly line, or component of any of the foregoing. The target may be a roadway, a vehicle track, a construction site, a combat training ground, a waterway, an airspace, a volume of outer space, a vehicle, a structure, a firearms target, an ordnance target, a medical patient, a workpiece, etc. Exemplary procedures include, but training or operations in vehicle transportation; construction; manufacturing; maintenance; quality control; combat actions on land, at sea, or in air; combat support actions on land, at sea, or in air, e.g. air-to-air refueling, takeoff and landing of aircraft from aircraft carriers; space operations, such as EVAs (colloquially, “spacewalks”), docking, etc.; and more that will be readily occur to the person of ordinary skill in the art having the benefit of the present disclosure.

“Procedure instruction data,” refers to any combination of elements that may be presented by an augmented reality display to the user, wherein the elements provide

instructions for one or more actions to be performed as part of the procedure performed by the user on the target, such as through action of his or her body members and/or his or her manipulations of the tool of the equipment system.

In some cases, the procedure instruction data may be in form of a text, an icon, an image, and/or an interactive element. Examples of the interactive element include a text or an icon that may receive augmented reality input (e.g. a pinch, squeeze, flick, and/or other motion of one or both hands and/or one or more fingers; a turn or other gesture of the head; a voice command, etc.) from the user. The procedure instruction data may also be a visual cue, a number of instructions displayed simultaneously, and/or an auditory cue. The auditory cue may be a pleasant sound when the user brings the tool to a desired position and/or orientation. The may also be an unpleasant sound when the user attempts to perform an action with the tool when the tool is in an undesired position and/or orientation. Another example of the auditory is a narration.

The system may also include a user input module that is configured to receive a user input from the user regarding a user's belief that he or she has completed an instruction presented to him or her through augmented reality display. The user input module may include a physical button, switch, or slider; a touchscreen; a microphone; among others; or two or more thereof. In this example, the controller provides the procedure instruction data based at least in part on the user input.

The system may also include an augmented reality user display. The augmented reality display presents the procedure instruction data, generated by the controller, to the user while the user is performing procedure. The augmented reality display may be any known augmented reality hardware, such as a HoloLens 2 (Microsoft Corporation, Redmond, WA); among other augmented reality hardware currently known or yet to be developed or commercialized.

In some examples, the augmented reality display is a device that is used in proximity to the eyes of the user. However, in some examples, the augmented reality display is a device that presents graphical data to the eyes of the user, as well as auditory data to the ears of the user. The augmented reality display may provide any of graphical data, auditory data, olfactory data, tactile data, haptic data, gustatory data, among others, or two or more thereof.

The system may also include a memory that may include one or more database(s), such as the 1st database through Nth database. The database(s) may store data relating to one or more of the equipment system, the target, the augmented reality display, procedure instruction data generated by or to be generated by the controller, etc. The database(s) may be a relational databases, lookup tables, or other types database structures.

The memory may additionally comprise a memory interface that is configured to read data from the database(s) and/or write data to the database(s), and/or provide data to, or receive data from, the controller, the equipment system, and/or other components of the system.

The system may also include a communication interface that is configured to transmit data generated by the system to a remote location and/or receive data generated at a remote location for use by the system. The communication interface may be one or more of a WiFi interface, a Bluetooth interface, a radio communication interface, cellular communication interface, or a telephone communication interface, among others. The system is capable of guiding one or more procedures performed by a user. In this manner, using guidance provided the controller, the user may perform a task upon an equipment/patient/tool in a mixed-reality scenario.

The technology described above may be implemented into one or more systems of the Tienovix Technology Series™.