among others. Accordingly, the plug-in I/O modules can have different hardware structures that may require custom drivers and other custom software to allow their use with the industrial controller. For example, the plug-in I/O modules may have different types and/or numbers of inputs and outputs. Providing custom drivers typically requires on-site firmware upgrades and testing. It is now recognized that this adds complexity, cost, and development time. Further, providing custom software can involve the use of extensive software libraries, which may result in slower I/O scanning during operation of the industrial controller.

BRIEF DESCRIPTION

[0004a] According to an aspect of the present invention, there is provided an industrial automation device, comprising: a port configured to receive a plurality of different types of plug-in I/O modules; and an interface for enabling communication between the industrial automation device and the plurality of different types of plug-in I/O modules, wherein the interface comprises: one or more setup mechanisms configured to detect connection of one of the plurality of different type plug-in I/O modules to the interface through the port, configured to write module configuration data to the connected plug-in I/O module, and configured to retrieve I/O format data and feature data from the connected plug-in I/O module; and one or more operational mechanisms configured to exchange operational mode data with the connected plug-in I/O module.

[0004b] According to another aspect of the present invention, there is provided a non-transitory computer-readable storage media comprising instructions for: detecting connection of different types of plug-in I/O modules to an industrial automation device; retrieving plug-in I/O module configuration data for the different types of plug-in I/O modules and writing the plug-in I/O module configuration data to the different type plug-in I/O modules; requesting a plug-in I/O module number of inputs and a plug-in I/O module number of outputs from the different types of plug-in I/O modules and storing the plug-in I/O module number of inputs and the plug-in I/O module number of outputs in designated registers; and requesting feature data from the different types of plug-in I/O modules and storing the feature data in additional designated registers, wherein the feature data comprises input latch mechanism data, output latch mechanism data, or user interrupt functionality data, or a combination thereof.

[0004c] According to another aspect of the present invention, there is provided an industrial automation control and monitoring system, comprising: an industrial automation device configured to control and/or monitor a process; a plug-in I/O module connected to the industrial automation device through a port of the industrial automation device designed to receive different types of plug-in I/O modules; and an interface of the industrial automation device for enabling communication between the industrial automation device and the plug-in I/O module, wherein the interface comprises: a module identification mechanism configured to detect connection of one of the different types of plug-in I/O modules to the interface through the port; and a module I/O mechanism configured to request a number of inputs and a number of outputs from the plug-in I/O module and configured to store the number of inputs and the number of outputs from the plug-in I/O module in designated registers of the interface.

[0005] Embodiments of t~~T~~he present invention provides a novel approach to connecting and using plug-in I/O modules with an industrial controller, such as a control/monitoring device for controlling or monitoring an industrial process. In particular, embodiments of the present invention provides an interface, such as a common driver, for a control/monitoring device that enables connection of the control/monitoring device to different types of plug-in modules. The interface includes several mechanisms, which can be implemented through control logic, circuitry, and/or software, that enable the control/monitoring device to operate in conjunction with different types of plug-in I/O modules.

[0006] According to certain embodiments, the interface includes setup mechanisms that enable initial communications between the plug-in I/O modules and the control/monitoring device. For example, the setup mechanisms may detect connection of a plug-in I/O module, request identification data from a connected plug-in I/O module, write module configuration data to a connected plug-in I/O module, and retrieve I/O data and feature data from a connected I/O module. The interface also may include operational mechanisms that facilitate communication between the plug-in I/O modules and the control/monitoring device during operation. For example, the operational mechanisms may communicate operational mode data between the control/monitoring device and a connected plug-in I/O module and may enable the connected plug-in I/O