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The Future of Programmable Logic Controllers

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Abstract: The effective operation of a Programmable Logic controller (PLC) in a process for robotics or manufacturing is integral to the proper operation of a process. The future of these systems is brighter than ever, as they become more compact, robust, and able to support evolving requirements for automation.

Keywords: Automation, Human Machine Interface, Ladder Logic, Programmable Automation Controllers, Programmable Logic Controllers

I. INTRODUCTION

Programmable Logic controllers (PLCs) are evolving at a very fast rate, due largely to the fact that PLCs are being used in an increasing number and variety of applications in industrial automation. Today's PLCs are equipped with more memory, offer greater programming flexibility, have more scalability, have higher speeds, and are smaller in size [1]. PLCs today offer the options of connecting to Ethernet or wireless networks. These features were not available in the past, but have evolved over the last 25 years along with the technology of and need for connectivity. As requirements and technology evolve, PLCs in the future will continue to evolve without end. This paper will discuss the possible features with which future PLCs will come equipped.

II. FUTURE OFPLCS

One of the main aspects that future PLCs are expected to have is that they will be smaller, faster, and more powerful. This emanates from the fact that this is the route that all consumer technologies are taking. Electronic components like circuit boards and processors are shrinking in size in all aspect of electronics. This means that PLCs will continue to shrink in size as time goes on. As they become smaller, these future PLC processors will need to have stability, ruggedness, and reliability built into their hardware [2]. The smaller processors will also need to be faster in cycle time, have larger memories, and have new communications features as they become available.

Today's PLCs have capitalized on the decline in memory stature and the associated costs. This allows for greater data storage at the local level and is one area that future PLCs will capitalize on in order to offer more applications. This localized storage will allow for onboard storage of information which will ease trouble shooting. Mini SD and Micro SD memory cards can add additional 32GB of onboard storage to PLCs as needed by the systems integrator or machinebuilders [3].

Today's PLCs are already making the most of USB technology. This has allowed PLCs to go online for programming and monitoring the control systems and allows connectivity to peripheral hardware andsensors. In the future,smaller-sized PLCs will be able to make use of smaller sized USB ports, which are already widely available.

III. PROGRAMMABLE AUTOMATIONCONTROLLERS

Another major area that engineers see as a way forward for PLC development is the merging of PLCs with Programmable Automation Controllers (PACs). PACs, while similar to PLCs, can handle more complex automation systemsthat may include applications such asHuman Machine Interface (HMI), asset management and historian applications, and Advanced Process Control (APC). Additionally, a PAC is also desirable for when dealing with extensive process control requirements and functions. Compared to current PLCs, PACs provide greater programmingflexibility and memory capacity, and better interoperability. Merging PLC technology with PAC technology will augment the simple and stable technology of PLCs with the advanced capabilities of PACs. These mergers will help improve how PLCs communicate through their hardware and software, providing them with advanced communication potential from the plant floor to top-level management [4]. Currently, suppliers of industrial controllers maintain that there is a difference between PLCs and PACs. However, future automation technicians will likely categorize both as the same when it comes to sales and integration. Engineers will focus more on performance and their specific features when they need to order these systems. As PLCs and PACs evolve, they will merge as they will have similar roles, functions, andfeatures.

As this merger continues, it will create room in the market for both low- and high-end processors. This will be enabled by the advancement in hardware technology, which will start from the high-end processors and will gradually make its way to the low-end processors. The result of this will compel suppliers to add more features on the high-end processors so that they can be differentiated from the low-end processors. A recent studypredicts that some of the features that could be added to high-end processors in the future include vison systems, motion controllers, and multiple communication protocols [5]. These PAC-inherent features will be added while still maintaining the simplicity of PLCs, as this is what makes them so attractive to theusers.

IV. Ladder Logic

A more constant aspect of PLCs that is expected to play a key role in the future is ladder logic programming language. Though this technology has been around for over 50 years, the fact that it has been kept simple and unchanged has really helped engineers and technicians who are familiar with relay logic. The introduction of ladder logic with its graphical ladder diagrams has provided it a longevity that is expected to develop even into the future. While there are other graphical, assembly, and text base languages in use for PLCs, ladder diagrams have remained the most popular of PLC programming languages [4, 6]. Suppliers are looking to the future to support their customers in large installations with PLC programmed ladder logic. This is because technicians and engineers now are preferring to work with the simple and graphical programing language provided by ladder logic. Regardless of the hardware used, the language has remained simple and it has gone a long way in making PLC the standard leader and this is expected to continue.

PLCs will in the future allow for a single programming environment, made possible by combining PLC, motion controllers, and HMI into one programing environment. This will also result in PLC and HMI processor integration to be possible, which will allow a monitor to either be included in the package or be part of the package as an external option [2]. Many engineers agree that having a single programming language is ideal if it is not too complicated for the end user. The advantages of having a unified programming environment is that it reduces the learning curve and the time required to develop a new process. It is important to point out that if a unified programming language is not well thought out can be complicated to navigate [4]. It is projected that in the future a unified programming environment will help ensure that devices will be able to share the same tag name in a given database. This will eliminate the duplication of tasks and reduce the overall development time by reducingerrors.

In the 1990's a variety of communication protocols were developed. However, only a select few have withstood the test of time. This trend will continue, and the future will depend on the kind of communication that will focus more on the plug-and-play solutions, with communication protocols that are self-configuring. Future communication protocols will also need to be real time as the speed of Ethernet and other control devices will be much faster. Though USB is very promising in this area it has its limitations. The USB plug and play will in the future be integrated with software and hardware to improve its capabilities[5]. High-end PLCs support many communication ports that enable multiple protocols. In the long term, this might change as more users demand additional options to be included as standards. Such communications options will largely involve industrial Bluetooth connectivity.

The future will involve more robust wireless communication technology. These wireless communications will have an improved range as well as the permeation of data integrity. Examples of the wireless technologies that will in future be applicable are Wi-Fi and ZigBee. The use of mesh and Ad hoc will rise alongside that of Near Field Communication (NFC). The future will also encompass the adoption of wireless technology that works better with applications like remote terminals units (RTU) [5]. Wireless technologywill also be applicable in critical applications where real time control is mandatory. Perhaps the biggest development in future will be the "connected factory." This will involve the integration of enterprise resource planning (ERP) and other sophisticated computing systems on the factory floor. The challenge today is how to extract process data and then feed it upstream. However, in the future, that will be solved by adding hooks, features, and functions that will simplify this integration. In the future PLC suppliers will have to take into consideration the user's needs, and be able to do so with integration of various technologies. PLCs in future will have the controlling applications as well as have the capacity to seamlessly present and manipulate he data at the users will require. This will be made possible by including a web browser via mobile apps or other tools that interface with the data [1]. A combination of enhanced communication, greater memory capacity, and improved processing power will allow PLCs to manage the data that they willcreate.

In the future, advanced robotics, cloud computing, artificial intelligence, big data analytics, and sophisticated sensors will change the manufacturing landscape. This will mean that PLCs will play a major role as the main controllers, input centers, and HMI [2]. PLCs will also play a major role in real time industrial processes and they will be equipped with sensors to help them work better with the Internet of Things. This will

allow PLCs to collect data and provide it to the machine's learning process. One way that this will happen is through the PLCs data working alongside other device data, integrated into the PLC in order to provide the bigger picture as a lot of collection of big data [1]. The plant managers can the use the analysis tools at their disposal to work out logistics, leverage on resources, supplier timings as well as track big adaption other supporting functions. The result will be a manufacturing process that is moreefficient.

The data collected by the PLCs can be tracked and analyzed to help plant managers maintain their plants and also keep them at optimal performance. PLCs in future will need to be very robust in their design, as PLCs and their housings will need to adapt to the changing climate [2]. As PLCs become used more widespread and climate conditions change, more extreme climatic conditions like cold snaps, floods, and heat waves are more often encountered, and they easily damage electronic components that are not properly housed. For PLCs to withstand such harsh climates, they will need to be made from tough materials like fiber glass, which is more durable and is suitable for areas that are hostile to electronics like the plant floor. Other designs will need the PLCs to be operated remotely and housed in isolation in areas with little or no electronic interaction. This is especially important if the sensors are sensitive or if the sensors require precisemonitoring.

V. CONCLUSION

In conclusion, PLCs in future will be required to do what they do today, but in a more compact and robust manner. The technology will help monitor and control multiple applications that will be distributed across the plant. PLC will be expected to offer a bigger and more comprehensive picture of the plant's operations. PLC will also need to be accessible to multiple stakeholders such as maintenance engineers, production teams, business operations, and the IT people. PLC will also result in the increased use of analytics and cloud based supervisory systems of control as well as SCADA systems that will be used for data acquisition. These future trends will influence the automation industry. It has been predicted that future PLCs will alone allow for the growth of the industrial automation industry by 8% [4]. The future of PLC automation is moving to a future that will be characterized by unparalleled productivity, higher energy efficiency, better operator visualization, better design, and ultimately better and saferstandards.

PLCs will still be used in many industrial automation controllers well into the future. However, major changes will be realized in terms of performance and purpose. The sizes of PLCs will continue to reduce in size, and improvements in hardware will expand their functions and capabilities. The merging of PLCs and PACs will also be a feature that will be present in future PLCs. Ladder logic will still have a place in the future due to its simple language that engineers and technicians find easy to understand. A single programming environment will allow engineers to program different aspects of the PLC and other plant functions from a single HMI. The connected factory floor will be the main feature of future PLCs,which will make PLCs integral in future automation. Essentially, PLCs in the future will evolve to create a completely new industrial automation platform but bearing the same classicname and similar programming structure.

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