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# The Integration of a PLC into a Work Cell

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**Abstract**

*The purpose of this project was to be a stepping stone in my current thesis project I am working on. The goal of my thesis project is to integrate Human-Machine Interfaces, Programmable Logic Controllers, and industrial robotic agents to dynamically communicate and automatically control an industrial process. The integration of a PLC to a work cell was the first step to my project and this allowed me to better grasp networking through the use of setting IP addresses and communication through Ethernet. I was also able to create a IP address list of all the addresses of the devices that can be found on the workbenches in Osburn Halls Automation Lab. This project is also paving a way for students to better understand industrial networking and will be applied to current and future classes.*

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A programmable logic controller (PLC) is an industrial computer that controls processes in different environments. Using this device, different operations can be controlled in factories, warehouses, and other facilities where there is an industrial process. PLC's are most commonly used in industrial settings because of its use of inputs to control separate outputs, making them ideal for these types of applications. They are also used as the primary interfacing equipment in Industry 4.0; industry 4.0 refers to the ongoing fourth industrial revolution which is the automation of traditional industrial and manufacturing processes. According to Statista, the market for PLC's is expected to grow at a compound annual growth rate of 5% and reach a market size of 15.5 billion dollars by 2026.

## Communication via IP Address

An IP address is what allows someone to identify a device on a network. When using IP addresses, there needs to be an Ethernet configuration used to enable the PLC to communicate with the computer which will have the software that programs the PLC to run certain tasks. IP addresses are used to identify a piece of technology from a network perspective, if there is a device that does not have an IP address, then there will be no way for that device to communicate with other devices and be recognized through the Ethernet cable. IP Addresses are similar to how we have our own address system; if you wanted to send a package to someone, you would need to list who the recipient is, what state they live in, what their zip code is, what street they live on, what their house number is. Each set of octets in an IP address is the

breakdown of the device's address (state, street, zip code..). If a device had an IP address of 192.168.0.49, then the octets 192 and 168 would be the state and zip code, and as you get to the end of the IP address with the octet of 49, that would be the specific address. When connecting and using multiple devices, it is essential to use IP addresses to locate and identify different technologies.

**Inputting an IP address to a PLC**

When inputting the IP address to a PLC in the Millersville University Automation lab in Osburn Hall, the first thing that needed to be done was to set up a list of IP addresses of devices that could be found on different lab benches. Then, the next step would be to plan and make IP addresses for the PLC's at each lab bench making sure that each device had its own special address so there wouldn't be any issues when it came to communicating with the device. Establishing an IP address to a PLC can be done through the use of the software RSLinx and RSLogix. RSLinx is used to communicate to the PLC from the computer via a RS232 cable; this software manages and establishes communication between different automation technologies like Human Machine Interfaces (HMI's) and PLC's. Once that connection is established and the PLC is identified, the program RSLogix then uses the communication that was established in RSLinx to configure the channels of the PLC and where the designated IP address can be set and is used to then program the devices. Once the IP address is set and the power of the PLC is cycled to test that the IP address was retained, the PLC can then be connected to an Ethernet hub. The Ethernet hub is where the local network of the work cell branches all of its connections to the other devices on the lab bench to a computer. For example, the Ethernet hub could connect a computer to a HMI along with a PLC and other Ethernet capable devices. In order to test that the PLC can be communicated to through the Ethernet hub, you would have to open up the computers command prompt which is where you can ping the PLC. Pinging a device tests to see if a device like the PLC is reachable, in order to do this, you would need to type "ping" followed by the IP address you would like to ping. This is done when the host (the computer) sends bits of data to the device which in this case is a PLC, and the data is sent back to the host and then lists out how much was actually received. For example, if someone wanted to ping the device with the IP address listed earlier, all I would type is "ping 192.168.0.49" and the computer would then list out if it was able to locate and communicate with the specified device. It would also list how long it took to send a bit of data which then plays into the network speed and how long it took for the data to be sent by the computer, received by the device, and sent back to the computer.

**Conclusion**

Doing this project, I was able to learn more about PLC's which are a key part to industrial operations, they are also essential to running different components in a work cell. Assigning an IP address to a PLC to communicate to other devices on a local network is a great way to start connecting other devices and eventually unifying a work cell. Conducting this research is vital to the unification of a work cell which is the overarching objective for my thesis project. Using ethernet connections to unify the PLC and a computer has already led to a basic understanding of what will be necessary for linking other technologies to the work cell. For example, the universities Automation lab has a Mitsubishi Scara Robotic Arms, a cognex camera vision system, HMI's and PLC's which can all be linked together and communicate via an Ethernet network.

## References

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