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MAKER: Mobile Device App for Wireless Control of a PLC-Based Automated System

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MAKER: Wireless Control of Programmable Logic Controllers

Abstract

This paper describes how a wireless connection has been established to allow the use of a tablet or smartphone to monitor and control a Programmable Logic Controller (PLC) using a tablet or smartphone. This includes the use of software to set up a connection through a router to the Ethernet adapter of the PLC. This activity is currently being used by industry to monitor and control manufacturing processes and equipment. Potential employers are asking for our graduates to have hands on experiences with this type of control. Future plans are to conduct comprehensive evaluation of learning outcomes and expand the control of manufacturing processes using wireless technologies. Security issues will also be addressed. Students will develop an industry standard of methodology in securing wireless connections

Motivation

Automation of manufacturing and process equipment plays an important role in our society today. Manufacturers and now compete with foreign companies due to the expediency of automation. A higher quantity of products with a higher level of quality can be produced when automation is properly employed. Programmable Logic Controllers (PLCs) provide the ability to automate many assembly processes controller the movement of product as well as the dispensing of liquids needed to fill containers. PLCs are also used by General Motors to control large robots in the assembly of automobiles. Welding heads, grippers, vacuum gripper, furnaces, pressure vessels, motors, dispensers and actuators that move parts can all be controlled by PLCs. PLCs are also used in the Oil & Gas industry on the production site and in the refineries. Power generating companies use PLCs to control the production of high voltages being transmitted to sub-stations which in turn transmit to local business and residential communities.

Since the PLC has the ability to control many processes, the management and maintenance personnel need a method to monitor these activities to ensure the most efficient process is being followed. Maintenance technicians can also access the status of equipment to determine if interventions are required.

Employers in industry are asking for technicians to have experiences in programming using Supervisor Control and Data Acquisition (SCADA) software. Therefore we have chosen SCADAMobile software by Sweetwilliam as the control software for this project. Once the student has a working knowledge of PLCs and programming PLCs with ladder logic, they will be introduced in the steps that must be taken to set up this wireless connection between a tablet or smartphone.

Manufacturing Automation and Controls

The author teaches a two year Associate of Applied Science course in automation and controls for the Electronics Technology students at the local community college. The course covers (1) advanced programming of PLCs, (2) sensor technology and application, (3) industrial applications and programming, and (4) industrial interfaces. The labs include using industrial heaters that are interfaced, monitored and controlled; the interfacing of Ultra-sonic sensors to control liquid levels; the interfacing of motors and pneumatic actuators for the simulation of industry applications. Now the inclusion of wireless control of PLCs will be a skill set that our students will develop to open more doors for employment.

Project System Platform

The automated system typically consists of controller, sensors, actuators and system structure. The Advanced PLC course enrolls about 15 to 25 students per semester. Students usually work as a team of two or individually depending upon student preference and Instructor's agreement to gain the most from this course. Table 1 lists the components of the platform used for this project. The Allen Bradley Micrologix 1200 PLC and the RS-Logix 500 PLC software are included with the Lab Volt portable PLC trainer.

Project System Platform Items	**Cost**
Lab Volt portable PLC trainer	$2500.00
Allen Bradley Micrologix 1200 PLC	
RS-Logix 500 PLC software	
Allen Bradley Ethernet Adapter	$150.00
Apple iPad	$500.00
Belkin router	$45.00
ScadaMobile 2.4.0 software	$60.00

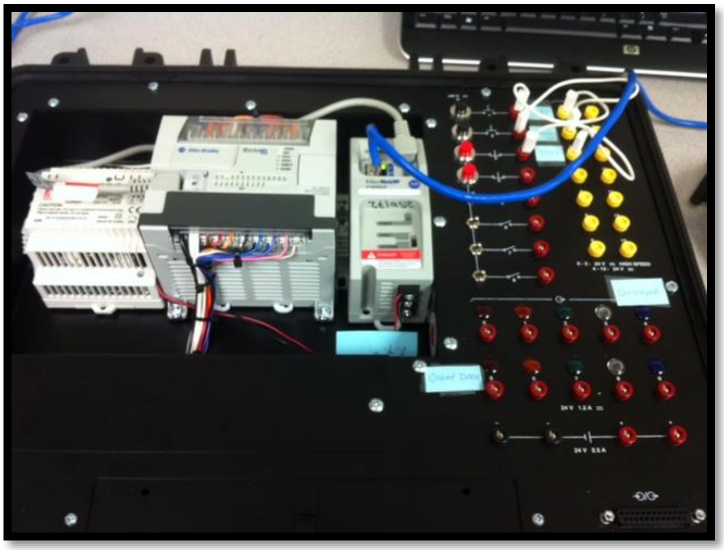
All of the hardware listed above belongs to Tarrant County College, with the exception of the Belkin router.

Wireless control of PLC

This project was to develop a lesson based upon the equipment listed above giving students experiences in programming, set-up, and troubleshooting a wireless system. Following is a detailed description of the equipment used, Input and Output assignments, system schematic, ScadaMobile program and Ladder Logic program.

Students use either a tablet or a smartphone to communicate with a PLC using ScadaMobile Software via a router and Ethernet connection.

Figure 1.

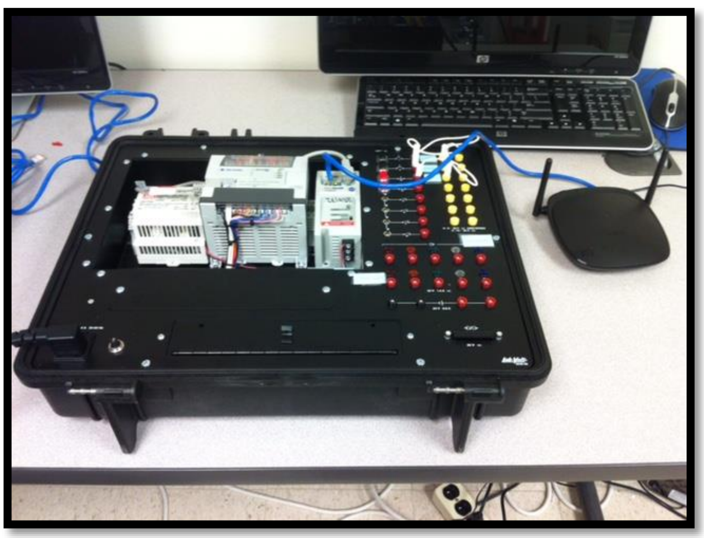


Trainer Switch 0 =
Stop
HMI 0 = Stop

Trainer Switch 1 =
Start
HMI 1 = Start

Trainer Switch 2 =
Counter
HMI 2 = Counter
HMI 3 = Reset Counter

Figure 2.



Lab Volt Trainer with PLC connected to Ethernet adapter, and Router connected to Ethernet adapter.

The trainer plugs into 120vac outlet. A Direct Current power supply sits left of the PLC and converts 120vac to 24vdc.

The PLC requires 24vdc to operate.

Figure 3. Screen Shot of ScadaMobile display on Tablet.

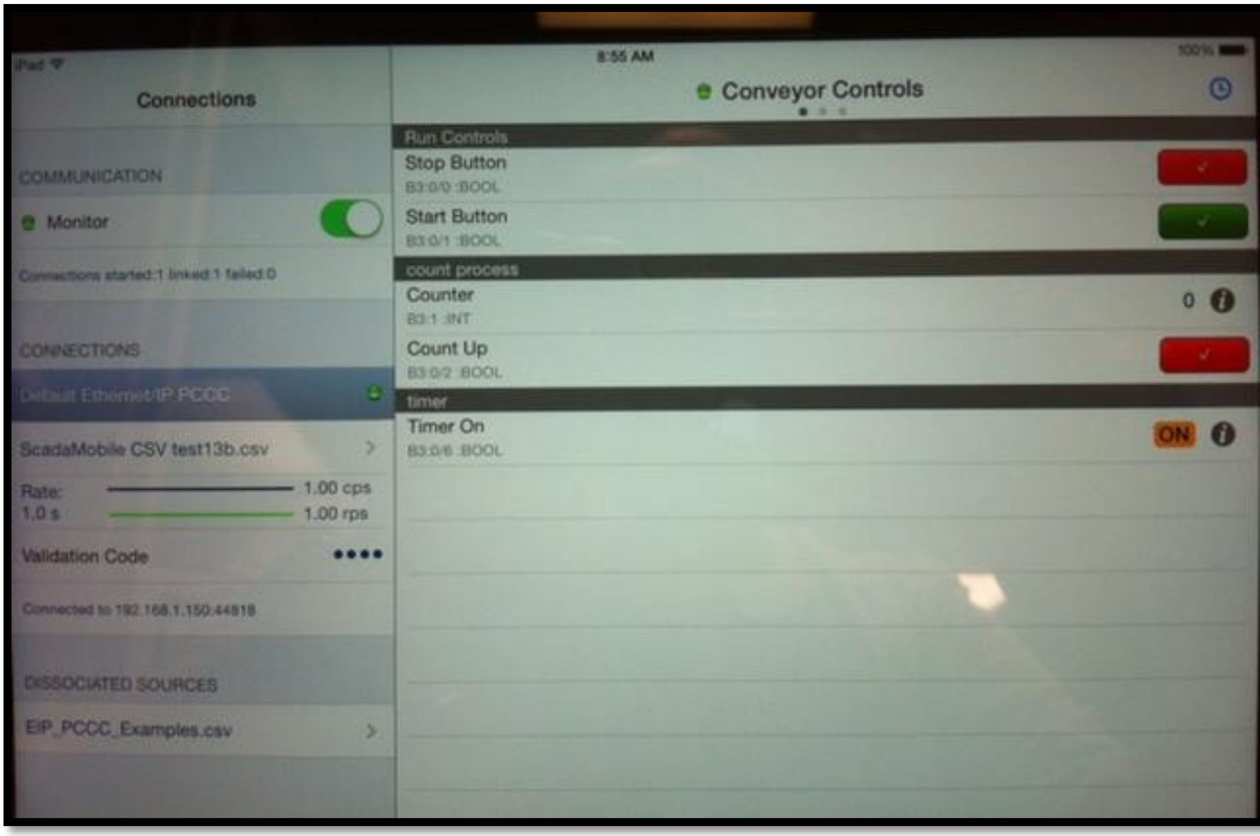


Figure 4.

The STOP button is represented in PLC memory as B3:0/0, which is true or false.

The START button is represented in PLC memory as B3:0/1, which is true or false.

The Counter Accumulative value is represented in PLC memory as B3:1.0 as an integer.

The Count button is represented in PLC memory as B3:0/2, which is true or false.

The Timer On or Timer Timing bit is represented in PLC memory as B3:0/6, which is true or false.

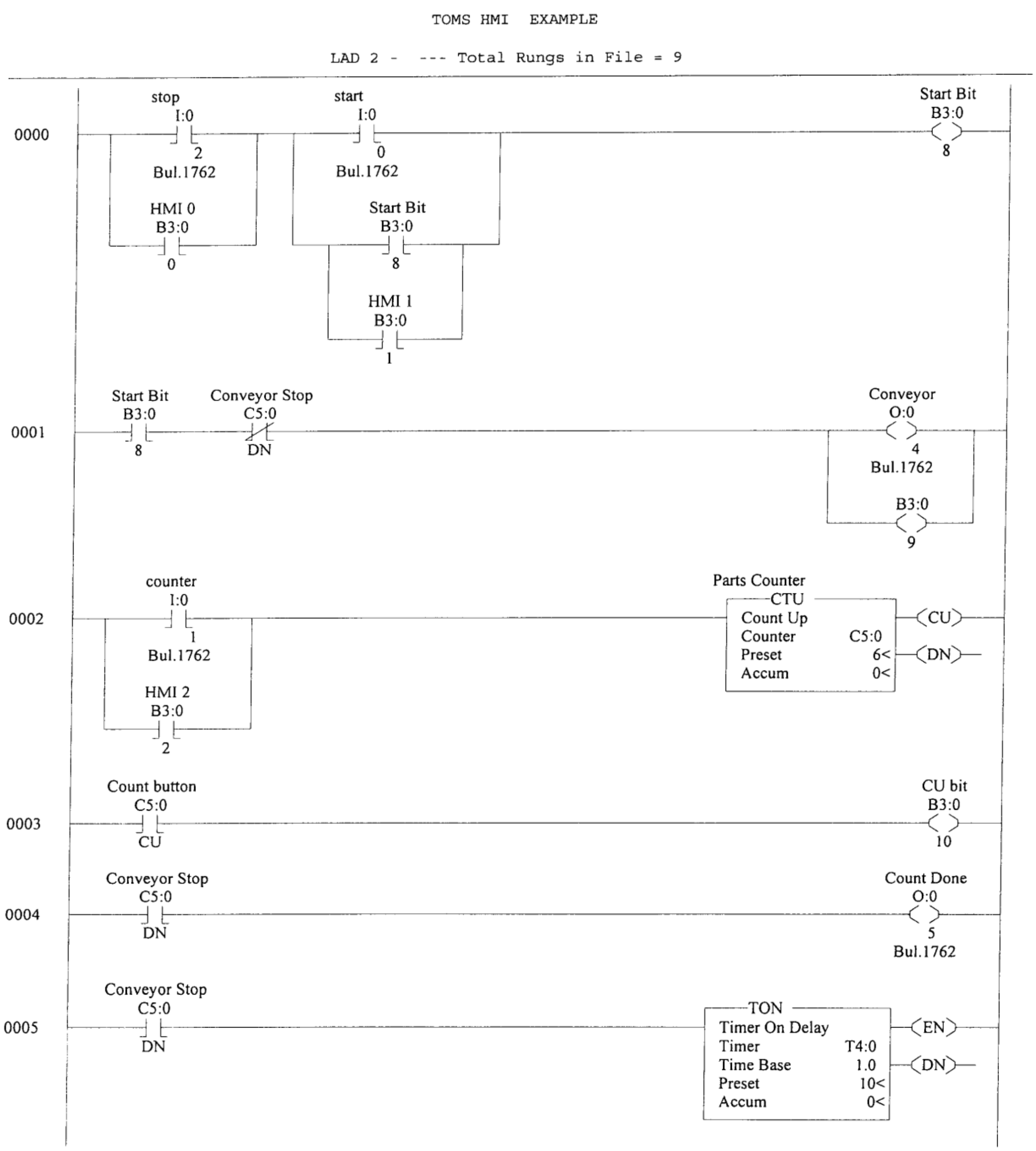


Figure 5. Ladder Logic Program Using HMI Commands

Rung 0000 is the standard Stop-Start station for conveyors. HMI bits parallel the instructions to allow for control from the wireless smart device.

Rung 0001 is the starting of the conveyor.

Rung 0002 is the counter positioned down the conveyor that will count each part that passes.

HMI Bit 2 allows to control counter remotely.

Rung 0004 sets the Count Done bit when the count values equals the Preset value.

Rung 0005 the 10 second timer is started when the Count Done bit is true.

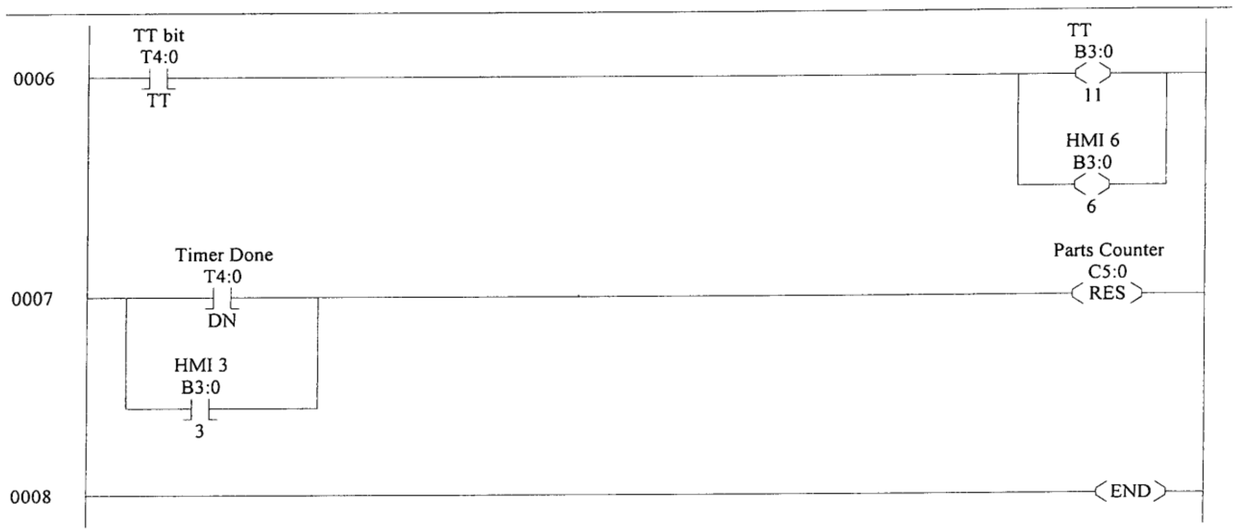


Figure 6. Ladder Logic program continued

Rung 6 is used to display the timing of the 10 second timer on the smart device using the Human Machine Interface (HMI) bit6 command.

Rung 7 allows the Timer Done bit to reset the counter to begin another count sequence.

Rung 8 is the terminating rung used in Ladder Logic Programming.

Outreach Activities

This lesson will provide students with hands-on experience in setting up the PLC, Ethernet Adapter, Router and smart devices in communication with one another. The students will learn the importance of IP Addresses and how smart devices can be used to monitor manufacturing processes and equipment to ensure product is being produced as efficiently as possible.

Figure 7. Examples of Tarrant County College Students Learning PLC Programming

Conclusion and Future Directions

In this paper, we described the motive, design, and results related to a project based learning activity that will prepare students for employment in industry with advanced technologies. This activity provides an excellent opportunity for students to integrate their knowledge of PLCs, data communication and wireless technologies. The experience is challenging but is well received by students and potential employers. Future plans are expand the control of manufacturing processes using wireless technologies. Security issues will also be addressed. Students will develop an industry standard of methodology in securing wireless connections. As technologies advance, it is our desire to simulate these technologies in a lab setting that is safe and conducive to learning.

Acknowledgements

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