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Feasible Interfacing and Programming of Industrial Control Technology Unit with PLC's and Robots

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ABSTRACT

Industrial control technology unit is a representation of an industrial assembly system that allows the study of control methods used in product assembly and inspection in a manufacturing process. The Sensors and actuators are used to sort components, assemble them and test for correct assembly followed by acceptance or rejection. The unit assembles two components a plastic ring and an aluminum peg can be controlled from a PLC using the 24v DC I/O interface. Correct programming of the controller must be achieved to ensure scrap components are not sent to the final assembly area. A programmable logic controller is a digital computer used for automation of electromechanical processes. ICT unit is interfaced with Robot for work piece transfer. In present work PLC'S is Interfaced with the 6-axis robot -Pneumatic gripper.

Keywords: *Industrial control technology, programming logic controllers.*

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I. INTRODUCTION

Industrial control system (ICS) is a general term that encompasses several types of control systems used in industrial production, including supervisory control and data acquisition (SCADA) systems, distributed control systems (DCS), and other smaller control system configurations such as programmable logic controllers (PLC) often found in the industrial sectors and critical infrastructures. ICSs are typically used in industries such as electrical, water, oil, gas and data. Based on data received from remote stations, automated or operator-driven supervisory commands can be pushed to remote station control devices, which are often referred to as field devices. Field devices control local operations such as opening and closing valves and breakers, collecting data from sensor systems [3].

DCS systems generally refer to the particular functional distributed control system design that exist in industrial process plants (e.g., oil and gas, refining, chemical, pharmaceutical, some food and beverage, water and wastewater, pulp and paper, utility power, mining, metals). The DCS concept came about from a need to gather data and control the systems on a large campus in real time on high-bandwidth, low-latency data networks. It is common for loop controls to extend all the way to the top level controllers in a DCS, as everything works in real time. These systems evolved from a need to extend pneumatic control systems beyond just a small cell area of a refinery [4].

. PLC (programmable logic controller) evolved out of a need to replace racks of relays in ladder form. The latter were not particularly reliable, were difficult to rewire, and were difficult to diagnose. PLC control tends to be used in very regular, high-speed binary controls, such as controlling a high-speed printing press. Originally, PLC equipment did not have remote I/O racks, and many couldn't even perform more than rudimentary analog controls.

The boundaries between these system definitions are blurring as time goes on. The technical limits that drove the designs of these various systems are no longer as much of an issue. Many PLC platforms can now perform quite well as a small DCS, using remote I/O and are sufficiently reliable that some SCADA systems actually manage closed loop control over long distances. With the increasing speed of today's processors, many DCS products have a full line of PLC-like subsystems that weren't offered when they were initially developed. The Industrial practitioners and researchers have been dealing with this area to overcome such problems [5-6].

II. LITERATURE SURVEY

II.1 Introduction

In early 20th century, microprocessors are used for controlling power distribution among various units of an industry(Hughes, 2000). The applications of microprocessor suffer from a basic limitation that it fails to alter the maximum demand level during load fluctuations. This has resulted in development of PLC circuitry to be incorporated in the place of microprocessor, in order that the demand level can be altered to suit the load fluctuations resulting in a smooth uninterrupted and continuous power distribution. PLCS are miniature individual computers, using hardware and software to perform the control functions. [1-2].

The major disadvantages of the controls are, the problem of fixed imaginary values used for comparing and controlling. PLCS are preferred more for their merit of providing flexible and absolute real values. The first PLC was traced back to (Hughes, 2000) when Bed Ford Associate developed a device called modular digital control for general motors. This was used by General Motors to replace the traditional relay based machine control system. Today's PLCS are designed not only to communicate with control systems, but also to perform reporting functions and diagnose the failures. Table1: brings out a comparison between the applications of microprocessors and PLCS.

Table 1: PLCS in comparison with microprocessor controls

S.no	PARTS	µC	PLC
1.	Inputs	3-5 V	Higher rating
2.	Input condition	Non-isolated I/O	Isolated I/O
3.	programming	Complicated	easy
4.	Environment	Affected by noise	Can't affected by noise
5.	Outputs	Fast and it may vary because of disturbance	Rugged outputs

II. 2 Problem Statement

In todays the large and medium scale industries, are frequently hold with vibrations, temperature, humidity, and noise factors. Microprocessor controllers are well utilized until the PLCs are coming into picture. The biggest single disadvantage of microcontrollers is speed. If you need a response to an input in less than a few microseconds, then hardware is pretty much the only way to go. Correcting errors and pre-testing phenomena are very much reliable need during above mentioned working conditions.

To address above issues a program PLC is proposed in the place of a microprocessor circuitry. PLC is a controlling device consisting of a programmable processing unit using specialized computer languages.

II. 3 Objective Of The Project

The objectives of this project are to:

i. Build PLC circuit to control valves sequences and counter to move the ICT system.
ii. Integrate PLC with Industrial robot system.
iii. Improve flexibility of existed µC controller system.
iv. Compare the programming easiness with existed Microcontrollers.

III. MATERIALS AND METHODS

III.1 Project Requirement Specification

• Inputs	5 x 24V d.c.
• Outputs	11 x 24V d.c.
• Chain conveyor	24V d.c. Motor with gearbox and slipping clutch
• Belt conveyor	24V d.c. Motor
• Sensors	3 x Infrared sensors 4 x Inductive Sensors 1 x Capacitive Sensor 1 x Fibre Optic Sensor
• Solenoids	1 x 24V d.c. rotary solenoid 2 x 24V d.c. linear solenoid
• Switched Faults	Six switchable faults
• Control	1 x Start and Stop switch in

enclosure
1 x Emergency Stop Switch

- Connection: 1 x 15 way D type connector 24v dc Outputs
  1 x 15 way D type connector 24v dc Inputs
  2 x 4mm power terminals
  2.1mm power jack socket
- Power supply requirements: 24V d.c. @ 2.5A

III.2 Software Requirements

All the software's that used in this work are as mentioned in the following;

- Siemens S7-200
- Aristocate

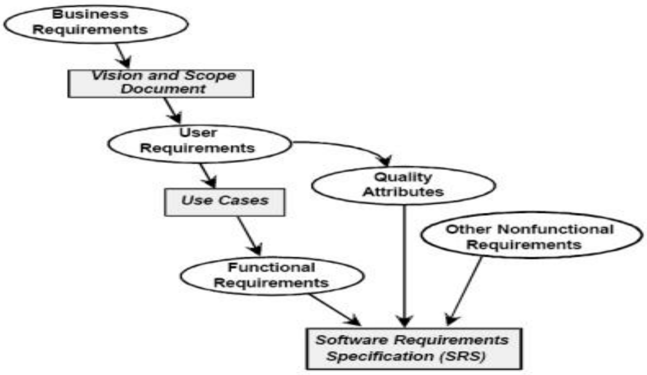


Figure 3.1: Software requirements

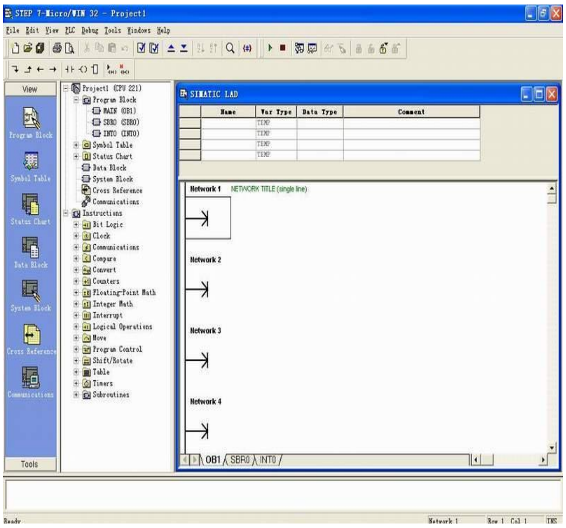


Figure 3.2: Siemens S7-200 Home Page

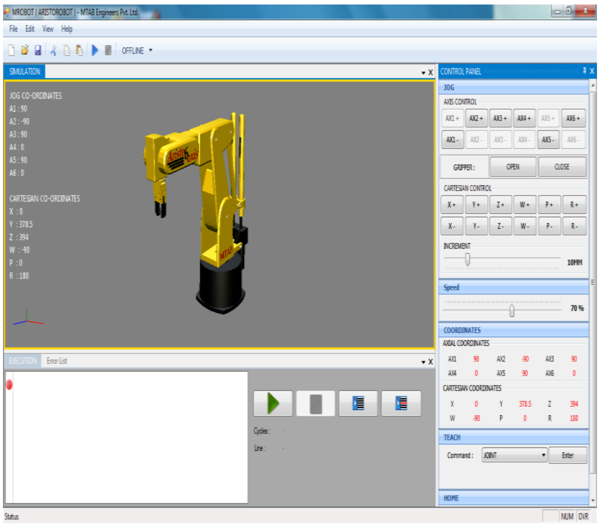
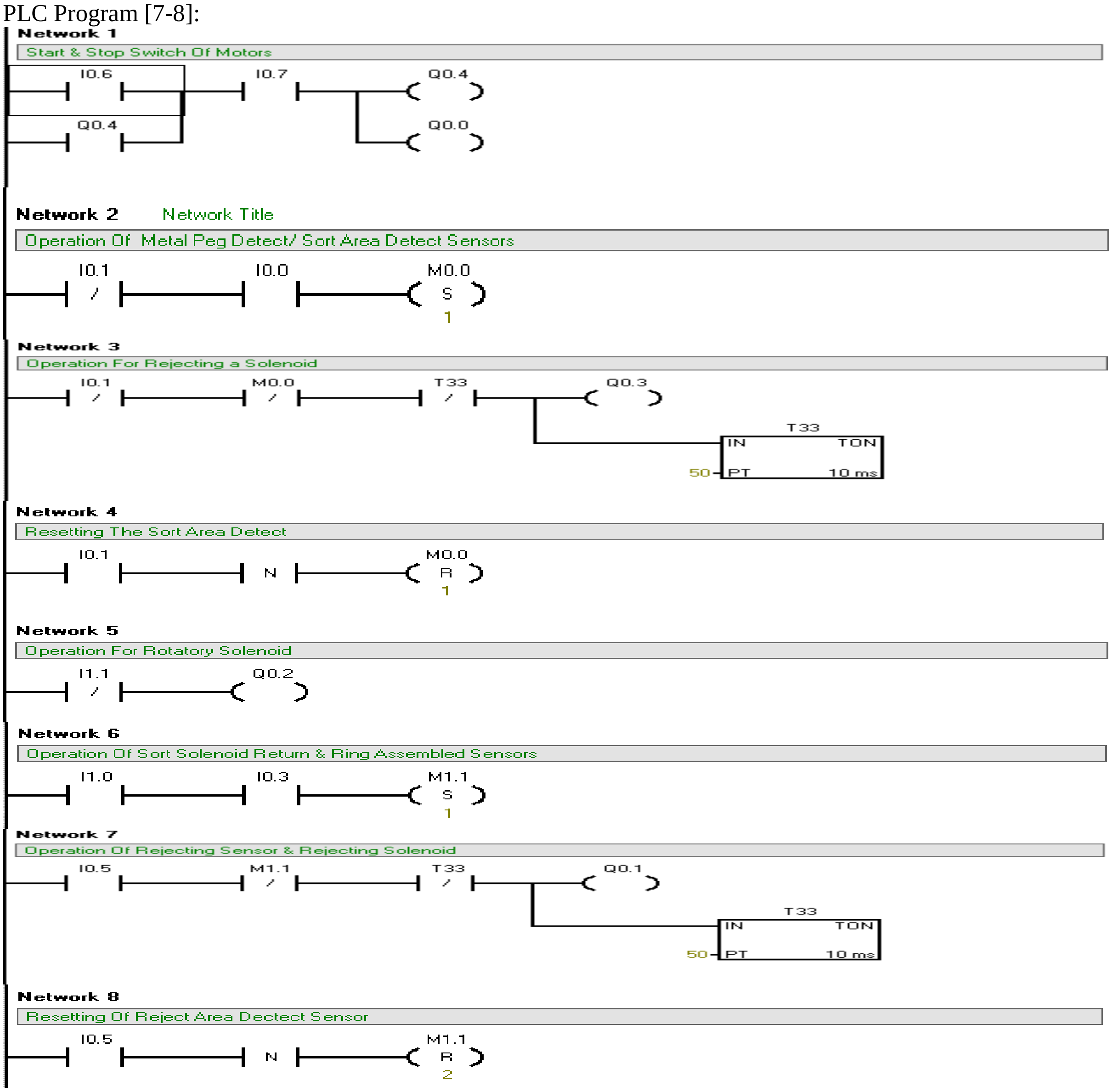


Figure 3.3: M-Robot Aristo Software main screen

III.3 Programming Methods

Digital computers, being general-purpose programmable devices, were soon applied to control of industrial processes A PLC is an example of a hardreal-time system since output results must be produced in response to input conditions within a limited time, otherwise unintended operation will result. Generally the software provides functions for debugging and troubleshooting the PLC software, for example, by highlighting portions of the logic to show current status during operation or via simulation. The software will upload and download the PLC program, for backup and restoration purposes. In some models of programmable controller, the program is transferred from a personal computer to the PLC through a programming board which writes the program into a removable chip such as an EEPROM or EPROM.

PLC Program [7-8]:



Here after a ARISTO ROBOT is interfaced with the system for transfer of entity. The program is as follows:

ARISTO-M Robot Program:

```
SPEED 60
LABEL MTAB
IF_PORT 0 JUMP LOAD
IF_PORT 1 JUMP UNLOAD
JUMP MTAB
LABEL LOAD
PORTMASK 0
JOINT A1 86.51 A2 -86.96 A3 88.34 A4 0.00 A5 -4.64 A6 81.23
GRIPPER OPEN
JOINT A1 86.94 A2 -85.77 A3 85.05 A4 0.00 A5 -10.31 A6 81.23
GRIPPER CLOSE
JOINT A1 86.94 A2 -89.86 A3 89.09 A4 0.00 A5 -10.31 A6 81.23
JOINT A1 0.98 A2 -89.86 A3 89.09 A4 0.00 A5 -10.31 A6 81.23
JOINT A1 -1.47 A2 -87.61 A3 97.84 A4 0.00 A5 -14.59 A6 81.22
JOINT A1 -1.47 A2 -87.61 A3 99.26 A4 0.00 A5 -14.59 A6 81.21
GRIPPER OPEN
JOINT A1 -1.47 A2 -89.55 A3 101.19 A4 0.00 A5 -14.59 A6 81.22
```

JOINT A1 -1.47 A2 -90.00 A3 89.97 A4 0.00 A5 -14.59 A6 81.22
PORTMASK 1
PORTMASK 0
JUMP MTAB
LABEL UNLOAD
PORTMASK 0
GRIPPER OPEN
JUMP MTAB

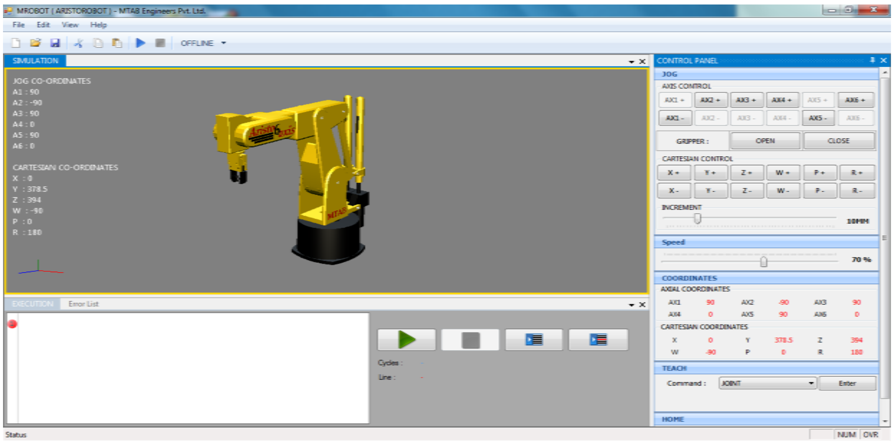


Figure 3.3: M-Robot Aristo Software main screen

Finally the work completed on plc programming for assembly operation and ARISTO-M programming for work piece transfer operation by following fundamentals. Thus, the total industrial control technology unit is implemented and completed the assembly operation successfully. And also completed the pick and place operation of work piece from one work station to another work station [9].

Chain conveyors utilize a powered continuous chain arrangement, carrying a series of single pendants. The chain arrangement is driven by a motor, and the material suspended on the pendants is conveyed. Chain conveyors are used for moving products down an assembly line and/or around a manufacturing or warehousing facility.

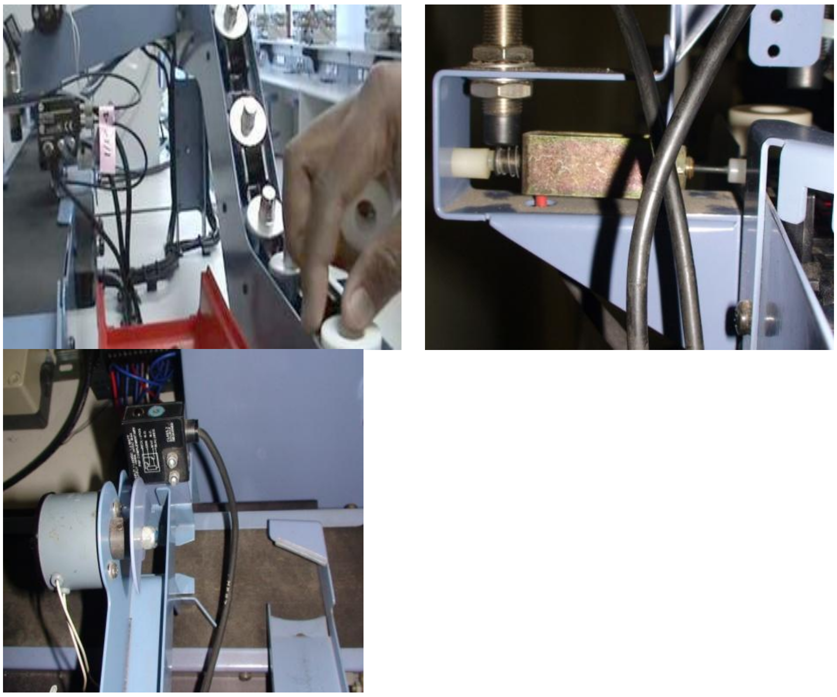


Figure 3.9: Chain Conveyer-Spring Solenoid-Rotary Solenoid Used In Project

Chain conveyors are primarily used to transport heavy unit loads, e.g. pallets, grid boxes, and industrial containers. These conveyors can be single or double chain strand in configuration. The load is positioned on the chains; the friction pulls the load forward. Chain conveyors are generally easy to install and have very minimum maintenance for users.

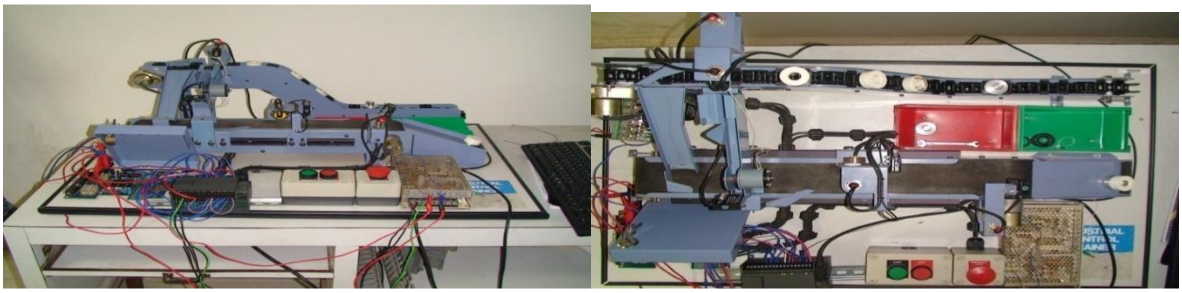


Figure 3.9: Front view and Top view

A chain conveyor processes the component through the sort area; the plastic rings and aluminum pegs proceed down a ring and peg chute and are then assembled on the belt conveyor. At the assembly check area components are inspected for correct assembly and when the components reach the final area, if correctly assembled they proceed to the acceptance area, faulty assemblies are rejected into a reject bin. Correct programming of the controller (PLC or PC) must be achieved to ensure scrap components are not sent to the final assembly area. Industrial control technology unit is interfaced with Robot for work piece transfer. In present work PLC'S is Interfaced with the 6-axis robot and programmed for pick and place operation using Pneumatic gripper [10].

IV. CONCLUSION

New technological advancements and current market and product domain conditions require new engineering design approaches to be applied, so that multi-functional, complex and reliable products in reduced time to satisfy market requirements can be designed and developed. This requires mechatronics design and eventually mechatronics education to be applied in real life and become a reality.

- ✓ The implementation of the PLC in industrial control technologies, proves to be one of the important controllers in industries for its simplicity and robustness and is used all over the world.
- ✓ PLC's are very good for controlling outputs based on the inputs. They are amazingly robust and are able to withstand all sorts of difficult conditions such as extreme temperature or dust in the air. They even last for a very long period. They don't have contacts that wear out, like relays do. They also can switch fairly quick without much heating in direct contrast to relays.
- ✓ For any application we need not to change the whole structure only different program has to be embedded as like any other programmable devices. Compared to relays PLCs are almost always a better choice.
- ✓ Today the PLC's are used for control & automation job in a single machine & it increases up to full automation of manufacturing / testing process in a factory.
- ✓ The interfaced 6-axis robot is more efficient than existing models for pick and place operation.

On the downside it could be observed that PLCs are not very good at handling large amount of data, or complex data. Lack of standardization is also one of the major disadvantage of the PLC. This causes much confusion if the PLC used for an application is replaced by one from a different manufacturer, or if a PLC programmer is replaced by a person with a different understanding of PLC programming.

REFERENCES

Journal Papers:

[1] Ho JM, Juang FC, A practical PWM inverter control circuitry for induction heating and studying of the performances under load variations, *Industrial Electronics Proceedings, IEEE International Symposium on , 7-10* Jul 1998, 1:294-299

[2] Kwon Y, Yoo S, Hyun D, Half-bridge series resonant inverter for induction heating applications with load-adaptive PFM control strategy, *Applied Power Electronics Conference And Exposition, 14-18* Mar 1999; 1:575 -581,

Books:
[3] L. A. Bryan, E. A. Bryan, *Programmable controllers: theory and Implementation* 2nd ed.,ISBN 0-944107-32-X, (Industrial Text Company, 1997).
[4] S. K. Bhattacharya and Brijinder Singh, *Control of electrical machines*
[5] M. H. Rashid, *Power Electronics: Circuits, Devices and Applications* 2nd Ed, (Prentice-Halllnc., 1993).
[6] W. Bolton, *Programmable Logic Controllers* Fourth Edition, ISBN-10: 0-7506-8112-8,
(Elsevier Newnes, 2006).
[7] *Programmable Logic Controllers Programming methods and applications*-Prentice Hall
[8] *Programmable Logic Controllers (PLCs)* © 2002 Keyence Corporation.

Theses:
[9] *Onur Alper Erdener, Development Of A Mechatronics Education Desk , master of science, the graduate school of natural and applied sciences of the middle east technical university, dec-2003.*

Proceedings Papers:
[10] Espi JM, Navarro AE, Maicas J, Ejea J, Casans S, Control circuit design of the L-LC resonant inverter for induction heating, *IEEE Power Electronics Specialists Conference*, 2000, 3: 1430-5

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