



PLC Based Automated Pick and Place System

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ABSTRACT: The process of selecting and replacing one of the technologies in manufacturing industry and designed to perform various functions. The system is very important to eliminate human errors and to get most accurate work. It can also save the cost in long run and help to solve problems and tasks that cannot be done such as on small area, high temperature area and very heavy load thing. This project is a basic development and modification of the system which use the peripheral interface Programmable Logic Control (PLC) as the programming brain to control entire robot movement. The gripper will position the product on to the next stage of production line. The software includes ladder logic programming, SCADA animation and hardware includes pneumatic system, limit switches etc. The benefit of this project is the robot can pick the object using gripper which is simple in construction and also cost effective.

KEYWORDS: Automation, Ladder logic, Plc, Sensor

I. INTRODUCTION

India is one of the leading countries in developing itself in every aspect. The developing sectors are Infrastructure, Engineering sectors, Economic conditions, Digitalization, InfoTech Industry, Research and Development, Space and Military organizations, manufacturing sector, banking sectors and more. These developing fields are thus introducing a lot more opportunities along with it. [1]. Highlighting the development of manufacturing and process industry in our country, innovation and automation have played a major role for bringing the respective sector to the upmost. Industrial revolution has been a large part of development, so papers use of data entries and records are been replaced by computers and similarly labors and human workers are been replaced by robots. [2].

The automation includes electronic, electrical and mechanical components. Accuracy, repeatability & manufacturing process are a major driving forces in the development of Automation Products. Proposed work is for Automation of Pick & Place of the objects. There is a lot of movement of the item under production before it is selected for export to the market or before it is shipped to another store within the production company. Before automation was assimilated into manufacturing, all these movements were either done manually or electromechanically. This is time consuming and reduced the productivity. Also, it leads to a lot of blunder due to human fatigue. There are very dangerous areas of machines which can cause serious human injury. In a fiber winding tension control system unstable tension results to a strength loss of 20-30% of the fiber wound component [3]. Automation overcomes all these barriers in industrial processes. Manual or semi-automatic machines are making production less efficient, human risk is higher & the production cannot be imagined with an unstructured system. Programmable Logic Controller is the logic controller whose program can be written in very flexible way. Over a time, all the hardwiring on the electrical panels of machines or processes has been reduced because of PLC [4].

II. RELATED WORK

Programmable Logic Control is a device that is on a greater scale used in the industry for interlocking of operations automation, event based control, and order of operations, is utilized in every process industry, requiring process safety and interlocks e.g. Thermal power plant, steel industry, cement industry, pharmaceutical industry, petrochemical industry etc. A programmable logic controller, called a PLC is a computer-type device used to control the devices in an industrial facility. The PLCs control variety of industrial facilities E.g. Conveyor systems, food-processing machinery, auto assembly lines [5-9].

PLCs have gained preference on the factory floor and will remain on the top of the list of choices for some time to come. These devices were originally designed to replace relay logic circuits. The basic programming language, ladder diagram feature the same relay logic schematics. They are real-time controllers using cyclic behavior. The ladder diagram and instruction list was the first programming language. Like mentioned earlier, the ladder diagram is historically connected with the relay logic used in control before programmable logic controllers emerged. The ladder diagram's basic structure looks like an electrical scheme, with contacts and coils connected between two power rails called rungs. [10,11].



Pick and place automation machines have been built using IR1400 ROBOT, since 'Robots' the term is only a small sub- set of the technologies covered by the much broader term Automation'. Also this machine has been built with PLC 4DOF (degree of freedom). Pick and Place machine has become very important for the industrial based applications as part of the industrial line.

III. NEED OF PICK AND PLACE SYSTEM

The drawbacks [12] of present systems in manufacturing industries are

1. Maximum human intervention. Thus, it increases the chances of human error in the systems.
2. Manual material analysis.
3. Manual process and its components reporting.
4. Tracing and material handling difficulty.
5. Only a few components from the entire packaging are monitored for quality testing, so proper testing is not done.
6. Error detection is not easy
7. Time consuming
8. Labor management
9. Invest a lot of Money and Time

To overcome these drawbacks pick and place system is required having following advantages:

1. Speed: Speed performs major roll in any manufacturing industry and speed is important feature of Pick and place system.
2. Precision: pick and place system work at a level of accuracy where human assembly can never work on.
3. Flexibility: Pick and place systems are extremely flexible. They are easily programmed to different specifications.
4. Safety: Safety is most essential part of Industry. Pick and place system make industry more safe.
5. Efficiency: Efficiency is most essential part of any business. This system raise the overall level of efficiency

IV. METHODOLOGY

The PLC has 230V CPU and 24V DC power supply. It is programmed using ladder diagram. The servo drive controls the movement of servo motor. The servo drive and servo motor form a feedback mechanism. There are some distinct types of application of electrical motor where rotation of the motor is not constantly required. Servo motor is used for such applications. We used a 220 V series servo motor. This system uses a pneumatic system, to keep the electronic arm at the top of the beam steady. Pick and place machines uses vacuum grippers, which are simple astrictive devices, large enough to hold large wooden planks and smooth enough to ensure suction of the pretension surface. I order to picking up the object, we need to sense it first. The position sensors are responsible for this. Capacitive Proximity sensors have been used considering the factors like range, accuracy, life, Cost and so on. Servo drive receives pulses from PLC. The Servo drive communicates with the servo motor which operates the lead screw mechanism on which the robotic arm holds. The conveyor belt moves parallel to this slide. The object to be picked moves on conveyor belt. When object is detected PLC directs the servo drive to stop the slider movement. The robotic arm then picks up the object.

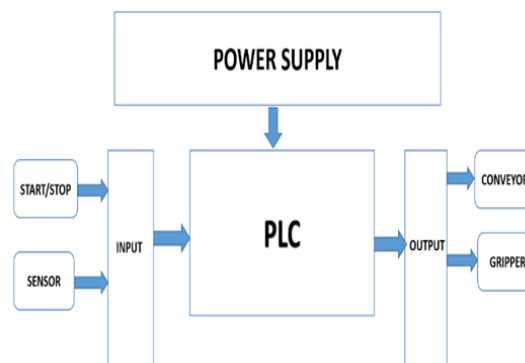


Fig.1. Block Diagram



V. HARDWARE

PLC: Programmable logic controller is “a digitally operating electronic apparatus which uses a programmable memory for the interior storage of instructions for implementing specific functions like logic, sequencing, timing, counting and arithmetic, to regulate through digital or analog input/output, various sorts of machines”.

Advantages of PLC over hardwired relay controller:

- The Change in software design is much easier and cheaper as compared to change in hardware design.
- Low maintenance.
- The technicians and engineers can easily adapt to PLC because using ladder logic requires no syntax, which is entirely based on logic.

Advantages of PLC over microcontroller and microprocessor: ▪Large capacity or Scalability, modular design distributed architecture, industrial grade, device interoperability, ladder programming, safety, utility, easy maintenance and repair, inbuilt functions and algorithms, diagnostic features. The system is user programmable. It uses "Relay Ladder" language. The name of this language implies that the control logic of the earlier days built from relays.

AB SLC500:



Fig.2.AB SLC500

The Allen-Bradley SLC 500 is a small chassis-based family of programmable controllers, discrete, analog I/O, and peripheral devices. The SLC 500 family delivers power and adaptability with a wide range of communication configurations, features, and memory options. The RSLogix500 ladder logic programming package provides flexible editors, point-and-click I/O configuration, and a strong database editor, also as diagnostic and troubleshooting tools to assist you save project development time and maximize productivity.

CAPACITIVE PROXIMITY SNSORS: A proximity sensor is used to sense the presence of object. They are also called as non- contact sensors because they don't make any physical contact with the object being sensed.

Capacitive sensor is a type of proximity sensor. They use the electrical property of capacitance and change of capacitance based on change in electric field around the sensor. They can detect both metallic and non- metallic objects. They are useful in detecting a wide range of objects. The sensing range for capacitive proximity sensors is from a few millimeters up to 1 inch.



Fig.3. Capacitive Proximity Sensor



TABLE1
MATERIAL SPECIFICATION

1.Conveyor	External body- 18 gauge Fabricated CRCA sheet Roller Material- PVC Mechanical arrangement- 20mm Bearing with screw arrangement
2.Sensor	Capacitive proximity PNP, Normally Open range Adjustable 1mm to 10mm Operating voltage- 9V DC to 24V DC
3.Pneumatics	1.Direction Control Valve- Type- 5/2 Coils- Electromechanical Operating Voltage- 12 V DC to 24 V DC Connection- Inlet from Compressor, Outlet to Cylinders by 4 mm pneumatic pipe 2.Double Acting Cylinders - Bore- 16 mm (Both Cylinders) Stroke- Cyl 1- 150mm, Cyl 2- 300mm Material- Steel Attachment- Mechanical linkage
4.Motorized Gripper	Motor- 220V Servo Motor 300 RPM Gripper Max. Opening- 150 MM

VI. SOFTWARE

RSLogix500 (Ladder Logic) and Intouchwonderware (SCADA) are used.

Ladder Logic: Ladder Logic was a written methodology used originally to document the development and design of relay racks utilized in process and manufacture management. Each device with in the relay rack is portrayed by a symbol on the ladder logic with connections between those devices. It gets its name from the observation that programs in this particular language resemble ladders with a series of horizontal rungs between two vertical rails.

- This logic consists of contacts that break and create circuits to control coils. Each contact or coil signifies the status of a single bit with in the memory of the programmable logic control. A ladder program can refer any number, multiple times to the status of a single bit.
- The "contacts" refer to physical inputs to the PLC from physical devices like limit switches and pushbuttons.

SCADA: Supervisory Control and Data Acquisition, A computer system for gathering and analyzing real time data. SCADA systems are used to monitor and control various plants in industries. Works like supervisor who supervise the complete plant area. This software is to be connected to PLC/PID/DCS systems which in turn are connected to field instruments.

Hazardous areas, unhygienic places, hilly areas and sea beds where an individual can't be send regularly but process has to be watched continuously or it should be controlled then it can be done using SCADA.

VII. RESULT

Ladder diagram is used to program the PLC.This program is then provided to PLC. Snapshot of PLC ladder diagram after programming is as shown in fig 4.

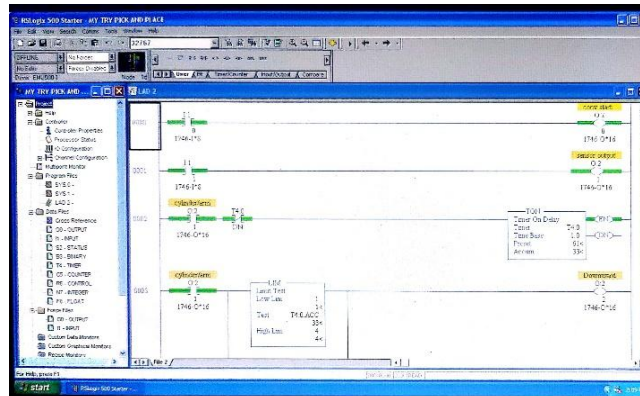


Fig.4.Ladder Logic

SCADA animation is used to demonstrate the working of pick and place system. Result of animation is as shown in Fig5 :

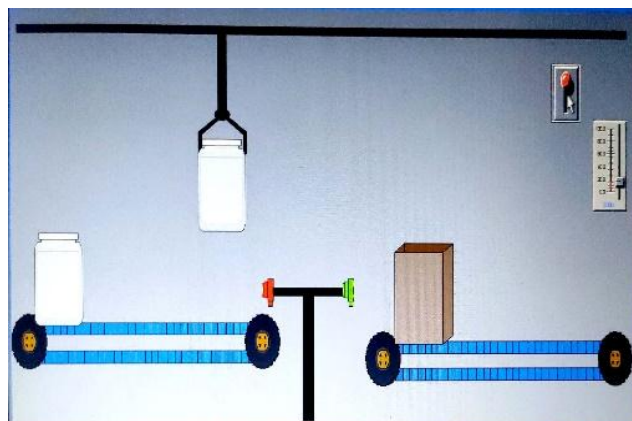


Fig.5.SCADA simulation

VIII. CONCLUSION

The proto-type robotic arm pick and place system uses a programmable logic controller, sensor technology, and pneumatic components such as compact cylinder, gripper, and directional valves. Ladder programming is the primary programming language used to execute the motion sequence of the robotic arm pick and place system.

The electro-pneumatics and programmable logic controller are found to be interdependent. Each of the pneumatic components has its own purpose and performance in the system. Programmable logic control (PLC) is used to control these pneumatic components. With PLC, the manipulations of the robotic arm pick and place system, make the task easier. It also requires minimum work area compared to hard-wiring system. The accuracy of the robotic arm increases with the right program installed in the robotic arm pick and place system, so decreases the quantity of human failures.

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