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Automatic Bottle Filling by Using PLC

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ABSTRACT: The application of PLC is widely known and use in this digital world PLC's application is applied at the industrial sector. Normally, the PLC's that have been used at the industrial field is usually to control a mechanical movement either of the machine or heavy machine in order to create an efficient production and accurate signal processing. In this paper, a discussion about PLC application will be explained in more details and specified. Whereby, a machine that used to prepare automatic filling water into the bottle is fully controlled by the PLC, which acts as the heart of the system. The system sequence of operation is designed by ladder diagram and the programming of this project by using DELTA software. Sensor usually plays its vital part as an input signal transmitter for the PLC in this system.

KEYWORDS: Motor, Solenoid, Sensor, PLC trainer kit, conveyor belt.

I.INTRODUCTION

The field of Automation has had a notable impact on a wide range of industries beyond manufacturing. Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provides human operators with machinery to assist them with the muscular requirements of work, automation greatly decreases the need for human sensory and mental requirements as well.

Automation plays an increasingly important role in the world economy. One of the important applications of automation is in the soft drink and other beverage industries, where a particular liquid has to be filled continuously. For these kinds of applications the trend is moving away from the individual device or machine toward continuous automation solutions. Totally Integrated Automation puts this continuity into consistent practice. Integrated Automation covers the complete production line, from receipt of goods, the production process, filling and packaging, to shipment of goods. This paper is an application of automation wherein I have developed a bottle filling system. The various processes are controlled using a PLC (Programmable Logic Controller).

II.PROGRAMMING LOGIC CONTROLLER

A programmable logic controller, commonly known as PLC, is a solid state, digital , industrial computer using integrated circuits instead of electromechanical devices to implement control functions. It was invented in order to replace the sequential circuits which were mainly used for machine control. They are capable of storing instructions, such as sequencing, timing, counting, arithmetic, data manipulation and communication, to control machines and processes. According to NEMA(National Electrical Manufacture's Association ,USA),the definition of PLC has been given as "Digital electronic devices that uses a programmable memory to store instructions and to implement specific functions such as logic , sequencing, timing, counting, and arithmetic to control machines and processes."
Before PLCs came into existence; sequencing, safety interlock logic for manufacturing, and other controls were accomplished using physical relays ,timers, and dedicated closed-loop controllers' relay is a simple device that uses a magnetic field to control a switch .When a voltage is applied to the input coil, the resulting current creates a magnetic field to control a switch. When a voltage is applied to the input coil, the resulting current creates a magnetic field. The magnetic field pulls a metal switch (or reed) towards it and the contacts touch, closing the switch. The contact that closes when the coil is energized is called Normally Open (NO).The normally closed (NC) close when the input coil is not energized and open when the input coil is energized. But the control industries were looking forward to eliminate the high costs associated with Inflexible, relay controlled systems. The specifications required a solid-state system with Computer flexibility which must be able to

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(1) Survive in an industrial environment,
(2) Be easily programmed and maintained by plant engineers and technicians, and
(3) Be reusable.

2.1 **Basic parts of PLC:-**

All programmable controllers contain a CPU, memory, power supply, I/O modules, and Programmable devices. Basic parts of the PLC are as follows:-
(1) Processor
(2) Memory
(3) Input/output devices
(4) Programming panel or unit
(5) Power supply

2.2 Processors module:-

Processor module is the brain of the PLC. Intelligence of the PLC is derived from Microprocessor being used which has the tremendous computing and controlling capability. Central processing –unit (CPU) performs the following tasks:-
· Scanning
· Execution of program
· Peripheral and external device communication
· Self- diagnose
Power of PLCs depends on the type of microprocessors being used. Small size PLCs use 8-bit microprocessors where as higher order controllers use bit-slice microprocessor in order to achieve faster instruction execute Modern day PLCs vary widely in their capabilities to control real world devices, like some processors are able to handle the I/O devices as few as six and some are able to handle 40000 or more. The no. of input/output control of PLCs depends on the, hardware, software, overall capacity and memory capability of the PLCs. The CPU upon receiving instruction from the memory together with feedback on the status of the I/O devices generates commands for the output devices.

2.3 Input modules:-

There are many types of input modules to choose from. The type of input module selection depends upon the process, some example of input modules are limit :-switches, proximity switches and push buttons etc. nature of input classification can be done in three ways, namely:-
· Low/high frequency
· Analog/digital (two-bit, multi-bit)
· Maintained or momentary
· 5V/24V/110V/220V switched
Some most industrial power systems are inherently noisy: - electrical isolation is provided between the input and the processor. Electromagnetic interference (EMI) and radio frequency interference (RFI) can cause severe problems in most solid state control systems. The component used often to provide electrical isolation within I/O cards is called an optical isolator or opt coupler. Typically, there are 8 to 32 input points on any one input modules. Each input point is assigned a unique address by the processor.

2.4 Output modules:-

Output modules can be used for devices such as solenoids, relays, contractors, pilot lamps and led readouts. Output cards usually have 6 to 32 output points on a single module. Output cards, like input cards, have electrically isolation between the load being connected and the PLC. Analog output cards are a special type of output modules that use digital to analog conversion. The analog output module can take a value stored in a 12 bit file and convert it to an analog signal. Normally, this signal is 0-10 volts dc or 4-20ma. This analog signal is often used in equipment, such as motor operated valves and pneumatic position control device. Each output point is identified with a unique address.

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III.COMPONENTS USED

3.1 PLC:-

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Fig1: DELTA PLC

3.2 Operation of PLC:-

During program execution, the processor reads all the inputs, and according to control application program , energizes and de-energizes the outputs. Once all the logic has been solved, the processors will update all the outputs. The process of reading the inputs, executing the control application program, and updating the output is known as scan. During the scan operation, the processor also performs housekeeping tasks. The inputs to the PLCs are sampled by processor and the contents are stored in memory. Control program is executed, the input value stored in memory are used in control logic calculations to determine the value of output. The outputs are then updated. The cycle consisting of reading of inputs, executing the control program, and actuating the output is known as "scan" and the time to finish this task is known as "scan time". The speed at which PLC scan depends upon the clock speed of CPU. The time to scan depends upon following parameter:-

· Scan rate
· Length of the program
· Types of functions used in the program

3.3 SOLENOID VALVE

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

The solenoid assembly consists of a coil, plunger, and sleeve assembly. In a normally closed valve, a plunger return spring holds the plunger against the orifice, preventing flow through the valve. When the coil is energized, a magnetic field is produced, raising the plunger and allowing flow through the valve

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Fig 2 Outer view of solenoid valve

3.4 CONVEYOR BELT

Today there are different types of conveyor belts that have been created for conveying different kinds of material available in PVC and rubber materials.

Belt conveyor is a machine transporting material in a continuous way by friction drive. It is mainly composed by rack, conveyor belt, belt roll, tensioning device and gearing. It can form a material delivery process between the initial feeding point and the final discharging point of jaw crusher .

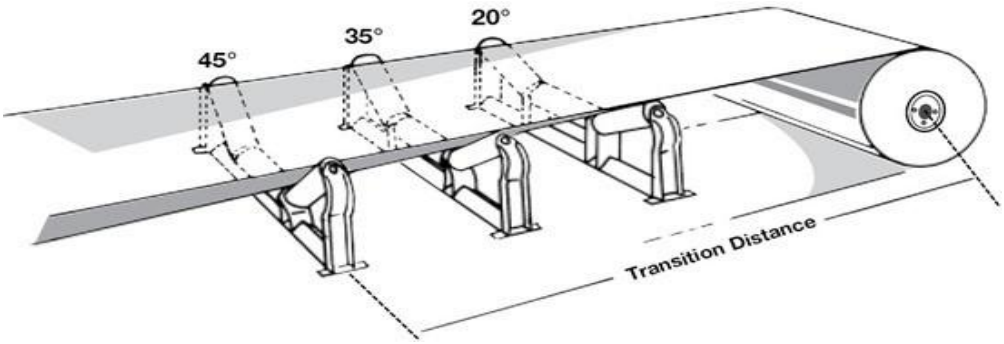

Fig 3 CONVEYOR BELT

3.3 INDUCTIVE PROXIMITY SENSOR:

Inductive Metal Proximity Sensor, which is also called non-contact proximity switch, it is composed of generator and shaping amplifier oscillator vibration in the switch after induction head, and produces an alternating magnetic field when the metal body detected.
This Inductive Proximity Sensor has high sensitivity, fast frequency response, high repeat positioning accuracy and also stability and reliable, it can detects metal components in 0~4mm distance, and is widely used in modern industry, such as machinery, metallurgy, transportation, electric power, military industry and so on.

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Fig 4 Proximity sensor

IV.OPERATION

4.1 Wiring diagram

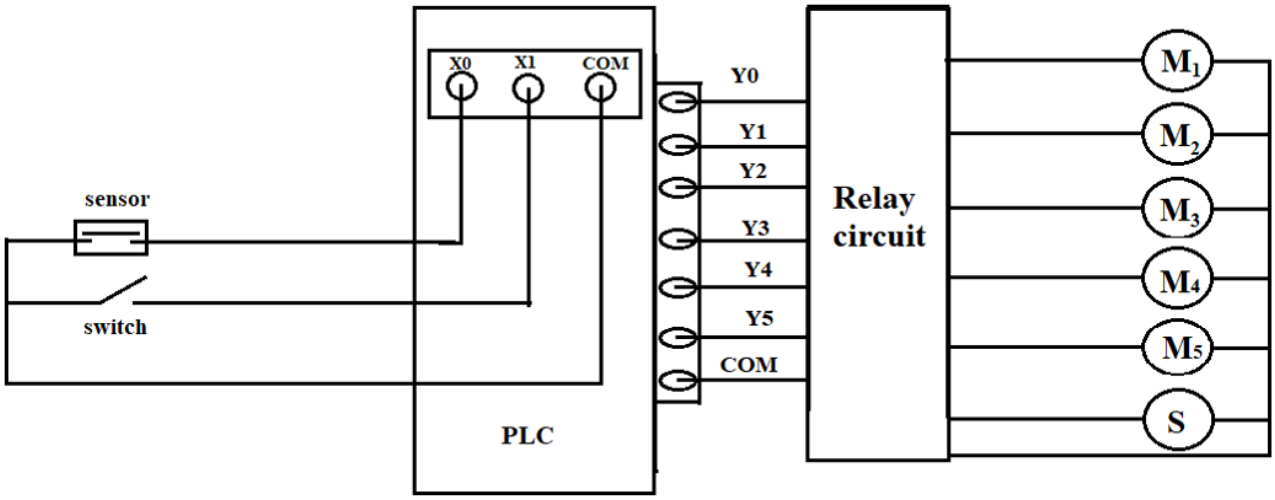

Fig 5 Wiring diagram

- When we switch on the supply the conveyer belt starts rotating.
- When the bottle comes near the sensor the sensor will sense the bottle position and give the signal to the PLC.
- The PLC stops the conveyer belt and switch's on the solenoid valve
- After preset time in program the solenoid is turn off and the conveyer belt starts moving until the next bottle come

4.2 Ladder Diagram

- When we switch on the supply the motor output is SET ON and the output Y2 is also SET ON
- If the sensor sense the bottle the timer is turn on and the RESET the output Y0 and Y2 SET ON the output Y1 and Y3
- After preset time the output is Y0 and Y2 is SET and output Y1 and Y3 is RESET

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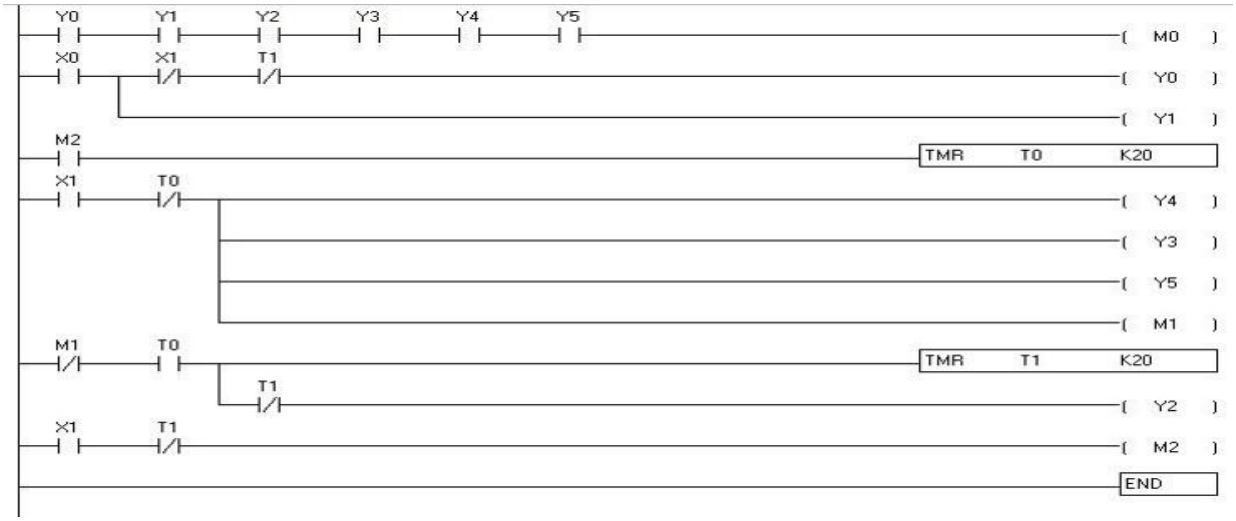

Fig 6 PLC ladder diagram for automatic bottle filling

4.3 WORKING

PLC Starts for programmable logic controller our project an application of the plc now a days where is a wide usage of plc especially in automation industries in our project each and every operation is done with a plc we give the references values to the plc according to the values the action of a plc is going the main conveyer belt starts rotating whenever the supply is given to the motor we are usage 12v DC gear motor then according to the supply given by the plc in that conveyer belt we place we p[lace the bottle manually the bottle tracks with conveyer belt the belt starts with the help of motor the bottle tracks up to disc there is place for the bottle to unsent into it after that the disc starting in a clockwise direction the disc also rotates with the help of motor but before the disc starts rotation there is a small operation bone by the solenoid the solenoid has 2 values for the filling of bottle the solenoid value reaches water to fill the bottle the solenoid release to water up to some limit of the bottle filling time after that solenoid stops releasing water then rotation of disc is starts in clockwise direction The disc rotation start when the bottle reaches 45* position from the position where is starts Where it reaches 45* position the disc motor starts the disc rotation as well as the plc starts giving supply to the disc motor The placing of cap Is obtain cap is placed at the mouth of the bottle after placing the motor starts rotating the disc plc takes the information to required supply is operated to motor again the bottle starts at the 90* position from the starting position of disc this is for fixing the bottle cap we design a stand for the fixing a cap we place a motor at the top of the stand which is used to move to and for motion of the tightening motor the top of position motor used to down the cap fixing motor up to the mouth of the bottle to fix tightly a cap then after fixing the cap the position motor take 112345 to the fixing motor Then after completion of fixing of cap the plc gives supply to the close motor the starts rotating up to the packing then conveyor belt the packing conveyor belt rotates continuously without any gap the bottle automatically placed a placing conveyor belt this conveyor belt tables the bottle to a packing this is a continuous process each and every function is organized by plc

V. RESULT AND DISCUSSION

The device can fill up any number of bottles sequence. There is no need of any external pumps and only two types of sensors are used. It is a time based control by which the pulse is generated in flow sensor and filling process is done. It can be used commercially in various coffee shops, juice shops; cold drink shops and reduces human effort. So the practical research result is much satisfactory. It also helps to understand the necessity of PLC in industrial automation and also to realize the necessity of studying it.

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VI.CONCLUSION

Automation systems are used to increase productivity, which in turn brings economic progress. The main purpose of PLC in automation is used to control the whole system. The cost of installation is not cheap but it can efficiently run for a long period of time. The performance, flexibility and reliability is based on the investment. A PLC based control system was applied to the automatic liquid filling station previously specified and the performance was measured. The entire system is more reliable, time saving and user friendly.

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