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PLC Based Automatic Bottle Filling System

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ABSTRACT: Filling is the process in which a machine packs the liquid product such as water, cold drinks etc. This method includes placing bottles onto a conveyor belt and filling bottles one at a time. This aim of this paper is to describe the methods for feeling more than one bottle at a time. In a conveyor system, stepper motor is used for its efficiency. It includes the user defined volume selection at the desired level. This system includes limited number of sensors, so it is less expensive. Filling is controlled by PLC (Programmable Logic Controller) using ladder logic method. In this bottle filling system, the PLC gets the sensor feedback and controls the solenoid valve timing as well as controls the conveyor belt. By programming the PLC, the entire system is being controlled. Sensor stands as the most important part for bottle filling. Normally in all automation industries, BLC is considered as the heart of any system. The entire system is made more flexible, time-saving and user-friendly. Every result leads to the conclusion that the operation of PLC is very effective.

KEYWORDS: PIC16f628a PLC, Photoelectric sensor, Flow sensor, Conveyor Belt, Solenoid valve, HMI

I. INTRODUCTION

Automation is used for all control systems and technologies in PLC is used to reduce the human work and helps in increasing the production. PLC plays an important role in the world of automation industry. It acts as a major function in the automation field which tends to reduce the complexity, increase safety and cost efficiency. In the system we have applied a PLC based control system in an automatic bottle filling station. The paper is divided into several sections where the first phase of the paper explains the description of the product. The second phase then gives the functional description of the product. PLC acts as a major function in automation feels bad, small PLC have a fixed number of built-in connections for inputs and outputs. Ladder logic is used to control the process. A sensor which is placed in the conveyor is used to sense the bottle placed under the tank and corresponding tank switched on to fill the bottle. Filling is done by using various methods using motor, sensors, conveyor belt, PLC, solenoid valve.

II. DESCRIPTION OF THE PROPOSED PROJECT

The system consists of a PLC (PIC16f628a), 12 DC Relay, Photoelectric sensor, Flow sensor, Solenoid valve, DC motor, conveyor belt, 12V DC source, ON-OFF button and some connectors. The ON-OFF button works as the input device. The PLC controls the input and output according to the program given.

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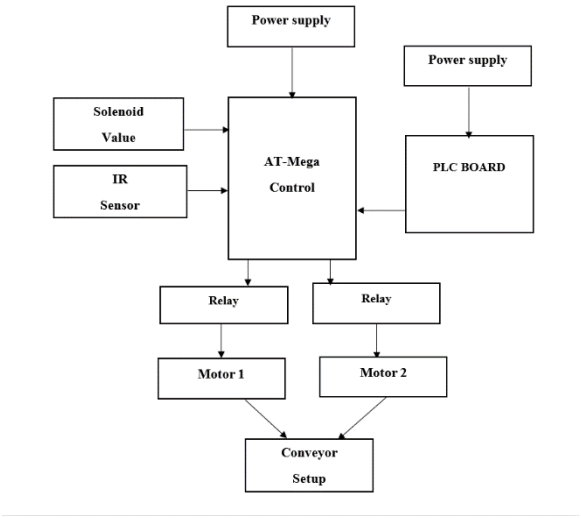

Fig 1: Block Diagram of the proposed system

A Programmable Logic Controller, PLC is a digital computer used for automation. It is an interface between program and the inputs. It is a programmable software. A PLC is an example of a real time application and therefore used to control various devices. The PLC depending on the inputs given and their state, turns on/off its output. The user enters a program, usually through software which gives the results. PLC is used in many real-world applications. For all application that needs some type of electrical signals, PLC works on the basis of inputs given by the user.

PLC works by a programmable support with some criteria. The PLC is connected with some components and it is made to run with the help of a program.PLC executes the program by one instruction at a time, where, if the first input isON then it should turn on the first output. First the PLC checks the input status and it scans the input by user defined programming. Next the process is executed and finally it checks the output status.

In out proposed system Ladder Diagram (LD) is used. This is to interface the ON-OFF button, programming logic. There are several programming software available but in this project ladder logic is used as it is easy to understand and the programming is made more flexible to users.

III. SYSTEM COMPONENTS

A. PLC

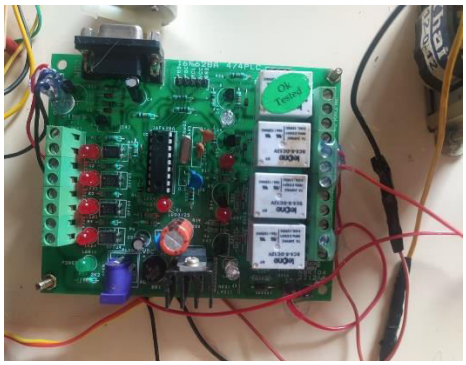

Fig 2: PLC

There are some main factors to choose a PLC for any application. They are input, output, memory, size,system speed, compatibility to HMI, easily communicable.Different PLCs have different number of I/O ports. And in some, adding external I/O cards can increase number of I/O ports In the proposed device PIC16f628aPLC is used. Inthe proposed device PIC16f628aPLC is used. In PIC16f628a PLC, there are 8 inputs and 4 relay type outputs. Four minutes full programs scanning time and memory isenough for the automatic bottle filling. Therefore,it is chosen.

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B. SOLENOID VALVE

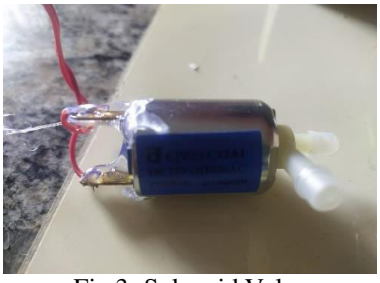

Fig 3: Solenoid Valve

When the water bottle placed over the conveyor belt, which is initially at motion, is sensed by the Photoelectric sensor, the conveyor stops running and at the same time the solenoid valve gets energized and water starts flowing through the valve for a certain time period (depending on the time we set on the timer in the PLC programming). As the time period is over then the solenoid valve gets de energized and water stops flowing through the valve. The conveyor belt starts moving again and the valve remains deenergized until and unless the bottle is sensed by the sensor again.

C. DC MOTOR

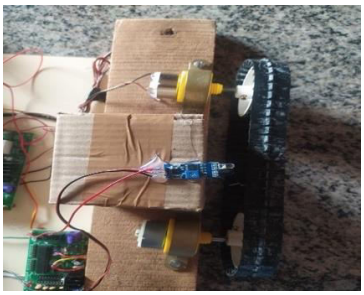

Fig 4: DC Motor

The DC motor used is a DC geared type motor whose shaft is interconnected with the shaft of the roller. This motor has an input voltage of 12v with an input current of 600mA to 14A. Its no load speed is 50 RPM. The reason for selecting this motor is to achieve high torque at a constant speed. It has a torque of 70 kg-cm amount of torque for our load. The motor comes with a metal gearbox and centered shaft. Shaft is loaded with bearing for wear resistance. The reason for choosing such a high torque is having such heavy rollers used on the either side of the hardware which is mounted with a conveyor belt which provides sufficient.

D. POWER SUPPLY

Fig 5: Transformer

The present chapter introduces the operation of power supply circuits built using filters, rectifiers, and then voltage regulators. Starting with an AC voltage, a steady DC voltage is obtained by rectifying the AC voltage, then filtering to a DC level, and finally, regulating to obtain a desired fixed DC voltage. The regulation is usually obtained from an IC

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voltage regulator unit, which takes a DC voltage and provides a somewhat lower DC voltage, which remains the same even if the input DC voltage varies, or the output load connected to the DC voltage changes.

E. IR SENSOR

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These typesof radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which issensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

IV. LADDER LOGIC

Ladder logic is the main programming method used in PLC. Ladder logic is based on mimic relay logic. The relay logic diagrams are difficulthence we have selected ladder logic as main programming method. In modern control systems they used relay but these are not used for logic. Relay is a device that controls a switch using magnetic field. Relays are used as one power source close a switch for another power source, while keeping isolated.

When the start button is pushed, the motor starts hence the conveyor belt starts moving. When the bottle is under the solenoid valve, the bottle is sensed and the motor stops, and the conveyor belt stops. Then the solenoid valve operates and the bottle starts filling the water. When the bottle completes the filling process, the solenoid valve is closed and the motor starts, the conveyor belt starts moving and carries the bottle away from the solenoid valve. If another bottle is sensed then the above process will be repeated. When stop button is pressed or activated and the entire process will be stopped.

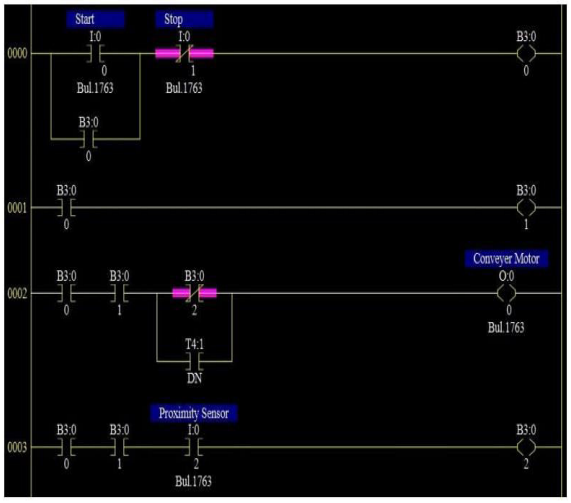

Fig 6: Ladder Logic Diagram

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V. CIRCUIT DIAGRAM

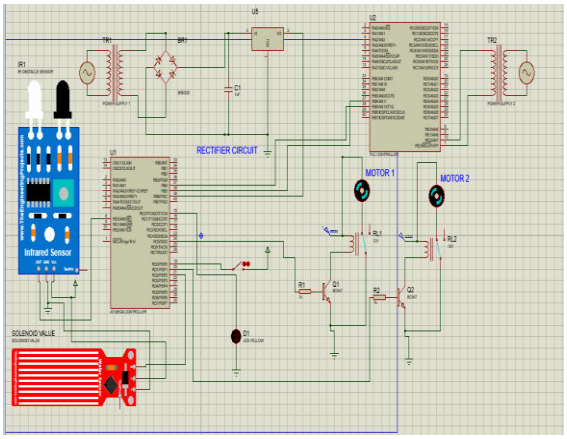

Fig 7: Circuit Diagram

VI. PROTOTYPE DESIGN OF PLC BASED AUTOMATIC BOTTLE FILLING MACHINE

Fig 8: Prototype Design

VII. LIMITATION

It can fill approximately one bottle at a time. The fluid is mainly handled mainly by the solenoid valve and the nozzle. So, the range of fluid types is limited. Positioning the solenoid valve is a critical issue and proper care is needed. Another disadvantage is no proper guidance for the bottle to move which causes vibration. Also,the time taken is long.

VIII. RESULTS

This system is able to fill 100ml bottles in 20seconds and the IR sensor used is able to sense the bottle and simultaneously the PLC is programmed in such a way that the solenoid valve allows the fluid from the tank to the bottle.

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.

IX. FUTURE WORK

By the installation of jet nozzle and strong solenoid valve, time to fill the bottles can be reduced and can efficiently increase productivity. A guide way could be used in case of vibration. A capping section could also be introduced. The nozzle positioning must be given more care and concentration. The system can be redesigned for increased bottle size and productivity.

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X. CONCLUSION

Automation systems are used to increase productivity, which in turn brings economic progress. The main purpose of PLC in automation is 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 has been applied to the automatic bottle filling system and the performance has been measured. The entire system is more reliable, time saving and user friendly.

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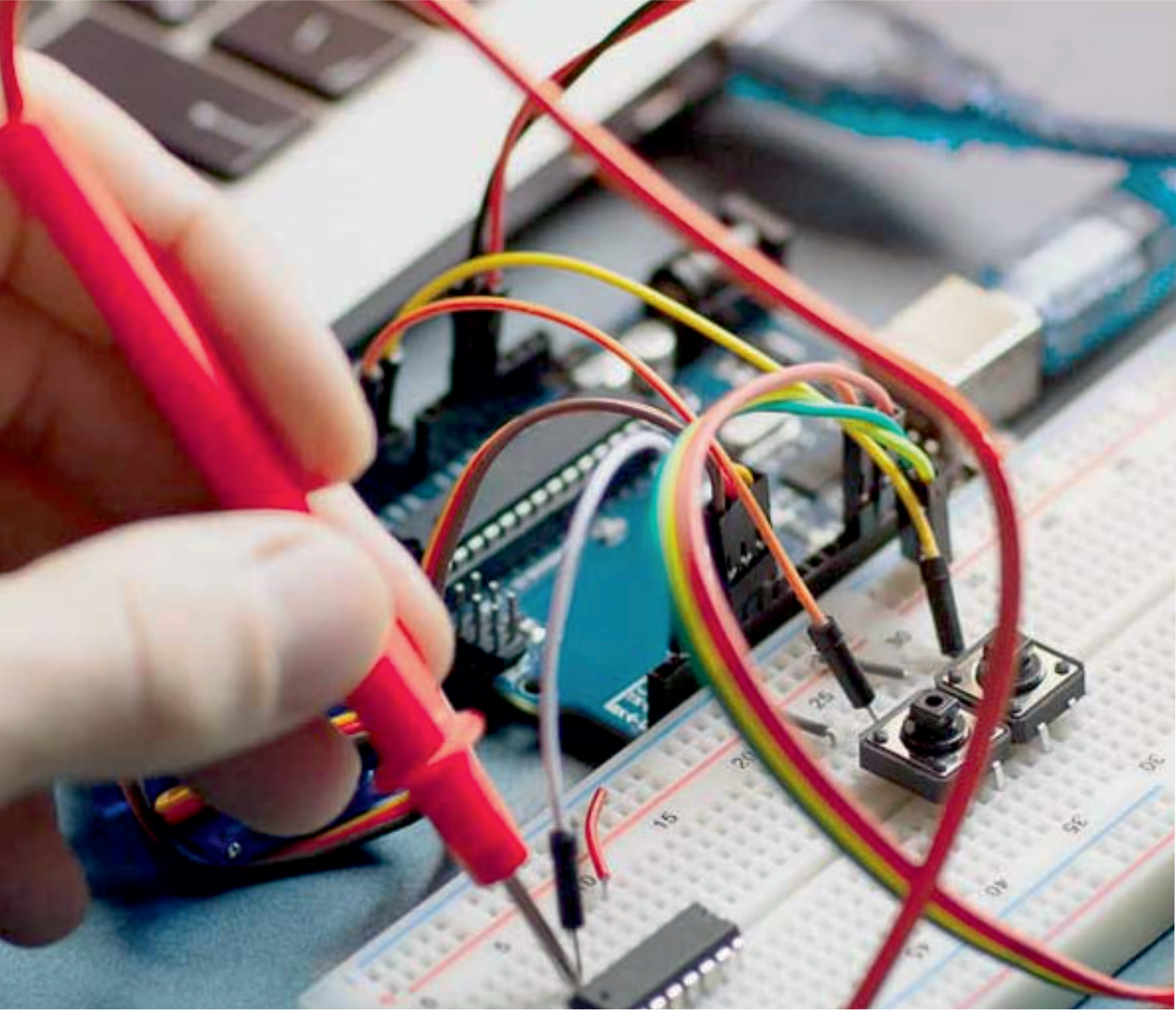

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