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Automatic Tablet Filler Using PLC

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Abstract— The project entitled "Automatic tablet filler using PLC" is an automating tablet filling processes in pharmaceutical companies. It differs from present tablet filling machines used in the industries in various aspects such as sensors, valves, conveyor belt, motor and PLC logic being used currently throughout the industries. This project focuses on automatically filling the tablets into the selected bottles using PLC ladder logic. It requires no human intervention during the tablet filling process once bottle is loaded manually at starting point on the conveyor. It is highly efficient and reliable system of tablet filling which will reduce the overall cost at great extent. It is user friendly and non-hazardous for workers who will be working in the vicinity of installed system.
Keywords— Programmable Logic Controller (PLC)

I. INTRODUCTION

As we know that PLC is widely used in the industries for controlling and automating the repetitive tasks and processes. Automation technology has revolutionized the industries and its way of handling the production systems. There are numerous number of filling machines used for various materials like powder filling, water filling but this project has been develop for filling tablets into bottles and hence called automatic tablet filler. Conventional way of tablet filling process is time consuming and inefficient if observed. This project has implemented PLC ladder logic to control the tablet filling machines in more efficient way. It uses different sensors, valves, motor and conveyor belt for hardware integration.[1] The project consists of three main parts which has been designed and integrated to complete the system at reasonable cost. The three basic elementary parts of the system are conveyor system , Filling station and feeding section called hopper.[2] This project is a good example where almost all elements of automation has been integrated to develop the system. This project is complete integration of electrical, mechanical, control system and computer system. In brief this system of tablet filling is boon for medicine industries where a lot of attention and precautions are to be taken to complete the filling task. Same thing has been achieved by this project in more easier and efficient way. This project automatically carries the bottle at filling station where desired numbers of tablet will be filled from hopper and process will be repeated for selected number of iterations. This is simple application of PLC in tablet filling process which will reduce the cost of production at great extent in coming future.[3]

II. EXPERIMENTAL DETAILS

A. Ladder Logic Implementation

When push start button is pressed it turns on the motor which drives the conveyor belt with bottle up to the filling station. For the continuous movement of conveyor, output of the motor is latched in parallel with start push button. Proximity Inductive sensor or object sensor detects the presence of bottle as a result of which after 1 sec of delay by timer activates the solenoid or electromagnet, as a result of which motor gets switched off. It is followed by opening of the hopper nozzle and filling the tablets into the bottle. [4]Through beam sensor counts the number of tablets falling and when it matches with preselect value as set by counter solenoid gets switched off. A delay of 1 sec will occur and then motor will restart to carry the bottle away from the filling station. Motor will run for period of 5 sec before getting stopped again and cycle will repeat for selected number of iterations.

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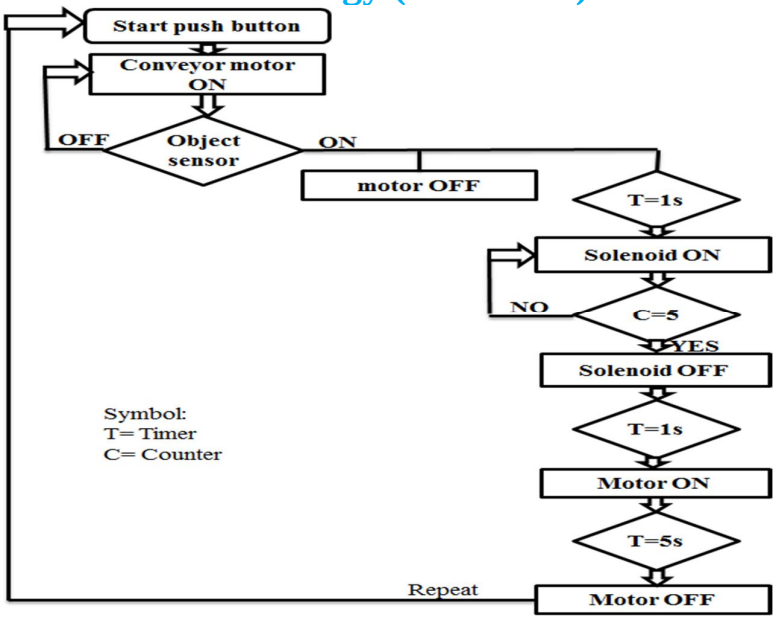

Flow chart 1: Ladder logic diagram for sequences of operations

B. Working Methodology Of System

When start pushbutton is pressed motor will start running which will drive the conveyor belt with bottles up to tablet filling station. When it reaches filling station inductive sensor detect the presence of bottle and a signal is passed which will stop the motor. Then solenoid valve open the nozzle of hopper to fill the tablet into the bottle for preselected value of counts. After filling process motor again start to carry next bottle at filling station and this cycle repeats during entire tablet filling process.[5]

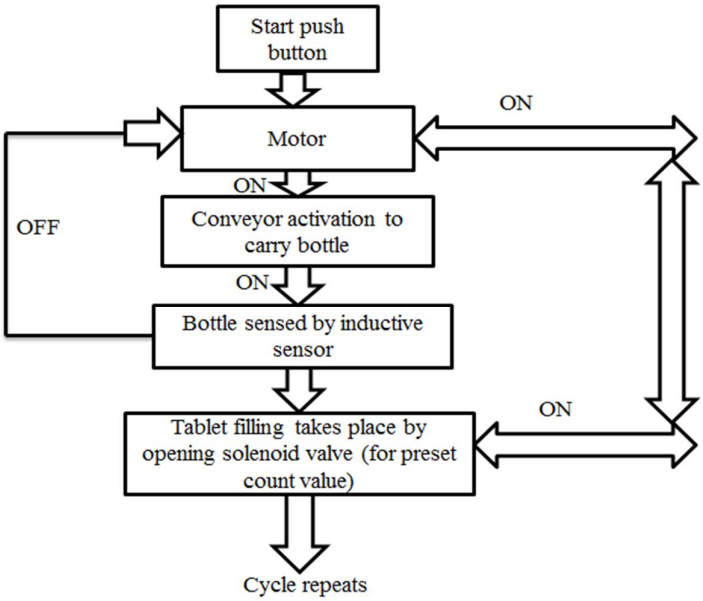

Fig. 1: Functional blocks of system

III.RESULTS AND DISCUSSION

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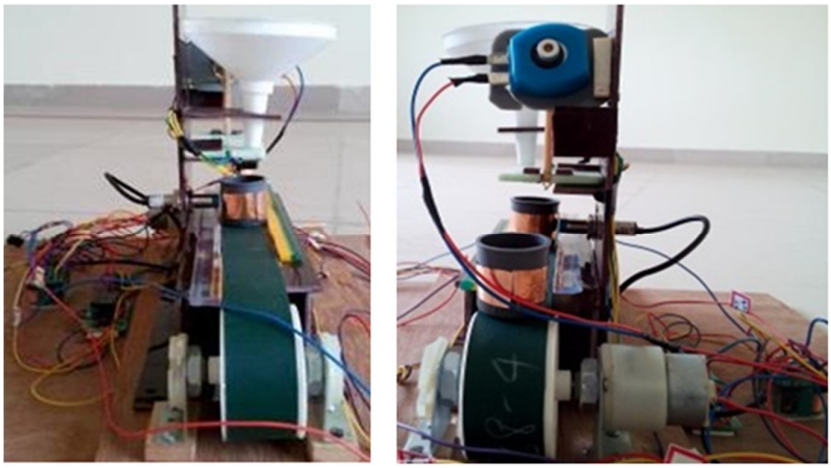
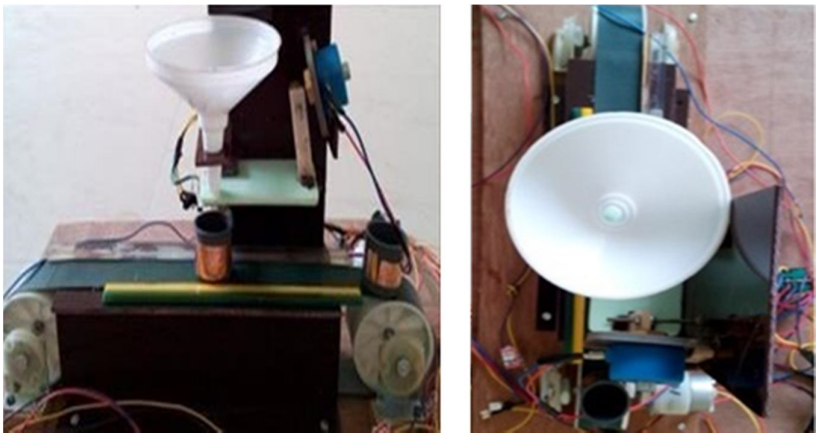
A. The Prototype



(a). Left side view (b). Right side view



(c). Front view (d). Top view

Fig. 2: Model from different viewing angles

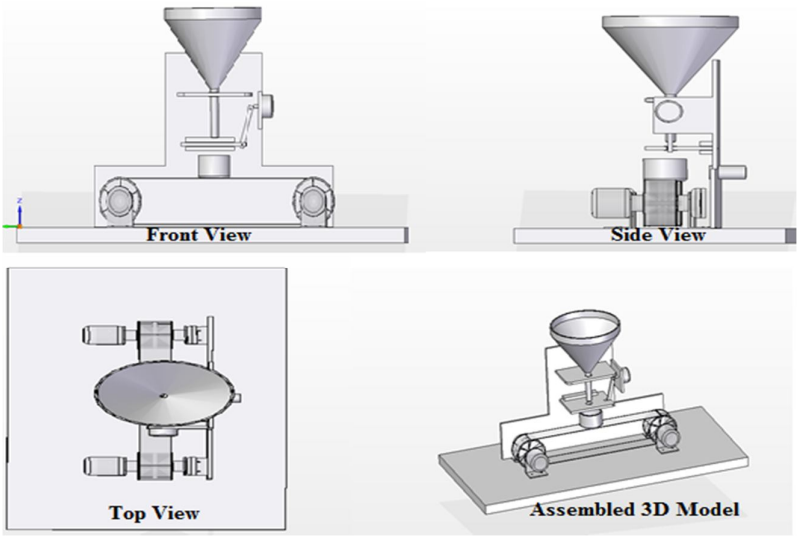


Fig. 3: 3D Model of the prototype

B. Tablet Filler Connection with PLC

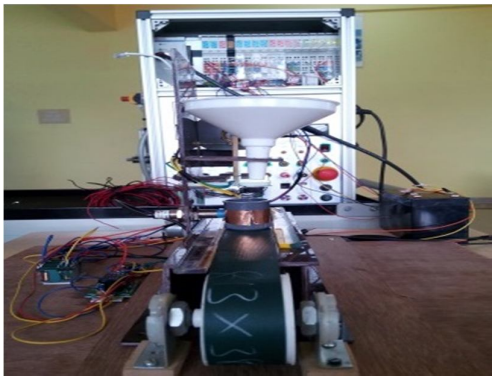


Fig. 4: Tablet filler interfacing to indralogic-10 PLC

This stage of connection is very important in aspect that system is going to be operated for desired sequences of operations. Before making this connection it has been being ensured that all inputs and outputs connection to the PLC is correct.[6] After making the connection two major objectives first one detecting presence of bottle using sensor and finally filling operation has been done successfully. During this final stage of connection sensors output can't be given as a input to the PLC directly because it runs on 24V DC power supply. Therefore a signal conditioning circuit is used which will modify the outputs in such a way that it can be given to PLC. To ensure the safety of PLC the inputs are connected through the relay driver circuit.[7] It means inputs are connected to common terminal of PLC which prevents it from damage.

C. Bottle Sensing Mechanism

It is achieved using the inductive sensor. Bottle used in project is of plastic material but inductive sensor detect metallic object only. To overcome this problem a thin film of copper sheet is wrapped around the bottle to ensure that it gets detected by the inductive sensor.[8] To make the project cost effective it has been done otherwise capacitive sensor is best available option for detecting the plastic material. When bottle reaches filling station that in front of inductive sensor, current starts to flow through the copper sheet wrapped around the bottle as a result of which a new magnetic field is generated in the vicinity of inductive sensor which opposes the original magnetic field of the coil of inductive sensor. At this point a net magnetic field is generated which changes the inductance of the coil. Now this inductance is being measured to detect presence of different metallic material. In this project copper sheet is being detected which allow the bottle to stop at filling station.

D. Tablet Filling Operation

This operation fills the tablets from hopper into bottle. Bottle arrival at filling station activates the solenoid or electromagnet which opens the filling nozzle and tablets starts falling into bottle. Through beam sensor below the nozzle detects tablets falling into bottle and for each interrupted beam it sends signal to counter where pulses are counted for preselected value once desired value of tablets are matched (say count=5) then supply to solenoid it cut off as a result of which hopper opening gets closed and tablets stop falling into bottle. This operation is controlled by PLC ladder logic and desired delay in opening and closing of solenoid has been set for proper functioning.[9] After filling process get completed motor is switched on to carry the bottle away from filling station to ensure that next bottle is being loaded. Motor also starts and stop after selected delay duration for facilitating smooth movement of conveyor.

IV. CONCLUSION AND FUTURE SCOPE OF WORK

A. Conclusion

In this project by applying the concept of control system Automatic Tablet Filler using PLC is successfully designed and prototype is tested for the same, test results meet the expected results. All the hardware components like sensors, solenoid, motor, conveyor, and hopper are integrated successfully. PLC software called IndraWork Engineering is successfully implemented to control the hardware parts. Besides hardware integration software parts of the project like writing ladder logic diagram for running the system has been successfully completed. Indralogic-10 PLC has been successfully configured with the tablet filler machine to control the sequence of operations. Finally all the objectives have been achieved successfully and a

simple, compact and reliable tablet filling system is developed using PLC.

B. Future Scope of Work

The performances of the system can be enhanced if some of the electrical and mechanical components are upgraded. Modification done in the hardware parts design and features can increase the efficiency of the system.[10] This is all about eliminating the drawbacks and demerits present in the current system. Some of the major recommendations that can be taken into considerations in this project are:

In this project only one sensor is used to detect the presence of bottle at filling station. System performance can be enhanced if one more sensor is used at loading station. By doing this whenever bottle will be loaded it will be sense by the sensor and automatically motor will start and carry the bottle to filling station.

Buzzer alarm can be used for alert in case of system failure.

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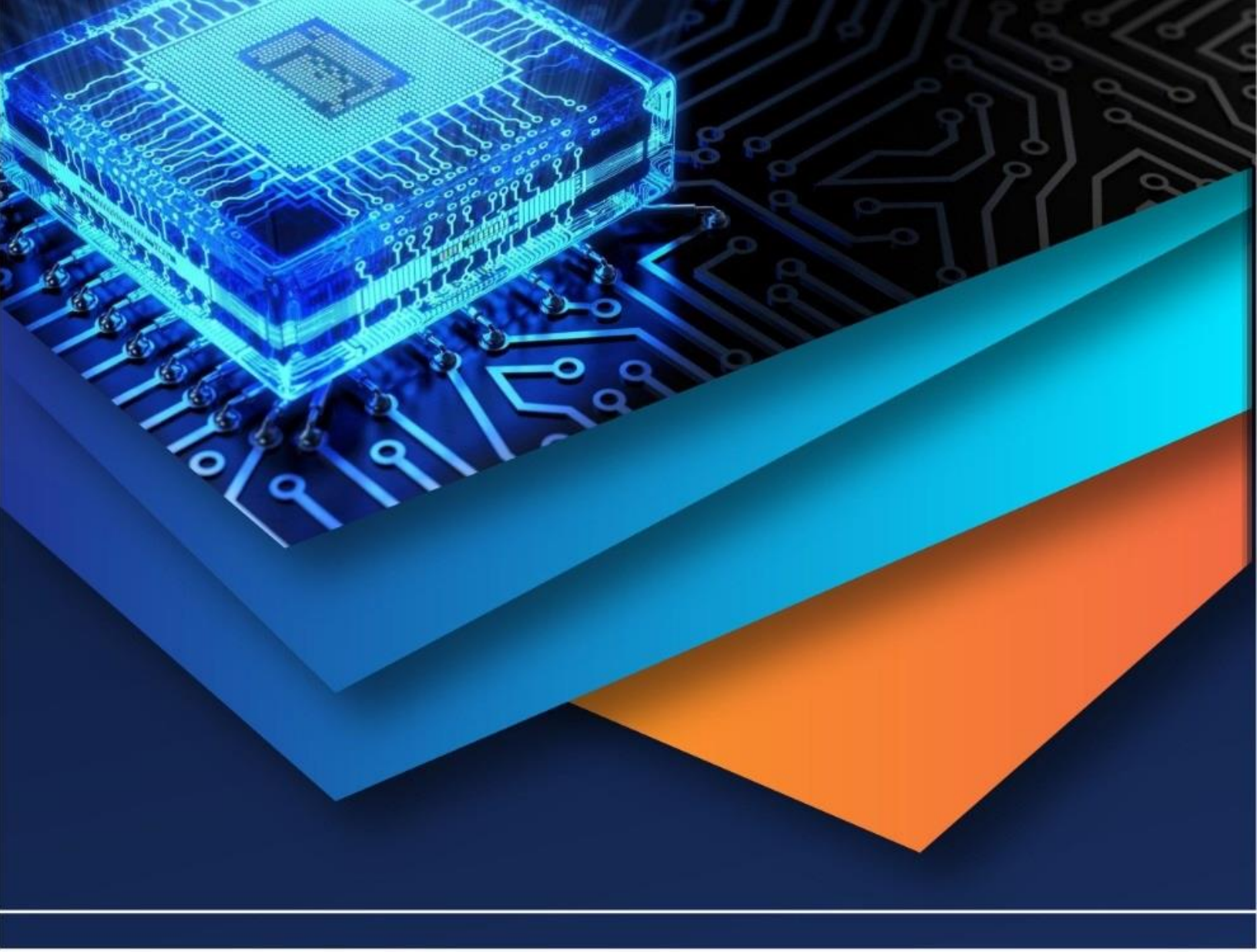

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