



PLC BASED CONTROL SYSTEM FOR AUTOMATIC CANDY PACKAGING

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ABSTRACT

In recent years automation can be seen in many applications. It has many advantages when compared to manual operations. One such important process is packaging. This paper gives a simple method for automatic candy packaging using a programmable logic controller. The process, methodology and components used are described briefly in this paper.

Key words:

Automation, Packaging, PLC, Siemens S7-200 Smart

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INTRODUCTION

Automation is a process that produces or delivers products and services with minimal human assistance. It can be applied in almost all industrial application. Food industry is one such application where automation can be implemented. It has improved the sealing, mixing, boxing, picking and packing operations that are carried out in food manufacturing process. It ensures high production rate, better quality product and removes human error. This paper proposes a simple method for automatic candy packaging using a Programmable Logic Controller (PLC). Siemens S7-200 Smart PLC is used in this process.

Packaging

Packaging is one of the essential process in an industry. It is used to protect the material from dust or other objects that will harm the product. The packed product is used for storage, transport and sales. [2] The manual packaging process has many disadvantages. It is costly and requires many workers. To overcome the disadvantages, automation is implemented in packaging process. [5] This paper is aimed for automatic candy packaging. The individual candies are packed inside a box using PLC.

Programmable Logic Controller

PLC is a computer control system that monitors the input and controls the output devices based upon a customized program.

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It is developed in the 1960s to replace the hardwired relay logic. The processor, power supply and input/output modules are the three main parts of a PLC. [3]

The following are the advantages of PLC.

1. Easily programmed and reprogrammed
2. Smaller in size than relay circuits
3. Timers and counter functions can be easily implemented
4. Suitable for all environments
5. Easy maintenance [4]

The Siemens Simatic S7-200 Smart PLC is used for automatic candy packaging. The Step 7- Micro/WIN SMART software is used to implement the logic for this PLC. The technical specification for CPU SR20 is tabulated below.

Table 1 Technical specification of Siemens Simatic S7-200 Smart PLC

Features	CPU SR20
Dimension (mm)	90 x 100 x 81
User memory	12 KB (program) , 8 KB (data memory) , 10 KB(retentive memory)
Expansion modules	6
Voltage range	85 – 264 V AC
Number of ports for communication	1 Ethernet port, 1 serial port (RS 485), 1 additional serial port(RS 232/RS485)

METHODOLGY

The proposed idea is to pack single piece candies into a larger packet or box using PLC with no manual operation. [1] There are two conveyors. The first conveyor is for the single candies and the second conveyor has the empty box where the candy

has to be packed. DC motor is used to control the conveyors. A capacitive proximity sensor is used to sense the empty box and gives a single indicating the arrival of the box. A photo sensor is used to detect the arrival of candies in the first conveyor. The PLC controlled counter coupled with the photo sensor gives the number of candies to be packed in the box. The process is continued until the stop button is pressed.

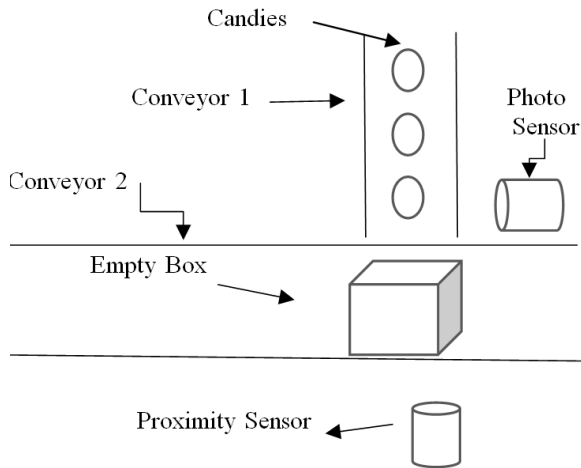


Fig 1 Block Diagram of the proposed method

Components Used

The components required are listed below.

1. Conveyors
2. DC motors
3. Photoelectric sensor
4. Capacitive proximity sensor
5. Siemens S7-200 PLC
6. Single piece Candies
7. Empty box

DC Motor

DC motor plays an important role in many industrial applications. It is coupled with a DC drive and used to control conveyors and material handling. [6] Two DC motors are used. The motor is mounted with a pulley to rotate the conveyors. The conveyor 1 brings the single piece candy for packaging and conveyor 2 brings the empty box to the desired position.

Photoelectric Sensor

The photoelectric sensor is used to detect the arrival of the single candies in the first conveyor. It consists of a light transmitter (infrared) and receiver. The receiver detects the emitted light and according to the amount of light changed the candies are detected.

Capacitive Proximity Sensor

This sensor is used to detect the empty boxes or plastic bags without any physical contact. The capacitance changes when the object is present. This property is used to detect the presence of the object. The capacitive sensor can detect plastic wood or any other raw material. The empty box can be made up of plastic wood or any material according to the user demand.

PLC Ladder Diagram

The Step 7-Micro/WIN Smart software is implemented for this PLC. The program is written in ladder diagram and gives the logic for the process.

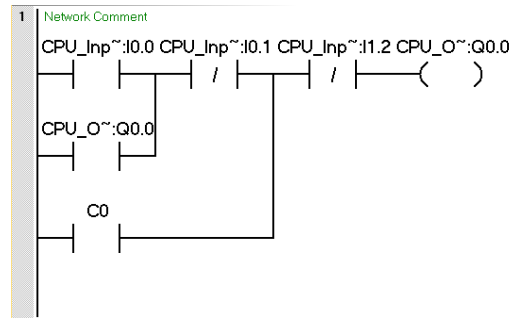


Fig 2 Network 1

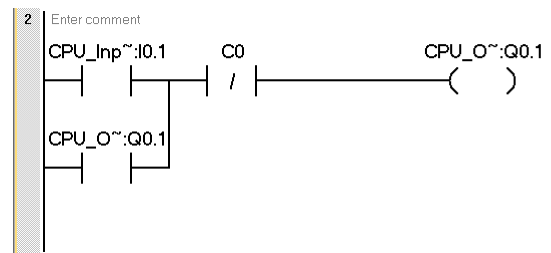


Fig 3 Network 2

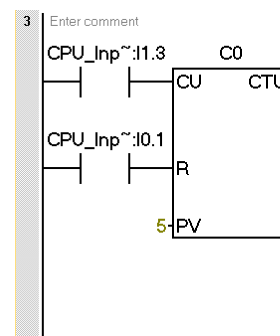


Fig 4 Network 3

Table 2 Description of the switches in ladder diagram

Name	Description
I0.0	Start Switch
I0.1	Proximity Sensor
I1.2	Stop Switch
I1.3	Photo Sensor
C0	Counter
Q0.0	Conveyor 2
Q0.1	Conveyor 1

When start switch is pressed, conveyor 2 is on and proximity sensor is on. When proximity sensor detects box, conveyor 2 stops, conveyor 1 is on, photo sensor and counter is on. When count reaches five, the conveyor 1 stops and conveyor 2 is on. The process is repeated until stop switch is pressed.

CONCLUSION

This paper proposes a very simple method for candy packaging. Additional features can be added according to the user requirement. The PLC can also be connected to a SCADA or HMI screen to control and monitor the process.

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