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Developing Program Code for Automatic Color Code Sensing Punching Machine Using WPL Software

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ABSTRACT- This paper presents the idea of developing a logic or program code for an Automatic Color code sensing and punching machine which is driven based on Pneumatic architecture and can be used at the packing section in industries where the end user can punch labels on the objects which are moving on the conveyor based on their color. The program code basically controls the Pneumatic valves present in the system which actuates the Cylinders and helps in clamping and de clamping of moving objects and henceforth achieving the label at required spot, whereas the desired color is acquired from the dedicated color sensor which helps in deciding the labeling process.

This paper uses the advanced industrial controller (PLC) software called WPL Soft which is the most widely used tool in industries. This software requires a dedicated programming language called Ladder diagram, which is the 80% preferred programming language worldwide for programming PLCs. A program has been developed for automatically creating the application for color sensing and punching label on the desired objects based on color.

I. INTRODUCTION

A. Description

The pneumatic system has gained a large amount of importance in last few decades due to its accuracy and cost. This convenience in operating the pneumatic system has made us to design and fabricate in this project. This unit can be operated easily with semi-skilled operators.

The pneumatic press tool has an advantage of working in low pressure, that is even a pressure of 6 bar is enough for operating the unit. The pressurized air passing through the tubes to the cylinder, forces the piston out whose power through the linkage is transmitted to the punch. The work piece thus got is for required dimensions and the piece can be collected through the land clearance provided in the die. The die used in this is fixed such that the die of required shape can be used according to the requirement. This enables us to use different type punch dies resulting in a wide range of products. Different types of punch as requirement can be thus got. According to the work material the operating pressure can be varied.

In this project the image sensors are used to avoiding the mistakes. The system automatically stops, when the image sensor detecting the any color difference of the component inside the machine [1].

The press is the automatic punching machine tool designed to punch letter or rivet metal by applying mechanical force or pressure. The metal is punched or riveted to the desired requirement. The presses are exclusively intended for mass production and they represent the fastest and more efficient way to form a metal into a finished punched or riveted product. Press tools are used to form and cut thin metals. There are Nemours types of presses in engineering field, which are used to fulfill the requirements. We are interested to introduce pneumatic system in presses. The main function of pneumatic press is to form or cut thin sheet metals or non-metals using pneumatic power. In this project we have used to punching process for simple application.

B. Working Principle

The compressed air from a compressor is used to press the work by means of the piston and piston rod, cylinder through a solenoid valve. The high pressurized air striking against the piston tends to push it upwards. This force is transmitted to a punch by means of a valve by its mechanical advantage. The punch forced downward pierces the work material. This is the main principle of the unit.

The compressed air from the compressor at the pressure of 2 to 7 bar is passed through a pipe connected to the Solenoid Valve with one input when the image sensor unit in normal condition. The DC valve (Solenoid Valve) is actuated with input power. The 5/2 Solenoid Valve has one input port, two output ports and two exhaust port. This solenoid valve is controlled by the electronic control timing unit.

The solenoid valve is in ON position; the compressed air pushes the pneumatic cylinder piston downward to punch the work piece forcedly. The solenoid valve in OFF position, the compressed air pushes the pneumatic cylinder piston upwards due to the high air pressure at the bottom of the piston. This solenoid valve ON/OFF signal is controlled by the control unit

The die used in this is fixed such that the die of required shape can be used according to the requirement. This enables us to use different type punch dies resulting in a wide range of products. Different types of punch as

requirement can be thus got. According to the work material the operating pressure can be varied.

The punch is guided by a punch guide who is fixed such that the punch is clearly guided to the die. The materials are in between the punch and die. So, as the punch comes down the materials are sheared to the required profile of the punch and the blank is moved downwards through the die clearance. When the piston is at the extreme point of the stock length, the exhaust valve is opened and the air is exhausted through it and the pressurized air come in at the top of the piston and it pushes the piston downwards. Now the piston reaches the bottom point of the required stroke length. Now the material is fed and the next stroke of the piston is made ready. When the material is correctly positioned then the switch button is again actuated and the process repeat itself. The correct position of the material is detected by the image sensor sensing by the color of the component.

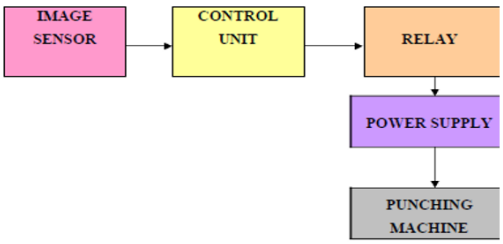

Figure 1: Black Diagram [1]

II. SENSORS

A. Introduction

There are numerous definitions as to what a sensor is but I would like to define a Sensor as an input device which provides an output (signal) with respect to a specific physical quantity (input). The term “input device” in the definition of a Sensor means that it is part of a bigger system which provides input to a main control system (like a Processor or a Microcontroller).

Another unique definition of a Sensor is as follows: It is a device that converts signals from one energy domain to electrical domain. The definition of the Sensor can be understood if we take an example in to consideration.

The simplest example of a sensor is an LDR or a Light Dependent Resistor. It is a device; whose resistance varies according to intensity of light it is subjected to. When the light falling on an LDR is more, its resistance becomes very less and when the light is less, well, the resistance of the LDR becomes very high.

We can connect this LDR in a voltage divider (along with other resistor) and check the voltage drop across the LDR. This voltage can be calibrated to the amount of light falling on the LDR. Hence, a Light Sensor.

B. Classification of Sensors

There are several classifications of sensors made by different authors and experts. Some are very simple and some are very complex. The following classification of sensors may already be used by an expert in the subject but this is a very simple classification of sensors.

- They are divided into Active and Passive. Active Sensors are those which require an external excitation signal or a power signal. Passive Sensors do not require any external power signal and directly generates output response.
- The other type of classification is based on the means of detection used in the sensor. Some of the means of detection are Electric, Biological, and Chemical, Radioactive etc.
- The next classification is based on conversion phenomenon i.e. the input and the output. Some of the common conversion phenomena are Photoelectric, Thermoelectric, Electrochemical, Electromagnetic, Thematic, etc.
- The final classification of the sensors is Analog and Digital Sensors. Analog Sensors produce an analog output i.e. a continuous output signal with respect to the quantity being measured. Digital Sensors, in contrast to Analog Sensors, work with discrete or digital data. The data in digital sensors, which is used for conversion and transmission, is digital in nature.

C. Types of Sensors

The following is a list of different types of sensors that are commonly used in various applications. All these sensors are used for measuring one of the physical properties like Temperature, Resistance, Capacitance, Conduction, Heat Transfer etc.

- Temperature Sensor
- Proximity Sensor
- Accelerometer
- IR Sensor (Infrared Sensor)
- Pressure Sensor
- Light Sensor
- Ultrasonic Sensor
- Smoke, Gas and Alcohol Sensor
- Colour Sensor

D. WPL Software

The software DELTA WPLSoft is developed by DVP programmable logic controllers. This is the official software used to create and simulate the ladder diagrams which are dumped in Delta PLC’s. For this, the WPLSoft is to be installed in the laptop. And the software is opened. By clicking on the file button, we can create new file and then the ladder diagram is generated according to our requirement.

The tool bar in the WPL soft is shown in the below figure 2 and some of the useful tools are explained.

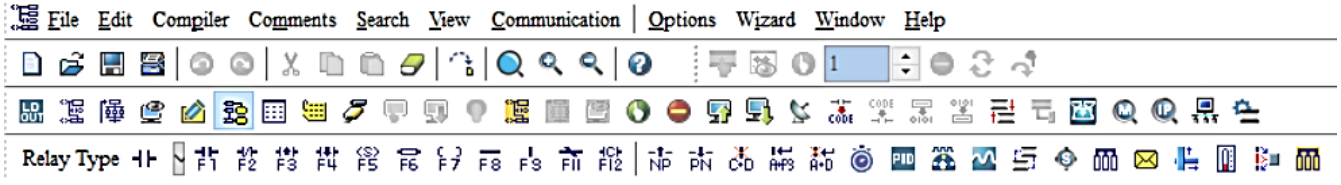

Figure 2: Tool bar in WPL Software

E. Tool bar in WPL Soft

Now the toolbar is explained in detail. In the figure 3(a) and 3(b), first row is used to create a new file, to edit a ladder diagram, to compile the ladder diagram, to add comments, to view the comments, to see the options and to be helped regarding a key in the entire tool bar.

In the third row, we can switch between the different programming languages; we can add or see comments. To simulate a ladder diagram, after entering the ladder diagram the ladder diagram needs to be compiled. And then, the program is converted into online mode. Then the simulator is set to run to get green color.

In last row, the inputs and outputs are given. Most used inputs are F1 for NO switch, F2 for NC switch, F8 & F9 for horizontal & vertical line extension. F7 for is used to add load in ladder diagram.

How to Start with Delta PLC:

- Click the delta PLC named as Delta WPL Soft icon in the desktop.
- Then a new page will be open as shown below.
- Then select a PLC model SA2 and then click ok. Then a blank page will be opened to enter the program. Then entered the program that to be run the project. In this chapter; WPL software description and process required to start the software has been explained and then ladder diagram takes place.

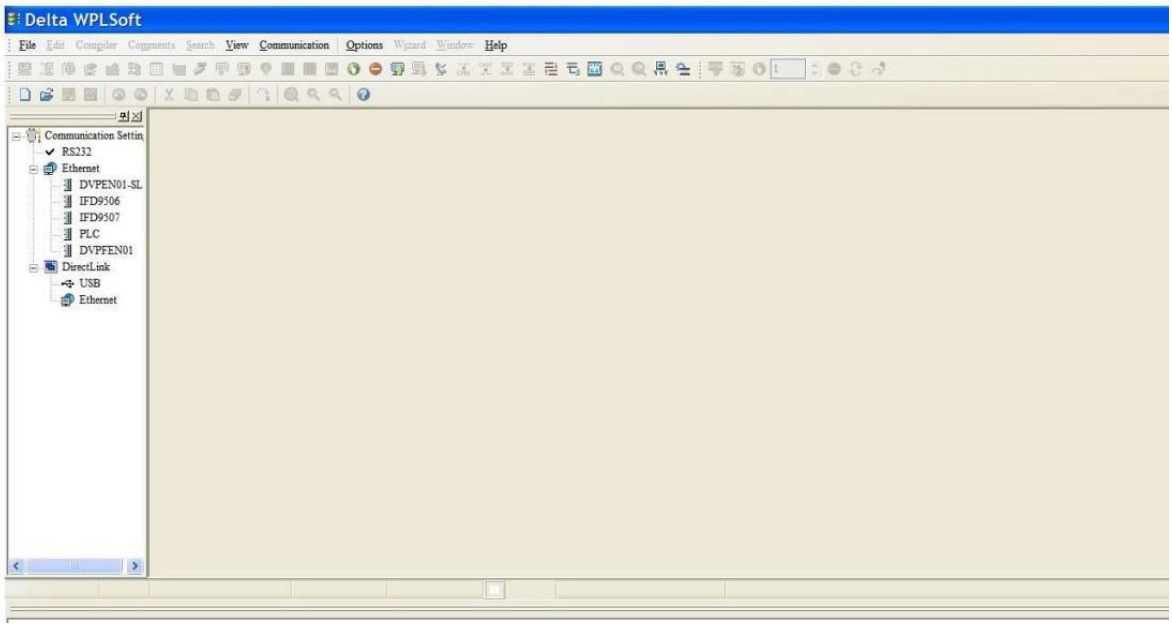

Figure 3 (a): Layout of WPL Soft

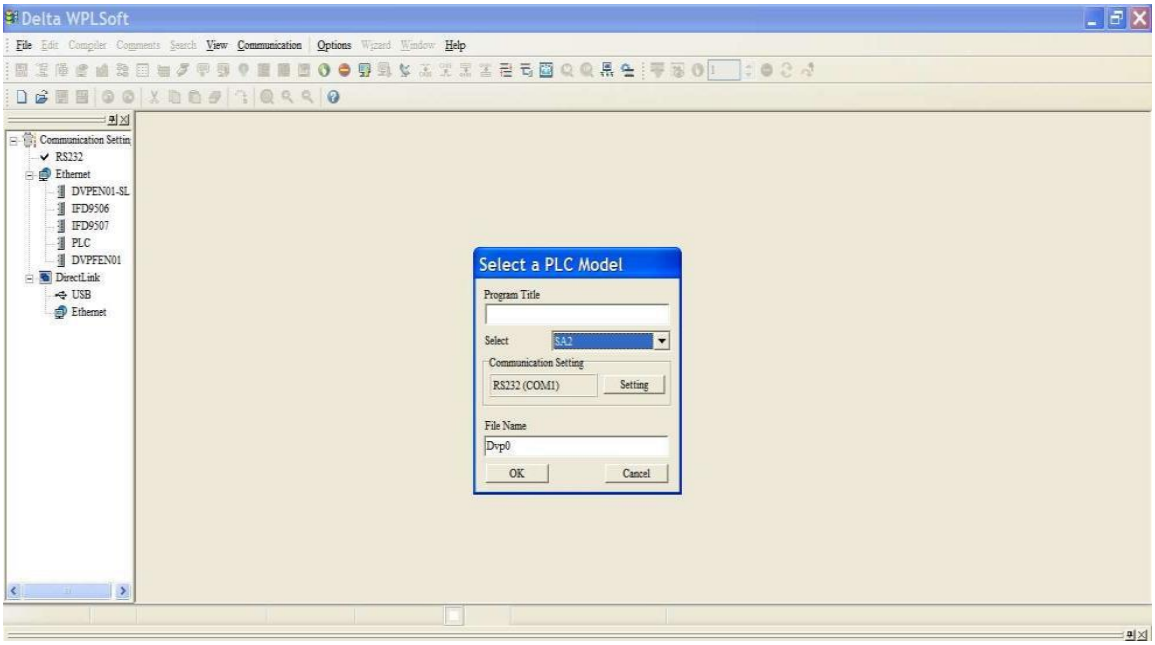

Figure 3 (b): Layout of WPL Soft

III. EXPERIMENTAL PROCEDURE

The work "Developing code for color code sensing punching machine (using WPL software)" has a following specific procedure.

It consists of a color sensor which is having two switches for indicating the on/off conditions and a pneumatic punching machine which is operated by a plc programming. For operation to perform the motor of the punching machine should be in on condition. Based on the output of the color sensor the color is detected and is then it is allowed to perform the punching operation. Before going into the punching operation, it follows certain procedure that is as soon as the color is sensed by the color sensor it gives the value of amount of color detected that shows number of same colors detected and allows the punching to get ready for the operation as the timer allows the punching machine to wait for a period of time for the color on conveyor to reach the punching machine as the specific time was given to each of the color. As the color reached to the punching machine reed switch will be activated and brings the pneumatic valve into action and allows the punching to take place once the punching is completed reed switch detects it and closes the pneumatic valve brings back piston of punching machine back to its normal position. similar kind of operation is performed for different colors based on their output.

A. Case Study-1

1) Detecting White Color

The condition for detecting white color is that the both switches of the color sensor should in OFF condition and the duplicate switch should in ON condition. The switch of motor should be always in ON condition (figure 4).

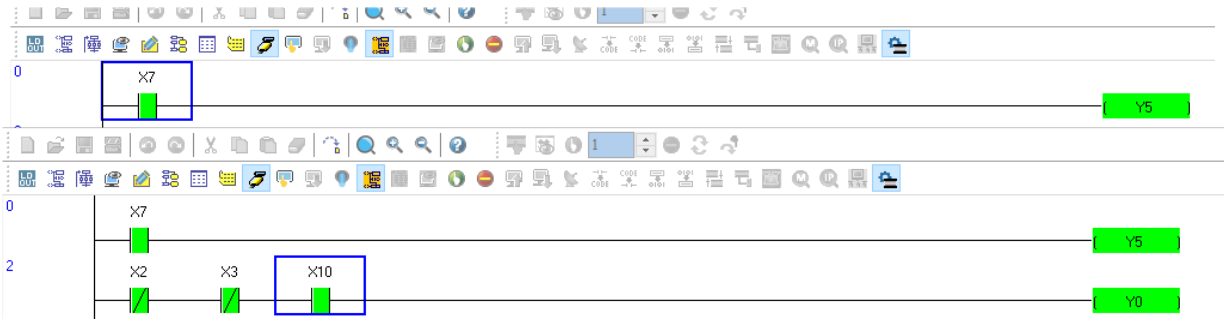

Figure 4: White Color Detection

B. Case Study-2

1) Detecting Red Color

The output condition for detecting red color is that the first switch of the color sensor should be in OFF condition and the second one should be in ON condition. As the color is once detected it sets the number of red colors detected and makes the punching machine ready by giving a specific waiting time for the conveyor to reach the punching machine once the color on the conveyor is reached to the punching machine reed switch which operates the pneumatic value gets involved and performs the operation (figure 5).

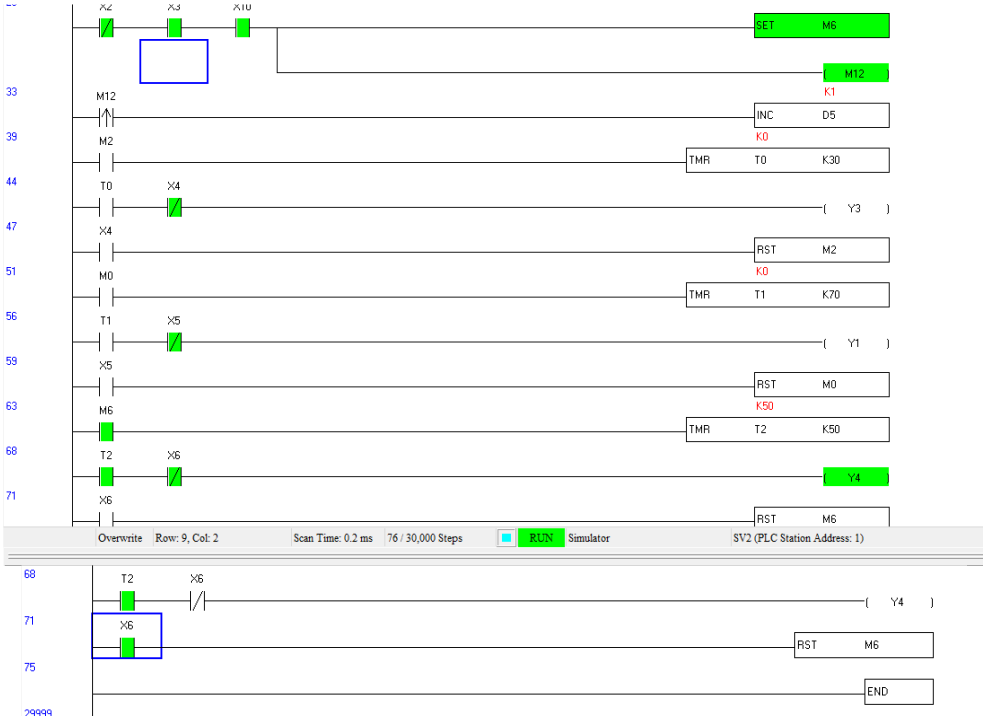

Figure 5: Red Color Detection

C. Case Study-3

1) Detecting Green Color

The output condition for detecting red color is that the first switch of the color sensor should be in ON condition and the second one should be in ON condition. As the color is once detected it sets the number of red colors detected and makes the punching machine ready by giving a specific waiting time for the conveyor to reach the punching machine once the color on the conveyor is reached to the punching machine reed switch which operates the pneumatic value gets involved and performs the operation(figure 6)..

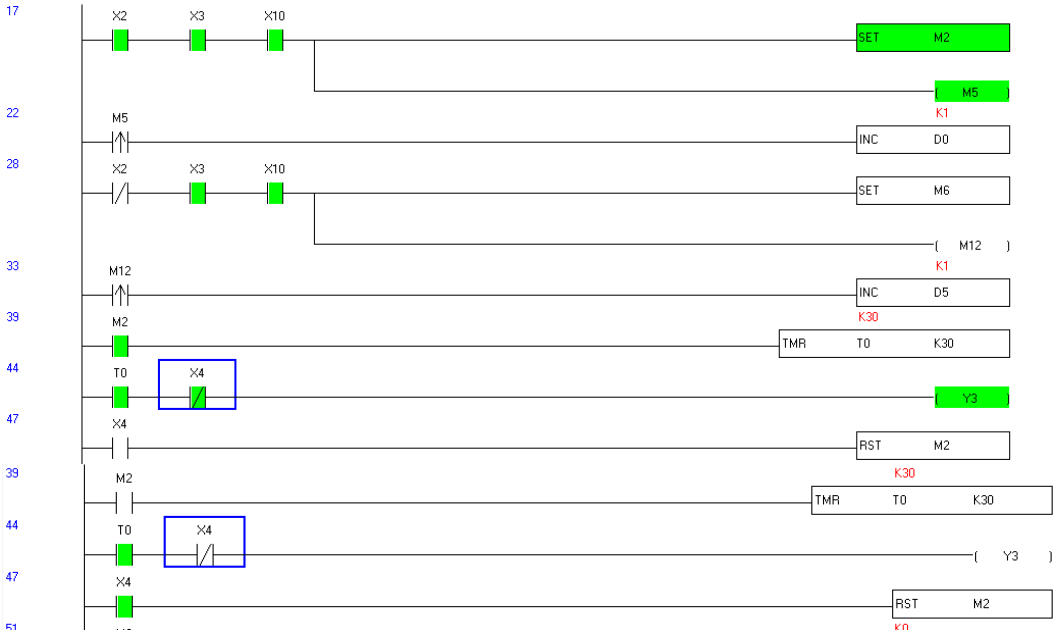

Figure 6: Green color detection

D. Case Study-4

1) Detecting Blue Color

The output condition for detecting red color is that the first switch of the color sensor should be in ON condition and the second one should be in OFF condition. As the color is once detected it sets the number of red colors detected and makes the punching machine ready by giving a specific waiting time for the conveyor to reach the punching machine once the color on the conveyor is reached to the punching machine reed switch which operates the pneumatic value gets involved and performs the operation. (figure 7).

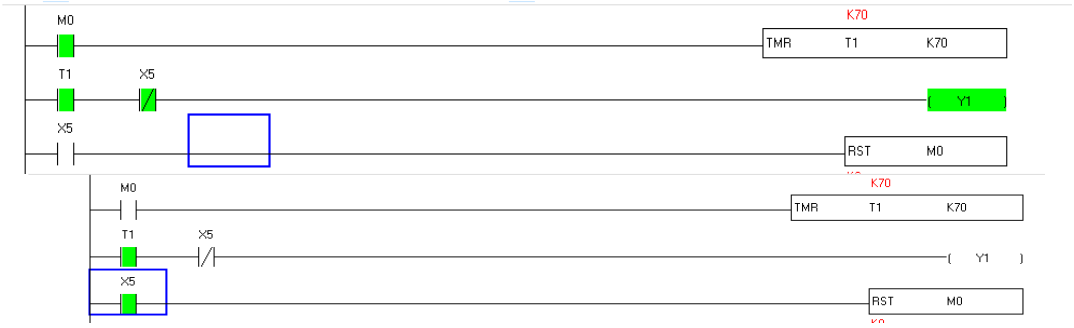

Figure 7: Blue color detection

IV. RESULTS AND DISCUSSIONS

Below ladder diagram(figure 8-10) describes the working of "automatic color code sensing punching machine" In this figure X7 is a switch to the motor which should be in on/off condition for starting/stopping. For the sensing of green color both the switches X2 and X3 should be in ON condition and temporary switch of X10 should be always in ON condition. Once the switches are ON the sensor detects the color for a period of time which is shown as INC (incremental) form and that can be seen D0 which indicates no. of green colors detected. As soon the color is detected the punching will in a SET condition for operation and it has to wait for a period of time so as to reach the conveyor. For wait of time the syntax given is TMR TxKy where TMR indicates the waiting time, Tx indicates the addressing, Ky indicates the period of waiting. As soon as the color reached to punching machine a reed switch named X4 will be activated valve opening takes place as P1and the process of punching takes place as the process completed reed switch will deactivate and the valve again goes to its normal position.

Similarly; for the conditions of blue and red colors the switches X2 and X3 should be in ON

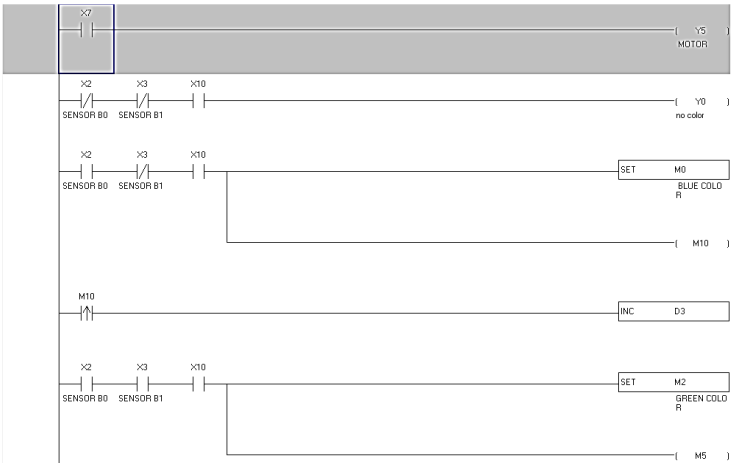

Figure 8(a): Automatic color code sensing punching machine

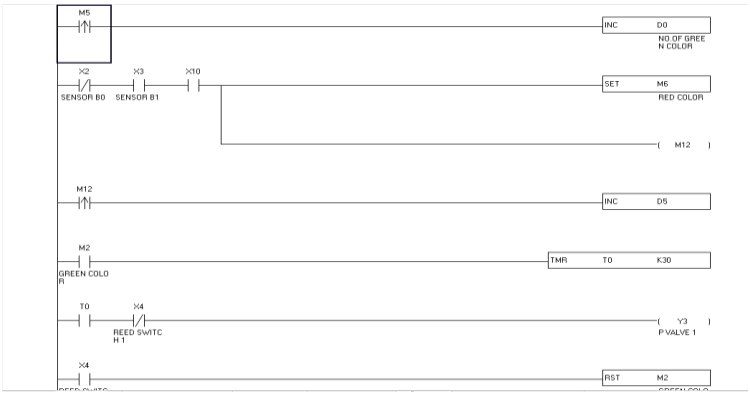

Figure 8(b): Automatic color code sensing punching machine

and OFF conditions and vice-versa and a temporary switch of X10 should be in ON condition. Once they are in ON condition the machines M0 and M6 will set ready for the operation and detects the color for a period of time which will be shown as D3 and D5. As the color reaches the punching machine the reed switch X4 will be activated and the valve will be opened and the process of punching takes place as soon as the process completed the valve closes and the reed switch

X7 = switch for the motor Y5 = stepper motor

X2 = sensor switch1 X3 = sensor switch2

X10= Duplicate switch for operation X4, X5, X6= Reed switch sensor

Y3, Y4, Y5= pneumatic valve M0 = Blue color

M2 = Green color M6 = Red color

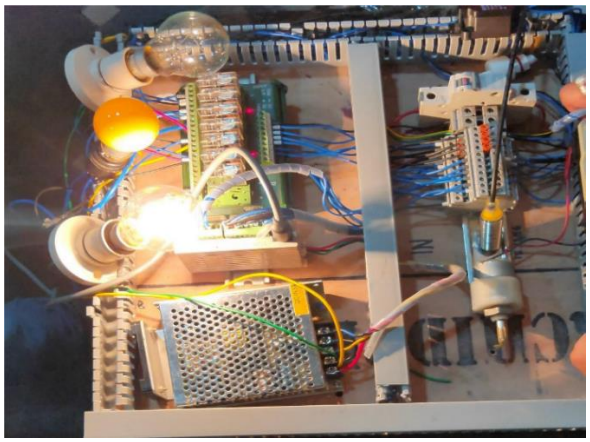

Figure 9: Blue Color Detection

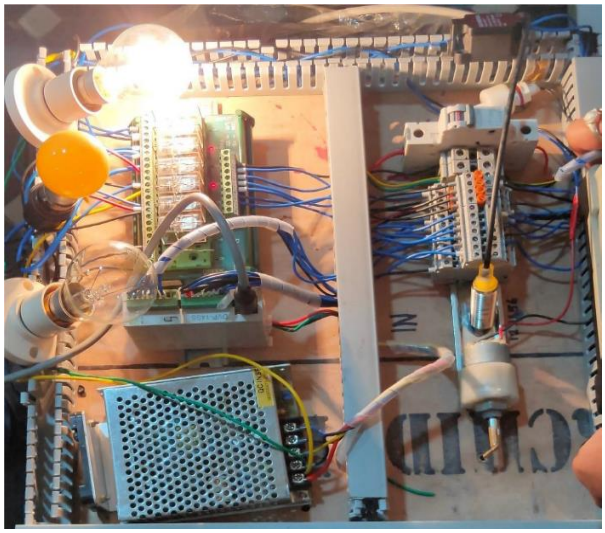

Figure 10: Red Color Detection

V. CONCLUSION

By this project we are concluding that, “an automatic color code sensing punching machine based on pneumatics and digital controller” which is generally used in packing systems and color sensing detections. This system is controlled by the PLC. In this paper a method of controlling the operations of punching machines is discussed. By using Programmable Logic Controllers as the controller of the system, good control over the system can be achieved, manufacturing lead time of the system can be reduced by developing automatic feeding mechanism and worker safety can be increased by reducing the human participation in the process.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest

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