# Automatic Sorting Machine

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**Abstract:** The automatic sorting system has been reported to be complex. Programmable logic controller used for the operation and the control of an industrial unnamed system, namely conveyor, pneumatic cylinders, solenoids. Thus, we have developed a system for sorting object with any metallic impurities using sensor and motor controlled by Programmable Logic Controller (PLC) and the conveyor in the system passes the object through sensors and hence sorting logic is decided. The research obtained shows that metals and red colors wood were sorted into their respective and correct position. The system can be implemented by choosing the desire colors which depend on the setup of the color sensor.

Keywords: plc, automation, cylinders, solenoids; color sensors

## 1. INTRODUCTION

Sorting is very important in any type of industry such as manufacturing processes. The main system is to sort the products manufactured in the Industry. The purpose of this research paper is to save the time and to reduce the human efforts in industry. An automatic sorting machine has main operation of sorting components according to the metals, nonmetals and colors. This consist of conveyor belt, proximity sensor, and color sensor, Pneumatic Cylinders and Solenoids, which reduces the efforts of material handling. A sorting machine is more practical and economical method of automation.

The design is quite simple and of flexible use, means only conveyor used for material handling. In this research work, we have developed a cost-effective automation system for sorting for any metallic impurity. The whole process is automatically with the help of PLC. Cylinders are used for pushing the object from the conveyor belt into the box. Conveyor belt brings the objects near the sensor and PLC is decided for select the materials and colors. The system consists of proximity sensor, color sensor, Omron sysmac PLC CP1E and conveyor belt. The metal defect is detected with the help of the proximity sensor. DC motor used for running the conveyor. The motor is interfaced with the PLC through relay cards. Sensor are above the conveyor. One sensor is mounted on the placing mechanism of the stacker lift. This sensor will detect the metal blocks and color blocks and then choose metals and colors blocks are kept in the box by the cylinder working with image processing, on the other hands, the database collection is the most challenging task. For database collection, it is necessary to collect the basic information about the crop and its diseases as the important task. Therefore, a detail study should be done on the types of disease, their symptoms on crop and the patterns of disease. By observing the patterns of disease, the system will get designed. The mainly occurring diseases on leaf are Bacterial disease, Fungal disease, Viral disease and diseases due to insects. The paper gives the detailing of these diseases [3].

## 2. COMPONENTS

### 2.1 Programmable Logic Controller System

A programmable logic controller (PLC) is an industrial computerized control system that continuously monitors the state of input devices and makes decisions based upon a custom program to control system the states of output devices. A fixed PLC is usually small, has little memory, and a limited number of input and outputs, or I/O as typically referred to Figure 1. The CPU, power supply, and I/O system are all constructed as a single entity [3].



Figure 1. PLC CP1E

The input sensing devices is fed to the input module which acts like an optical isolation. What is connected to the main device CPU and memory data. The monitor who acts like a programming device where it displays the given. This research paper is mainly device is used PLC controller because nowadays manufacturing products are very plentiful and more and more producing. Then the entire system is

connected to the output block where the output are the lamp, motor, etc [3].

## 2.2 Sensors

A metal sensor is an electronic instrument which detects the presence of metal nearby. Metal detectors are useful for finding metal inclusions hidden within the objects. The proximity sensor is shown in Fig. 2.



Figure 2. Proximity Sensor

Proximity (Metal) sensors are generally with four main elements:

- A coil and ferrite core assembly,
- An oscillator,
- A convertor/trigger circuit (detector), and
- Output device.

This sensor is used to differentiate between two colors red and green. The model of the sensor is E3FA DN12. This sensor is more useful than another color sensors because it system can be choice the desired colors depend on the position adjustment of the distance. The object is moving on the conveyor line is sensed by this sensor and it sent the signal to the PLC according to the wavelength produced by the reflected wave. The object is further sorted on the basic of the colors. The color sensor is shown in Figure 3.



Figure 3. E3FA DN12 Color Sensor

## 2.3 Geared DC Motor

65 RPM Side Shaft compact DC motor is suitable for small automation systems. Motor runs smoothly 18V and gives 65 RPM at 27W. Motor has 6m diameter, 13.5m length drive shaft with D shape for excellent coupling. This motor is suitable for this design because PLC controller is used 24 V DC. This voltage can reduced by using voltage regulator.

## 2.4 Pneumatics

In a pneumatic system, energy is stored in a potential state under the form of compressed air. Working energy (kinetic energy and pressure) results in a pneumatic system when the compressed air is allowed to expand. To perform any applicable amount of work then, a device is needed which can supply an air tank with a sufficient amount of air at a desired pressure. There are many different cylinder types [4].The cylinders used in this paper are listed below:

- Single acting spring return cylinder,
- Double acting cylinder,
- Directional control valves, and
- Four way valve.

The pneumatic cylinder is as shown in Figure 4.



Figure 4. Pneumatic Cylinder

## 2.5 Solenoid

A solenoid is a type electromagnet when the purpose is to generate a controlled magnetic field. If the purpose of the solenoid is instead to impede changes in the electric current, a solenoid can be more specially classified as an inductor rather than and electromagnetic [4]. The way pneumatic solenoid valve is shown in Figure 5.



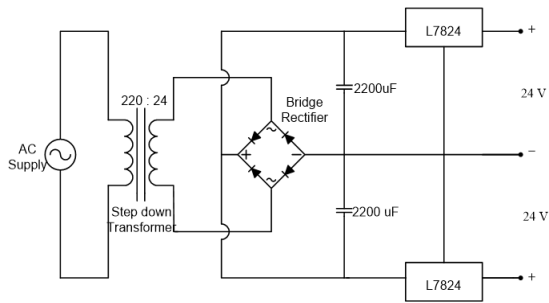Figure 5. 5/2 Way Pneumatic Solenoid Valve

Figure 6. Power supply of the solenoids

## 2.6 Circuit Function

The 5/2 way pneumatic valve has five connection ports and two states. It has one pressure port (P,1), two ports (A,2) and (B,4) that connect to the device that needs to be controlled, and two exhaust ports (EA,3) and (EB,5). The two states of the valve are [4]:

- Pressure port (P,1) connects to port (A,2),while port (B,4) vents through exhaust port (EB,5)
- Pressure port (P,1) connects to port (B,4), while port (A,2) vents through port (EA,3).

## 2.7 Design of Automatic Conveyor System

The main objective of the system is automatic sorting of materials which can be applied to industries. Here, by operating push button switch the conveyor starts to move and the items are being sorted. Design of the automatic sorting system is shown in Figure 7.



Figure 7. Design of the Automatic Sorting System

The color sensor and inductive proximity (metal) sensor are mounted on the model and are connected to the Omoron PLC kit. When the objects are detected by the color sensor the signal is sent to the PLC kit where according to the program ladder logic the conditions are analyzed and the output is given to pneumatic valves which activates pistons for sorting.

The metal detector is connected to Omoron PLC kit. The objects that contain hidden metal in them are detected and signal is sent to the PLC where according to the ladder logic, the objects are selected and put in the box from the conveyor by activating the pistons and hence carrying out the sorting mechanisms. We can consider the color of the objects, green, red and etc.

## 3. PROGRAMMING, OPERATIONS AND SEQUENCES

The flow chart of design automatic sorting machine for metals, non-metals and colors using PLC is shown in Figure 8. The block diagram is shown in Figure 9.
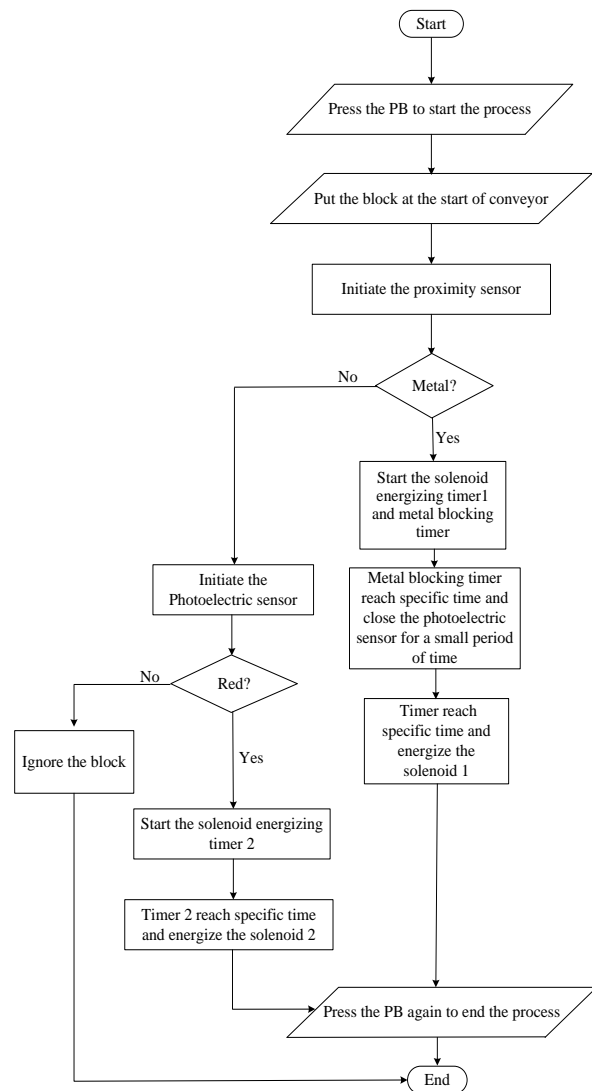


Figure 1. Block Diagram of the System

Figure 8. Flow Chart of Automatic Sorting Machine for Metals, Non-metals and Colors using PLC

In the flowing, for each device, are shown the programmed steps within the PLC.

- The conveyor belt is initiated, carried by the DC motor.
- Put the blocks of metals and wood color blocks, the machining piece are ejected by the cylinder on to the belt and conveyed.
- The metal sensor will detect any type of pieces traveling on the belt.
- And then the color sensor will detect the any color of wood travelling on the belt.
- The conveyor unit is initiated, by carrying the received piecce towards the sorting chute.
- The machining piece is transported under two sensors.
- Type A pieces are detected by the metal sensor which triggers the nearby piston, pushing the block.
- Type B pieces are detected by the color sensor which triggers the near the piston, pushing the piece down to slit 2.
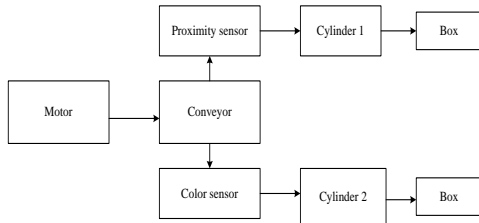
Figure 9. The Block Diagram of System

## 4. CONTROL UNIT

The control unit is composed of one push button for N.O and also use for N.C use by green color.All these items are shown in Fig. They are poower supply, Omron PLC (CP1E) , Connection , Relays and Cables.Although this structure is complexed, operation is good condition.This box is construced by hollow pipe of aluminium and optical fiber. The control board of system is shown in Figure 10. The circuit diagram of system is shown in Figure 11. The hardware configuration of the system is shown in Figure 12.
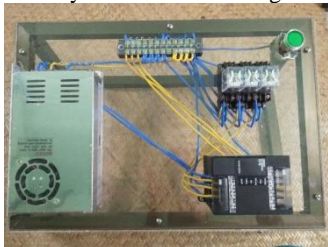

Figure 10. The Control Board of System

The operation of the control unit is the following.

- By pressing the geen button, the conveyor unit initiates and the DC motor begins to rotate.
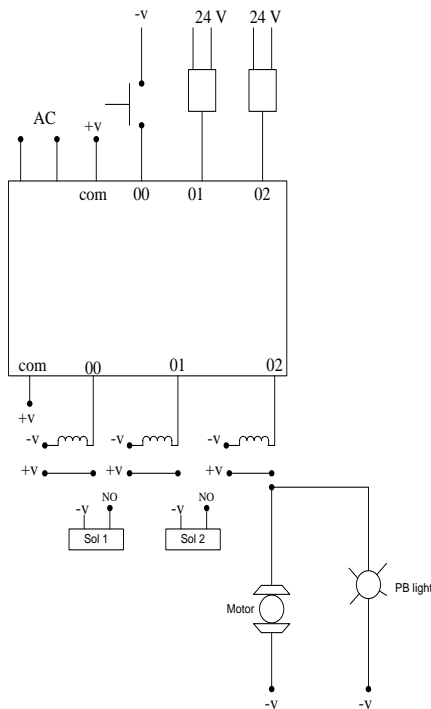- By pressing the this green button, the the conveyor unit will stop.


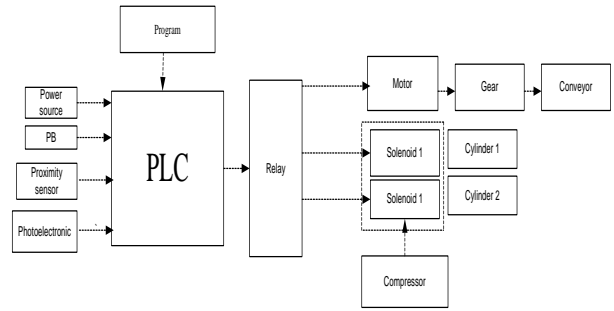Figure 11. The Circuit Diagram of System


Figure 12. The Hardware Configuration of System

## 5. PLC'S INPUT AND OUTPUT DESIGINATION

A complete analysis of the assembly, the necessary inputs were identified,thus setting the required number of controlled outputs of the PLC.Table 1 shows the designation of each inputs and that are used to collect data from its operation. Having established each input for the PLC , the program inside the controller was molded into altering the outputs according to the sequence of inputs received. Each step of the program is initiated by a certain input, or a consecutive set of inputs [5].

**Table 1. Table captions should be placed above the table**

| Process symbol | PLC input | Description |
|---|---|---|
| S0 | I 0.00 | Push button Start/Stop the process |
| S1 | I 0.01 | Proximity sensor sense the metal object. |
| S2 | I 0.02 | Photoelectric sensor sense the color |

**Table 2. Table captions should be placed above the table**

| Process symbol | PLC input | Description |
|---|---|---|
| K0 | Q 100.00 | Run the motor |
| Y1 | Q 100.01 | Active solenoid 1 and cylinder 1 push the metal block |
| Y2 | Q 100.02 | Active solenoid 2 and cylinder 2 push the desired color block |

# 6. SOFTWARE REQUIREMENTS

The main software is CX programmer software from the product of Omron trend. This software is cheaper than other PLC kit such as Siemens, Deltas. Easy to use and can choose suitable I/O ports. Among them the research paper is used CP1E model consists of 6 input ports and 4 output ports. This model is suitable and cost effective for any researcher. This software is shown in Figure 13.
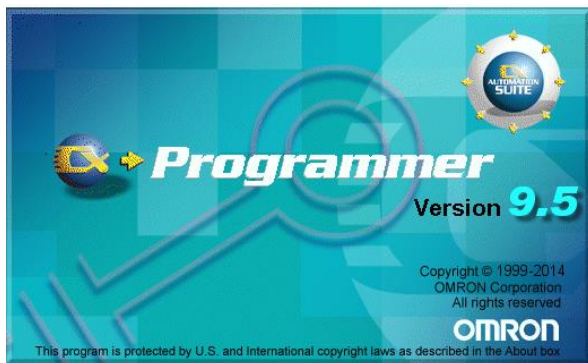


Figure 13. The Software of the CX Programmer

# 7. CONCLUSION

The research word presents a conveyor controlled unit application using a programmable logic controller.During the operation such a system is continuously changing its state due to various events that can be appeared. For a design engneer it is very important to identify all the possible states of the system in order to correctly program the behavior of the system in order to minimize the time needed to restore the operation [6].We have proposed a system which would increase the production rate and accuracy of material handling systems. The system whould segregate objects based on their type i.e metal or non-metal, color as required by the user. PLC with the frame of logic gates will make program modification easy and thus, we can modify the system according to the requirement [7].

# 8. ACKNOWLEDGMENT

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