PLC BASED SORTING OPERATION USING CONVEYOR SYSTEM

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Abstract:

In today's world of manufacturing industries the growth of production rate increases. And here sorting plays an important role on the basis of its colour, weight, shapes and so on. Finally, here we developed a Low Cost Automation for sorting the light weight objects on the basis of height variation which is controlled by Programmable Logic Controller (PLC) and the conveyor system passes the object in front of the sensor and thus sorting is decided.

Keywords: PLC, DC motor, conveyor belt,

IR proximity sensor, 5/2 solenoid valve

I. Introduction

The main task performed here is to sort the products manufactured in the company. The purpose of this project is to save the time and to reduce the efforts of the workers on material handling. An automatic sorting machine has main task of sorting components according to the height variation. A sorting machine is more practical and economical method of automation, which transfers the material to their respective place.

II. Literature survey

With the advent of liberalization and globalization, it is necessary that industries explore methods of enhancing automation and productivity to acquire greater competitiveness. In this regard Low Cost Automation (LCA) is a technology that promises to be very useful for any kind of manufacturing organization. Any manufacturing activity such as loading, feeding, clamping, machining, welding, forming and assembling can be subjected to LCA system adoption. Finally, many operations in food processing industries which used to be carried out under totally hygienic conditions can be easily through LCA system to sort boxes of different heights. We have used pneumatic power for this LCA system. This low cost automation system is controlled by programmable logic controller (PLC). Sensors are used to sense the height of boxes and actuate sensors and disc for sorting

III. Working principle

- Dc geared motor is used to drive the conveyor belt at low RPM (24), which carries the different size objects
- Medium size objects are being directly dropped into the bin at the other end of the conveyor belt.
- Large size objects are sensed by the infrared sensor simultaneously the vacuum gripper is starts to pick the object which is actuated by the vacuum generator and controlled by the two pneumatic cylinders(25*100mm), (32*200mm) bore diameter & Stroke length, and drop it in the bin.
- Here Programmable Logic Controller (PLC) plays a vital role in controlling the entire system according to the ladder diagram.

IV. Major components used

PLC

A programmable Logic Controller PLC or Programmable Controller is a digital computer used for automation of electromechanical process. The Programmable Logic Controller or PLC is an industrial computer design to run specific tasks quickly & efficiently. PLC is an user friendly microprocessor based specialized computer that carries out control functions of many types and levels of complexity.

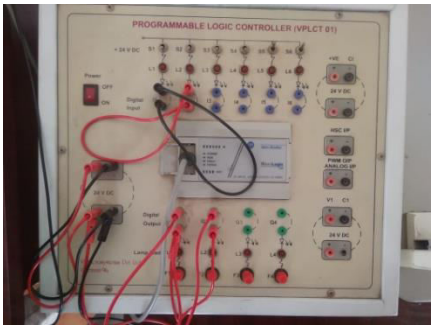

Fig4.1. PLC

Pneumatic cylinders

Double acting cylinders use the force of air to move in both extend and retract strokes. They have two ports to allow air in, one for outstroke and one for instroke.

*Fig 4.2 Pneumatic cylinder (25*100mm) & (32*200mm)*

Solenoid valve

5/2 way is a five port, two position valve that will put a fluid or air into one end of a double acting device as well as allowing the other end vent to exhaust. Zero Differentials are solenoid valves that can operate under zero head pressure (do need a differential pressure drop across the valve to work)

Fig 4.3 5/2 Solenoid valve

Vacuum generator

Vacuum generators operate according to the venturi principle. The compressed air flows from the pressure supply port into the outlet port.

Fig 4.4 Vacuum generator

The construction in the venturi nozzle increases the flow velocity of air to supersonic speed. After exiting the venturi nozzle, the air expands and flows through the receiver nozzle into the outlet port

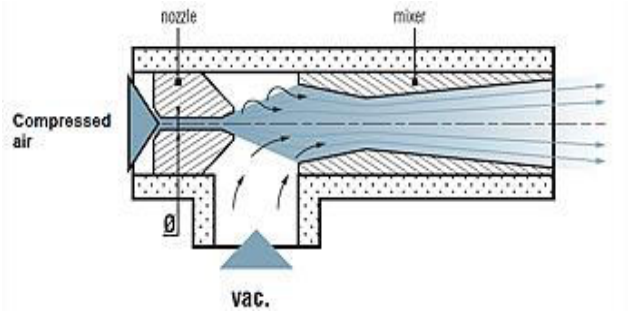

Fig 4.5 venturi effect principle

In this process a vacuum is created in the chamber between the venturi and receiver nozzle, which causes air to be drawn in from the vacuum port.

Vacuum suction cup

Vacuum cup or Suction cup is used as gripper by means of manual or automated method, which helps to move a wide range of materials.

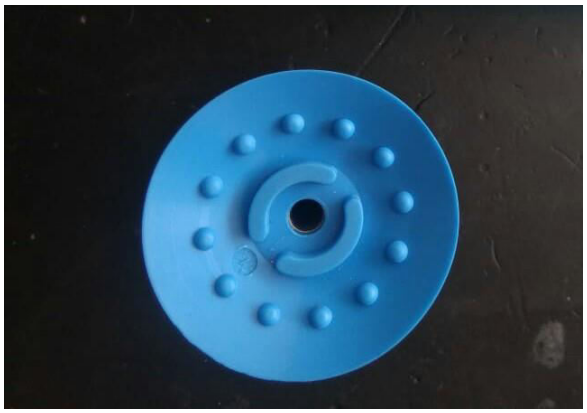

Fig 4.6 vacuum cup

Technically, the suction cup does not attach itself and grips the material. Instead of when a suction cup interacts with the workpiece surface it activates the vacuum generator which blows air from the cup interior and creates a vacuum

Wiper motor

Wiper motors are devices in the wiper system that functions on a power supply in order to move the wiper blades in a smooth motion. Like other motors, the wiper motor rotates continuously in one direction which is converted into a back and forth motion.

Fig 4.7DC wiper motor

IR Proximity sensor

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion.

Fig 4.8 Infrared sensor

V. Programmable Logic Controller (PLC)

A Programmable Logic Controller (PLC) is specialized computer used for the control and operation of manufacturing process and machinery. They were first developed in the automobile industry to provide flexible and easily programmable controllers to replace hard-wired relays, timers and sequences. The functionality of the PLC has evolved over the years to include sequential relay control, motion, process control, distributed control systems and networking. The data handling, storage, processing power and communication capabilities of some modern PLCs are approximately equivalent to desktop computers. PLC was developed as a replacement for large amounts of relays. Some modern PLCs are approximately equivalent to desktop computers. PLC like programming combined with remote I/O hardware allow a general purpose desktop computer to overlap some PLCs in certain applications.

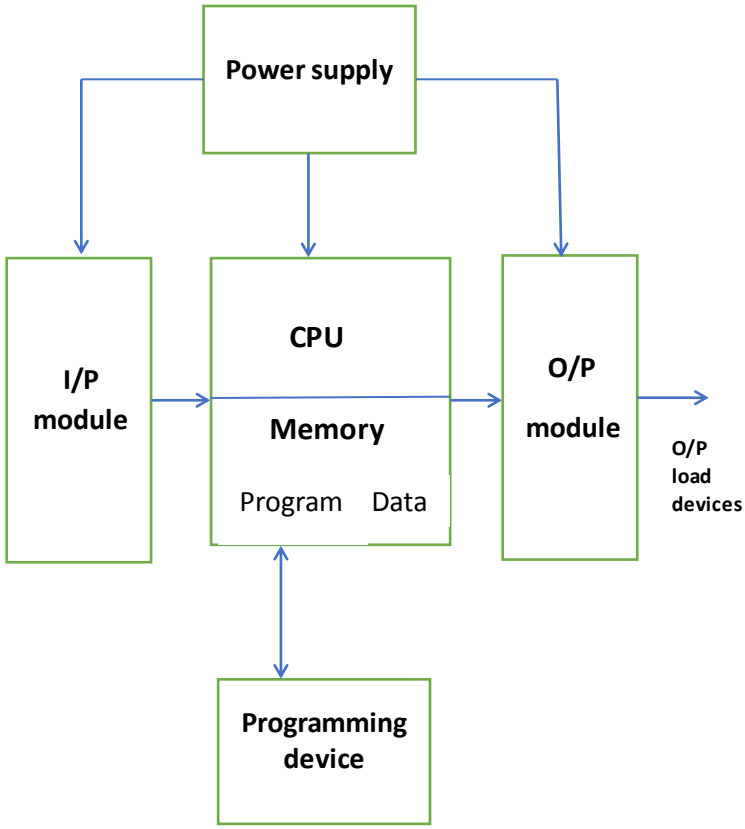

Fig 5.1 Block diagram of PLC

VI. Sorting operation

The sorting process involves the interfacing of the conveyor system with the PLC system. The block diagram consists of conveyor belt section, sensing section PLC section in which the interface has been taken place. After the sensing process takes place, the object sensed will be based on the height.

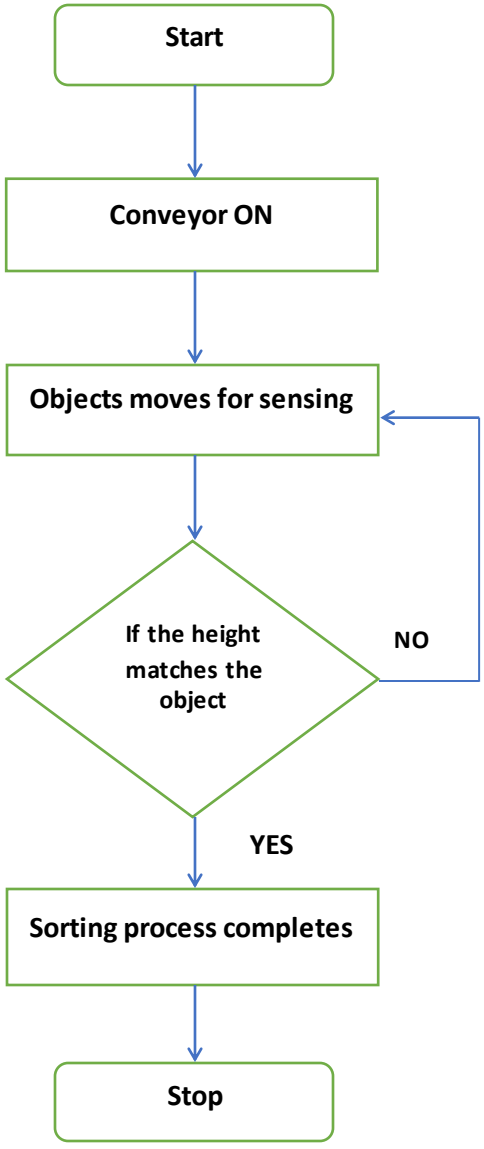

Fig 6.1 Working process of sorting

VII. PLC Ladder diagram

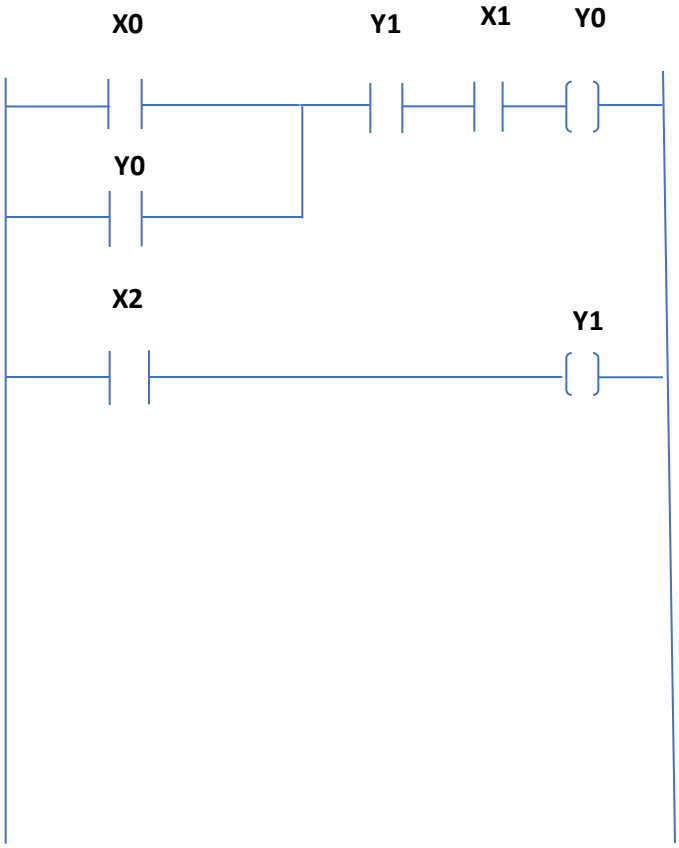

Fig 7.1 PLC Ladder diagram

Input

X0 = Green switch

X1 = Red switch

X2 = Sensor

Output

Y0 = Motor

Y1 = Pneumatic cylinder

VIII. 3D model of the conveyor

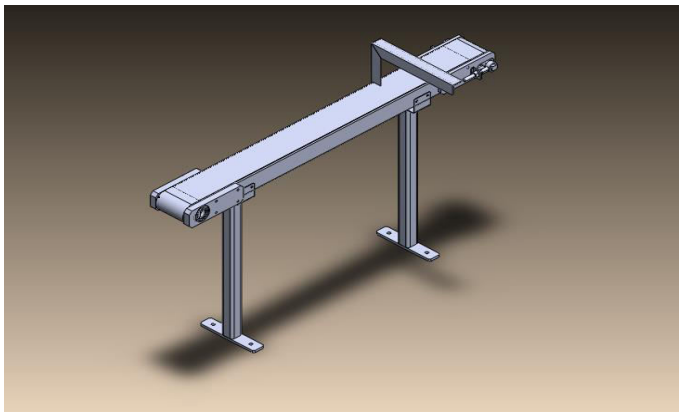

Fig 8.1 3D representation

IX. Design & working

The design and fabrication of the sorting process is very simple and it can be easily implemented. The entire setup consists of IR proximity sensor, PLC, Double acting pneumatic cylinders (25*100mm & 32*200mm) bore diameter and stroke length, conveyor belt, 5/2 Solenoid valve, DC wiper motor, Vacuum generator and Suction cup or Vacuum cup. The sensor has been placed in a stand like plastic. Two Double acting pneumatic cylinders having bore diameter & stroke length of (25*100mm & 32*200mm) are mounted the mounting clamp.

Fig 9.1Conveyor system

The source of compressed air is supply from the air compressor through 6mm air hose to the solenoid valve, pneumatic cylinders, vacuum generator and so on.

Fig 9.2 Pneumatic setup

Here the conveyor belt carries the objects having different heights such as medium and large, the medium size object directly drops into the bin which is placed at other end of the conveyor. When it comes to large size object the sensor detects it, simultaneously solenoid valve actuates the vacuum generators based on the venturi effect where the air flows from intake port to the outlet port vacuum is created in the nozzle which is clamped with the vacuum gripper it sucks the objects with the help of pneumatic cylinders to and fro motion. And when the cylinder goes to the position where the bin placed the solenoid valve actuates the compressed air flow becomes off and gripper holding the object gets dropped in to bin

X. Advantages

- Easy Operation
- Time consumption
- Segregation done at rapidly
- Cost effective
- Equipped in industrial to increase the production rate
- Low cost automation

XI. Conclusion

In this project, we developed a sorting of objects based on its height. The sorting will be very useful in the industries were the materials size is considered to be important. In some industries sorting plays a vital role only by sorting of different materials may get a chance of huge profit. The automatic sorting process helps to increase the production rate by decreasing the sorting operation time and to get rid of the human errors.

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