

Automatic Sorting in Process Industries using PLC

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Abstract

Sorting is an important thing in which any items or products can be differentiated based on their size, height and color. In order to sort items, we need to be able to compare them, i.e., to determine whether the object coming through the conveyor is smaller, greater, or equal to the respected height. Here we are going to do a simple object sorting system using the Programmable Logic Controller (PLC). The system consists of a conveyor model in which the sorting process takes place. The product will be coming through the conveyor system to the sensing part, based on the height of the object the product will be sorted through the conveyor system by using the Programmable Logic System (PLC).

Keywords- Conveyor, Sorting, Programmable Logic Controller (PLC), Sensor

I. INTRODUCTION

Sorting can be done in many ways like sorting of objects according to their dimensions like length and height. Here the object has been sorted according to their colours, according to their weight, using machine vision (image processing), according to the material of an object etc. [1]. Generally, manufacturing industries keep manufacturing same models with little variation in height, colour, weight, shape. And here sorting plays an important role. In such cases industries can't bare human errors for sorting these products. Thus it becomes necessary to develop Low Cost Automation (LCA) for sorting these products in accurate manner. Industrial automation mainly focuses on developing automations having low cost, low maintenance, long durability and to make systems user friendly as possible. Finally, here we have developed a LCA system for sorting the light weight objects on the basis of height variation using DC geared motors which is controlled by Programmable Logic Controller (PLC) and the conveyor in the system passes the object in front of sensors and thus sorting logic is decided [2]. In this paper they 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 [3]. In this paper, they have done the sorting process using Image processing technique. The objects using different image processing algorithms based on the parameters like colour and shape. The input for the system will be an image and then processed for detecting the colour or shape and accordingly the products will be further sorted using embedded algorithms [4]. Automated sorting system is widely used in food industry. In this paper, they also used image processing technique has been used. By using the image processing technique they have sorted the biscuits in food industry. The biscuits have been sorted with the help of MATLAB simulation software and PLC system. The technique of image processing based automated biscuit sorting is discussed. In this, biscuits would be sorted according to colour and size. It uses integration of MATLAB and PLC for sorting. Effectively it reduces the labour and working time. And biscuits can be sorted efficiently and in hygienic way through reduced manual handling [5].

A. PLC (Programmable Logic Controller) System

A Programmable Logic Controller (PLC) is a specialized computer used for the control and operation of manufacturing process and machinery. They were first developed in the automobile industry to provide flexible, ruggedized and easily programmable controllers to replace hard-wired relays, timers and sequencers. The functionality of the PLC has evolved over the years to include sequential relay control, motion control, 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. The need for Programmable Logic Controllers has been listed below.

Equipment will be located on the plant floor.

- 1) More than one "cell" or "subsystem"
- 2) Highly distributed I/O s
- 3) Local operator interface desired
- 4) Third party interfacing required
- 5) Large discrete content or good mix of discrete and analogue control with small amount complex batch, blending or multivariable analogue control.
- 6) Cost differential is an issue

B. Block Diagram of Programmable Logic Controller

Here the functional block diagram of the Programmable logic controller has been shown.

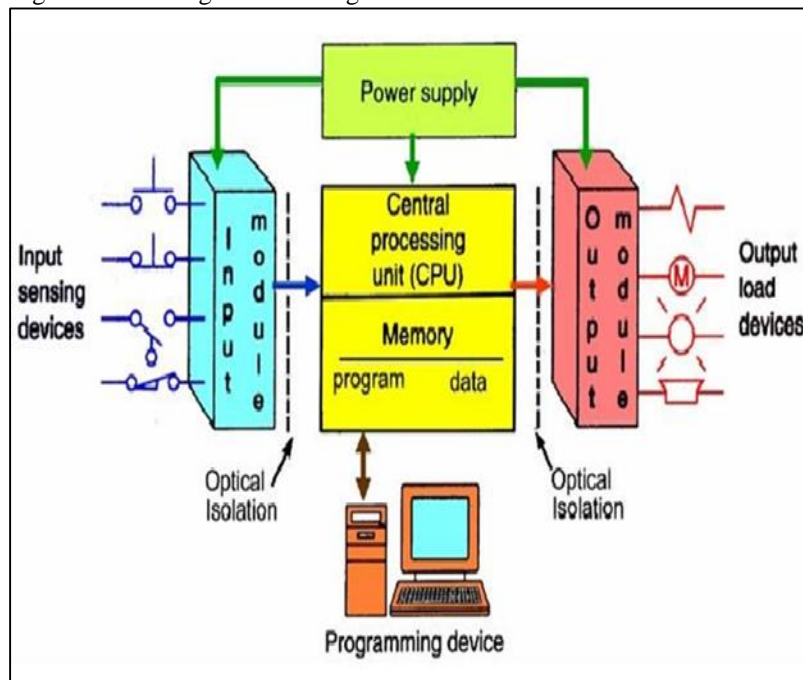


Fig. 1: Block Diagram of Programmable Logic Controller (PLC)

The Fig.1 represents the basic block diagram of the Programmable Logic Controller, which consists of the input module, central processing unit (CPU), and the output module. The three modules have been explained in detail as follows. The input/output system is the part of the PLC that physically connects to devices in the outside world. . The central processing unit, on the other hand, is where the PLC stores all of its data and does all of its computer processing. Each of the components of a PLC has specific functions. Input/output system. The input/output system is made up of two components, the input interface and the output interface. An input interface is a bank of terminals that physically connects input devices, like push buttons and limit switches, to a PLC. These input devices provide data to the PLC. The role of an input interface is to translate data from the inputs into a form that the PLC's central processing unit can understand. An output interface is a bank of terminals that physically connects output devices, such as solenoids and motor starters, to a PLC. These output devices receive control data from a PLC. The role of an output interface is to translate data from the PLC's CPU into a form that the output devices can understand. To put it simply, the I/O system communicates information from the input devices to the CPU. It also communicates data from the CPU to the output devices.

C. Input/output Module

They physically connect to field devices. Input modules convert electrical signals coming in from input field devices such as pushbuttons, to electrical signals that the PLC can understand. Output modules take information coming from the PLC and convert it to electrical signals the output field devices can understand, such as a motor starter, or a hydraulic solenoid valve. I/O comes in various forms.

D. Power Supply

The function of the power supply is to provide the DC power required to operate the PLC system. It is supplied by single-phase 120 or 240V AC line power that powers the PLC system.

E. Central Processing Unit

The CPU controls and supervises all operations within the PLC, carrying out programmed instructions stored in the memory. An internal communications highway, or bus system, carries information to and from the CPU, memory and I/O units, under control of the CPU.

F. Types of PLC

The PLC has been classified into three types based on their size and uses. The three types of PLC are small PLC, medium size PLC, large PLC.

G. Small PLC

In general, small and mini PLCs are designed as robust, compact units which can be mounted on or beside the equipment to be controlled. They are mainly used to replace hardwired logic relays, timers, counters, etc. that control individual items of plant or machinery, but can also be used to coordinate several machines working in conjunction with each other. A single processor is normally used, and programming facilities are kept at a fairly basic level, including conventional sequencing controls and simple standard functions: e.g. timers and counters. Programming of small PLCs is by way of logic instruction lists (mnemonics) or relay ladder diagrams.

H. Medium Size PLC

In this range modular construction predominates with plug-in modules on rack mounting system or Back Plane system. This construction allows the simple upgrading or expansion of the system by fitting additional I/O cards into the racks, since most rack systems have space for several extra function cards. Boards are usually ruggedized to allow reliable operation over a range of environments.

I. Large PLC

Large PLC are designed for use in large plants or large machines requiring continuous control. They are also employed as supervisory controllers to monitor and control several other PLCs or intelligent machines, e.g. CNC tools.

II. BLOCK DIAGRAM OF SORTING PROCESS

The sorting process involves the interfacing of the conveyor system with the PLC system. The block diagram basically consists of conveyor belt section, sensing section and 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.

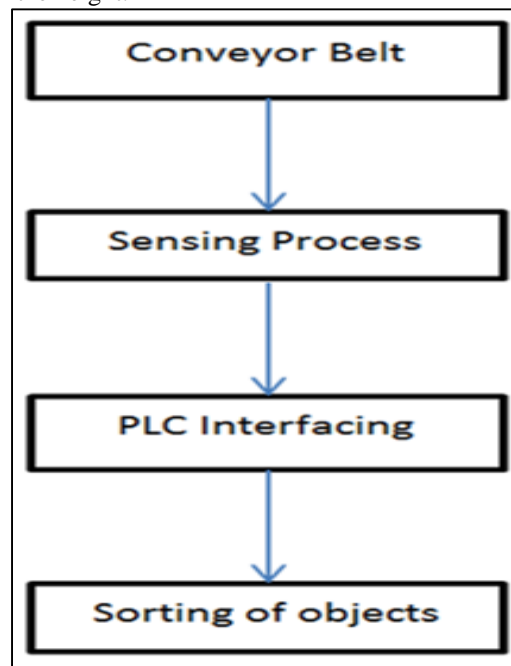


Fig. 2: Basic Working of Sorting Process

The fig 2 represents the basic operation of the sorting process. The setup consists of conveyor belt, in which the object is transferred through it. Then the object goes to the sensing area where the object get sensed using the sensor. This sensor and conveyor are interfaced using the Programmable Logic Controller (PLC). The motor of the conveyor is also interfaced using the PLC system.

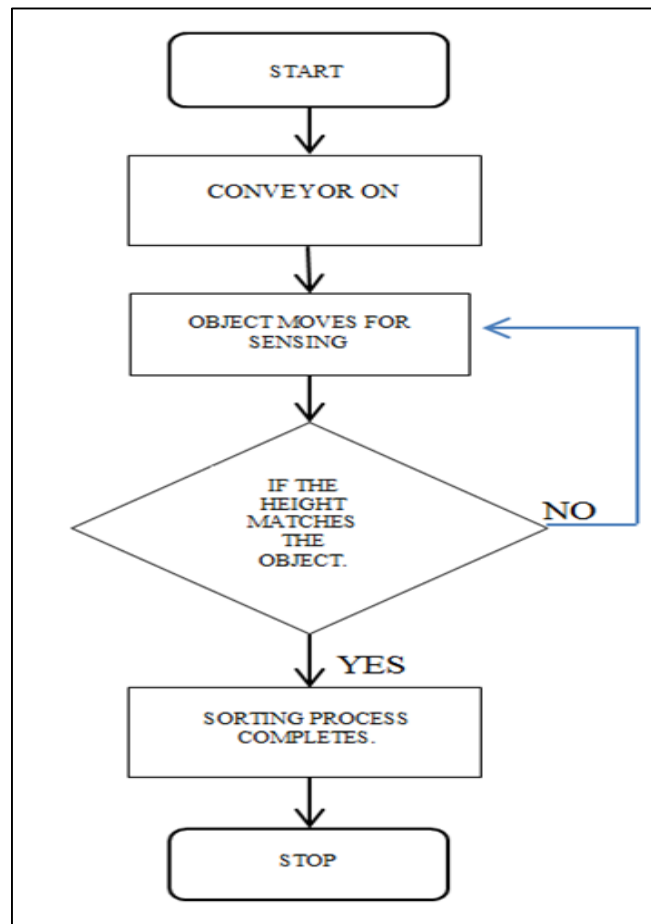


Fig. 3: Working Process of Sorting

The Fig.3 represents the basic step by step working of our sorting process. Initially the object which we are going to get sorted is to be placed in the conveyor. Then the conveyor is started and the object will start to move in the conveyor, then the object will pass through the sensor. The sensor will be in ON condition. When the object reaches the sensor, the sensor starts to sense the object. If the height of the object is been sensed by the sensor then the object will be further get sorted else it will get stopped.

III. DESIGN AND WORKING

The design and simulation of the sorting process is of very simple and it can be easily implemented. The overall system consists of a sensor by which the height of the object can be determined. The sensor has been placed in a stand like model, which is made of some plastic or wood in which the sensor has been imparted in it.

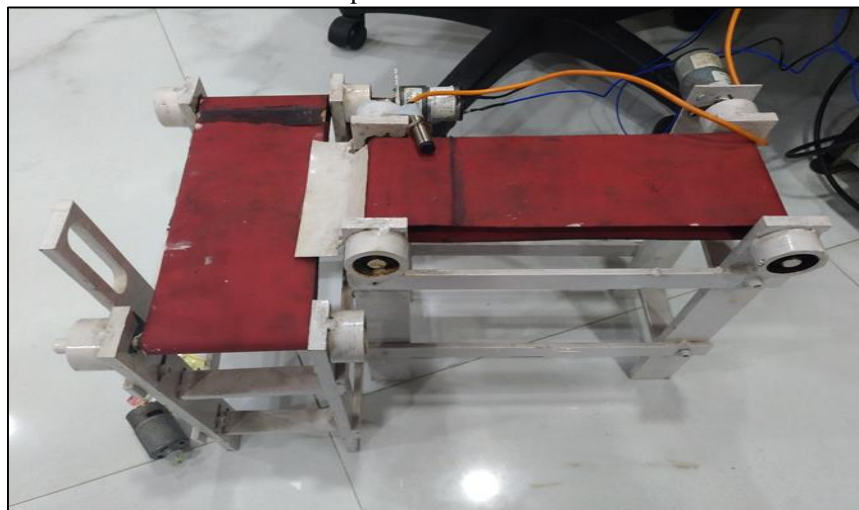


Fig. 4: Conveyor System

The Fig.4 shows the basic conveyor system in which the sorting process takes place. The system consists of two conveyors by which the incoming product will be sent through it. The object is then sent to the sensing section in which the height of the object is been checked and sorted. This conveyor is interfaced with the Programmable Logic Controller (PLC).



Fig. 5: Sorting Process

The Fig.5 represents that the sensor is being sensed for an object. The object will be coming through the conveyor system. Then the object will leads to sense by the sensor, if the object is matched to the height that is required for the sensor to be sensed, then the sorting process takes place. This sorting process will be dependent of the height of the incoming object by which it can be easily sensed based on the height. If the height is very small i.e. it cannot be sensed by the sensor. Then the sensed object will be further goes to the sorting process. Here the object has been sensed based on their heights.

IV. RESULT AND DISCUSSIONS

From the work by which, we made a simple sorting system using the Programmable Logic Controller (PLC). The sorting system is based on the height of the object that is coming through the conveyor system. Further some improvements can be done in our work by implementing it in a large scale sectors, and also by increasing the range of height. The sorting process can be done in many ways by sorting based on the color of the object, by size of the object or by based on the material by which it has been made. The process can be further improved by implementing different types of sorting system in a same sorting process and it can be made an two or three types of sorting system.

V. CONCLUSION

Thus, from our work we have learned about, how to sort an object based on the height of the particular object. This sorting will be very useful in the industries were the size is considered as important parameter. The sorting process is an important process by which we can easily differentiate an object. In some industries, sorting plays a major role so that by sorting a particular object, they may get a very huge profit. The sorting process also reduces the human effort in the food industries. The food industry mainly utilizes the sorting process. So the automatic sorting helps to increase the particular sorting in a reduced time.

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