



# **DESIGN AND DEVELOPMENT OF OBJECT SORTING MACHINE**

**Pratik Dorkar<sup>1</sup>, Ritesh Patil<sup>2</sup>, Samarth Revankar<sup>3</sup>, Onkar Vhasmane<sup>4</sup>,  
Prof. A. A. Khandagale<sup>5</sup>**

<sup>1,2,3,4</sup> Student, Department Of Mechanical Engineering, ATS SBGI MIRAJ, pan INDIA

<sup>5</sup> Professor, Department Of Mechanical Engineering, ATS SBGI MIRAJ, pan INDIA

## **Abstract**

*In today's world of technology and due to speed running industries, the production rate has increased tremendously. Generally, industries manufacture similar models with little variation in material, height, color, weight or shape. This is where sorting plays an important role. Sorting can be done by using many ways like sorting of objects according to their dimensions, according to their colors, according to their weight, using machine vision (image processing), according to the material of an object etc. In such cases there can be no place for human errors in industries. Thus, it becomes necessary to develop a Low-Cost Automation (LCA) for sorting in an accurate manner. This thesis proposes the development of an LCA system to sort objects according to their metallic property, using DC geared motors which are controlled by a Programmable Logic Controller (PLC). This paper is based on Delta PLC which is a basic type of PLC having 8 inputs and 6 outputs. It has a 24V input slot which acts as a power source and a USB slot which is used to run the program. The work consists of two parts. The first consists of the software, which contains a ladder logic program used to program the PLC that controls the whole process of the project systematically according to input data sequence. Then we have the hardware part, which consists of conveyors, used to transport the objects; sensors used to sense the metallic property of the objects; pneumatic systems used to sort the objects and motors to drive the conveyor belt.*

## **I. INTRODUCTION**

This paper here aims in designing a real time application which helps in sorting the objects of any kind using PLC. This system helps in achieving effective communication between objects using multiple sensors to monitor parameters like height, weight, physical and chemical properties etc. The modules interfaced with the PLC for this system are, Photo sensor and Limit switch are used to detect any object, DVD Drives for placing the objects, Inductive sensor for detecting metal objects. A PLC is used to establish communication between sensors for measuring continuously the above real time process. This work introduces an Automatic system with a combination of PLC having high impact on Object sorting. In India, Steel Plant is one of the Navarathna Company which has largest units of manufacturing with its various stages. The main aspect of the project is to automate the process of transportation of the materials to the respective destinations using Sensors and PLC. With the ever-growing industry, the efficiency of work is also expected to increase. In countries where the markets have moved onto automation in their industries, the efficiency of those industries has increased remarkably. Keeping this in mind, we are developing a system that will reduce the



burden of manual labor along with the errors that can be caused by it. This system would help spend less energy and effort, so that there would be a definite increase in efficiency. There are many such systems that can help in metallic property, etc. We have selected the situation of sorting objects on the basis of their metallic characteristics. This system of sorting products is optimized to differentiate between products on the basis of their metallic property, which is done with the help of a metal detector. It uses sensors in order to sort them accordingly and into their respective boxes. Though it can be achieved using a microcontroller, using a PLC guarantees higher speed, performance and reliability. A continuous conveyor belt carries the products and a pair of pneumatically actuated pistons pushes them into the sorting bin. If it is a metal product the first piston pushes the product into the container, and the skipped product goes further towards the second piston, which detects the oncoming product using the proximity sensor and pushes it into another container. All these functions are precisely controlled by the PLC. We can further modify the project by replacing DC motors by stepper motors to increase accuracy. Sensors can be replaced by cameras for digital Processing which can be done using MATLAB. We can also segregate them on the basis of size, height, etc. Robotic arms can be used instead of pneumatic pistons to place the objects in the desired locations. Such a system can not only be used in industries, but also for segregation of wastes, mineral sorting, agricultural grading, etc. Our main aim is to build a system that can effectively sort metals from nonmetals. Since such systems can form an integral part of industrial processes, our objective would be to further increase the speed of performance, reduce labor, increase accuracy as well as efficiency. In this project, we create a setup that will decrease human effort to an extent by using the LAC to avoid risk, improve accuracy, increase speed of production and reduce the cycle time. Limitations will be there due to the practical difficulties in programming the project according to the availability of the materials and components. This setup can be further improved to a sorting system that sorts the items based on the other physical consideration. This can be achieved using the various sensors. In industry it can be used for sorting of various objects, tools, with a high degree of accuracy and quality.

## II. SYSTEM ARCHITECTURE

The system consists of many functional units such as photo sensor, Inductive sensor, Conveyor belt, DVD Drives. Here PLC plays vital role i.e. it is heart of this proposed system. The PLC is burnt with program that is necessary to control the sensors and relays, and conveyors interfaced to it. The interfaced units are controlled by the PLC in an efficient and faster manner, thus providing the system to be reliable than the existing ones.

## III. PROPOSED SYSTEM

Our project is PLC based automatic object sorting machine divided into six cycles namely: Object Detection, Object placing on to conveyor belt, Conveyor starting, Sensory Detection, and Sorting mechanism. Our project involves reducing the industrial cost employed in installation and functioning of multiple conveyor belt systems in different industries like Food Processing Industry, Brick Industry etc. for sorting of different objects. This is achieved by setting up a single conveyor belt which carries objects and then the PLC module along with the sensormodule which detects the objects and then the objects are sorted



accordingly. With this the operational costs, labour costs and installation costs are reduce in manifold by minimal increase of the inputs for the PLC.

We shall now discuss our project in detail by providing a descriptive analysis of various modules required in our project.

### 3.1 Overview of the Modules

- PLC Module
- Conveyor Belt Module
- Object Pushing Module
- Sensor Module

#### 3.1.1 PLC Module

Our PLC module consists of the following

- Allen Bradley MICROLOGIX 1200
- 24V DC power module
- 16 digital I/O Module

Understanding the basic features of MICROLOGIX 1200 in our facility would maximize our productivity by increasing the operation of our project. The MICROLOGIX 1200 includes fault detection with built-in diagnostics. Understanding these features is critical in running an efficient operation. Allen Bradley PLC is widely used in several industrial automation operations across Indian sub – continent.

#### 3.1.2 Conveyor Belt module

The next concept in our project is of the conveyor belt, on which the objects are kept. Here instead of using multiple conveyor belts for different operation we are using a single conveyor belt which takes the objects to the DVD drives where the objects are separated and the sensing of the objects is done and then sorting operation is done simultaneously.

#### 3.1.3 Object Pushing Module

The object sensing module in our project PLC based automatic object sorting machine with User Defined Volume utilized is a weight limit switch in which a rod is fixed to the upper surface of the weight limit switch. When the object is placed on it due to weight of the object a force is exerted on the rod of the weight limit switch and this rod makes a supply to the PLC and the PLC provides the supply to the DVD drive-1 which pushes the object on to the conveyor belt after 5 sec of time delay again the PLC provides the supply to the motor for which the conveyor belt starts rotating.

#### 3.1.4 Sensor Module

In our project PLC based automatic object sorting machine. We are using an IR Sensor for detection of object presence and Inductive sensor for detection of metallic objects. The operation of IR sensor and Inductive sensor here are programmed such that when the object comes and when it is detected the sensor senses it for some time delay and if the object is removed during that time delay and placed again then the sensor again starts the sensing time delay from the beginning and after that the instruction of bottle being sensed.

## IV. FIGURES AND TABLES

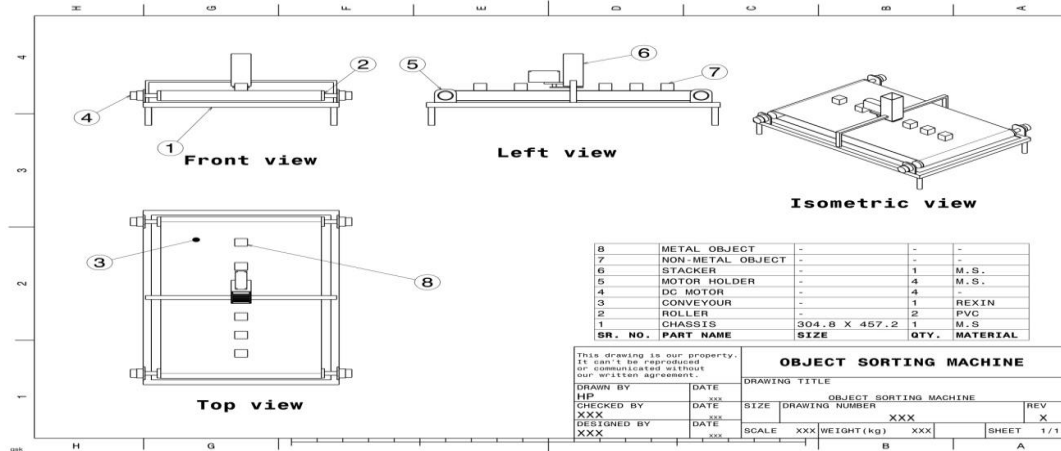


Fig.1 Isometric View of Object Sorting Machine

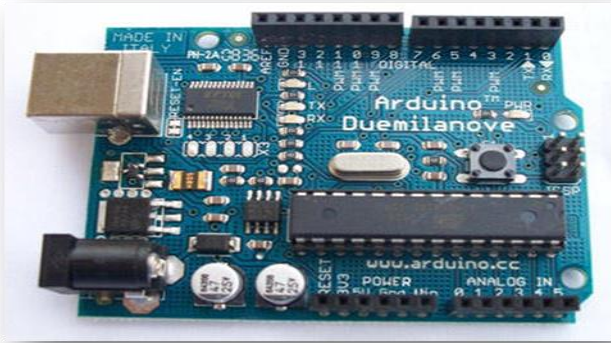


Fig. 2 ArduinoDuemilanove Circuit Board

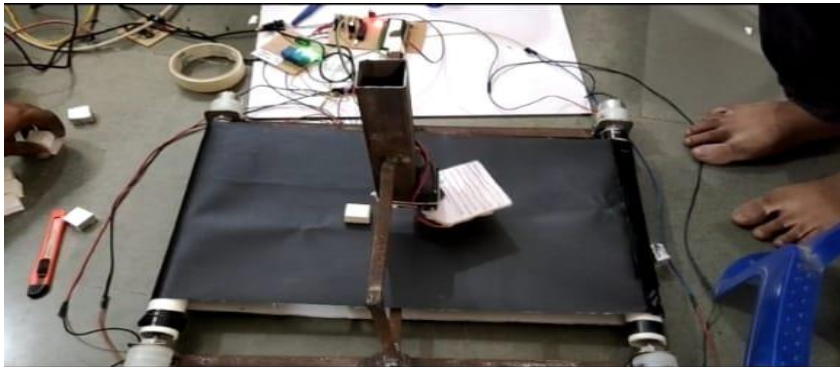


Fig. 3 Testing of Object Sorting Machine



### recommended operating conditions

		MIN	MAX	UNIT
Supply voltage	V <sub>CC1</sub>	4.5	7	V
	V <sub>CC2</sub>	V <sub>CC1</sub>	36	
V <sub>IH</sub> High-level input voltage	V <sub>CC1</sub> ≤ 7 V	2.3	V <sub>CC1</sub>	V
	V <sub>CC1</sub> ≥ 7 V	2.3	7	V
V <sub>IL</sub> Low-level output voltage		-0.3†	1.5	V
T <sub>A</sub> Operating free-air temperature		0	70	°C

† The algebraic convention, in which the least positive (most negative) designated minimum, is used in this data sheet for logic voltage levels.

Table. 1 Recommended Operating conditions for L293D Board

## V. CONCLUSION

The main objective of this project was to develop an object sorting system based on certain specifications. This was successfully implemented. We consider this project as a journey where we acquired knowledge and also gained some insights into the subject which we have shared in this report. PLC was used to control the various operations. More features can be added to this system as follows: depending on the size, shape and weight of the objects, sorting operations can be implemented. Sorting operation can be improvised using a piston arrangement.

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