

# Design and Development of an Automatic Color Sorting Machine on Belt Conveyor

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**Abstract:** Automatic color sorting is very much convenient in industry. Color and size are the most important features for accurate classification and sorting of product which can be done by using some optical sensors or analyzing their pictures. Color sorting machines are machines that are used on the production lines in bulk food processing and other industries. They separate items by their colors, detecting the colors if things that pass before them and using mechanical or pneumatic ejection devices to divert items whose colors do not fall within the acceptable range. The Color sorting machine using Arduino is a fascinating and renowned project for techies, who would like to combine electronics, machine building and programming. The Color Sorting Machine is used for sorting mainly RGB colors. A simple robot arm is used to apply a color sorting to a physical system. The objects are placed to the conveyor belt using robot arm with servo motors. One conveyor belt is used, which is controlled by DC motors.

**Keywords:** color sorting; Arduino; robot arm; conveyor; servo motors; DC motor

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## 1. INTRODUCTION

Nowadays, in the present state of intense competition, production efficiency is generally regarded as the key of success. Production efficiency includes the speed at which production equipment and production line can be lowering material and labor cost of the product, improving quality and lowering rejects, minimizing downtime of production equipment and low cost production equipment. Taking this matter under consideration the project is developed which is very useful for industries.

Machines can perform highly repetitive tasks better than humans. Worker fatigue on assembly lines can result in reduced performance, and cause challenges in maintaining product quality. An employee who has been performing an inspection task over and over again may eventually fail to recognize the color of product. Automating many of the tasks in the industries may help to improve the efficiency of manufacturing system. Automation is the technology by which a process or assistance. Automation or automatic control is the use of various control system for operating equipment such as machinery, processes in factories, boilers, and heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other applications and vehicles with minimal or reduced human intervention. Some processes have been completely automated.

This machine consists of mainly four parts: conveyor belt, color sensor, mini robotic manipulator by driving the servo motor, linear actuator by using the DC motor and L293D motor driver. The output and input of these parts was interfaced using Arduino. The Color Sorting Machines is used for sorting mainly RGB colors. This Color sorting machine separates different colored objects and classifies them into respective containers/cups. The Color Sorting machine is made up of Arduino UNO, RGB Color Sensor, three Servo Motors and some composite funnels and tube parts.

In today's industrial environment, a robot or rather a robotic arm to be precise is not something hard to find. These robots and robotic arms provide mechanical assistance for human workers in many factories.

Mainly the color sorters are used in agricultural machineries like rice sorter, beans sorter, peanut sorter etc. Color sorters are used in other, industrial applications also like quartz sand sorter, plastic granule sorting of colored nuts and bolts etc. It reduces the human effort, labor and cost.

The sensor handling systems which will drive the pick and place robot to pick up the object and place it into its designated place can.

There are three main steps in sensing part, objects detection and recognition. The system may successfully perform handling station task, namely pick and place mechanism with help of sensor.

The Arduino microcontroller sends signal to circuit which drives the various motors of the robotic arm to grip the object and place it in the specified location. Based upon the detection, the robotic arm moves to the specified location, releases the object and comes back to the original position.

The main advantages of the system are less time required to sort the product, as the whole system is performed by machine there is less possibility of mistake, less man power required. If the industry can produce the product within the required range then the demand of the product will be increased.

## 2. DESIGN AND CONSTRUCTION

As this project is color sorting machine project, color sensor is used to identify colors. TCS230 color sensor module is used in this project. The TCS230 color sensor is embedded in a flat rectangular shape aluminum plate. This aluminum plate is joined with the conveyor using rivets. A rivet is a permanent mechanical fastener. Before being installed, a rivet consists of a smooth cylindrical shaft with a head on one end. The end opposite to the head is called the tail. On installation, the rivet is placed in a punched or drilled hole, and the tail is upset, or bucked. Fix the color sensor in the conveyor with rivets firmly.

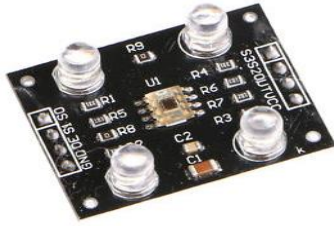


Figure. 1 TCS230 Color Sensor

The TCS230 color detector can measure three primary colors Red, Green and Blue and it also has a separate white light detector. Since any color can be created from different levels of these primary colors, the unit can tell you the color composition of a light source. So the authors will separate the Red, Green, Blue and other colors with this device. Color blocks are used to test the project. The authors have to consider separating and placing the blocks according to their colors. So the authors use four containers. Three containers are placed on one side of the conveyor.

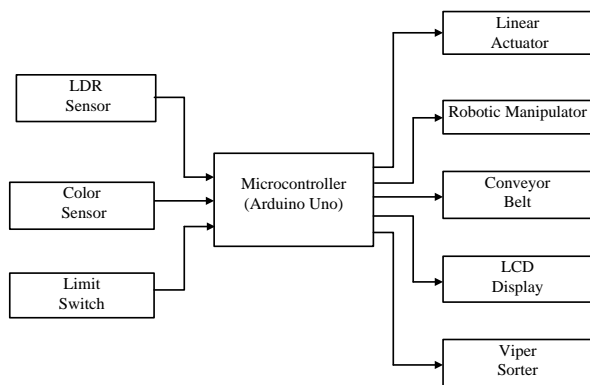


Figure. 2 Block Diagram of Color Sorting Machine

This side of the conveyor is linked with three inclined paths for three containers. Blue block will drop into the first container, Red block will drop into the second container and the Green block will drop into the third container. To drop the block, three arms are needed. These arms are placed on the other side of the conveyor and driven by the servo motors. First arm is for Blue block, second arm is for Red block and third arm is for Green block. The other color blocks will drop into the last container. The last container is placed at the end of the conveyor. These colors which are not customized by the color sensor will go straight to the last container without any obstacles. The whole system is controlled by the microcontroller and whole body is made sure to fix firmly by using screws and rivets.

### 2.1 Development of the Mechanical Structure

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the Transportation of heavy or bulky materials.

In this project, horizontal belt conveyor system, made up of aluminum frame, is used. A belt conveyor system is the carrying medium of a belt conveyor system. A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of three pulleys with an endless loop of carrying medium – the conveyor belt – that rotates

about them. One of the pulleys is powered moving the belt and material on the belt forward. The powered pulley is called the drive pulley while the upper pulley is called the idler pulley. The drive pulley is driven by the motor. The motor direction is controlled by the microcontroller. And then the authors use linear actuator to move the color block which are placed in the slot stand. Simple robot arm, constructed with small servo motor, is used to pick up the block and placed the block to the conveyor.

### 2.2 Development of the Electrical System

Electrical system is the heart of the sensing and sorting process. The authors use the TCS230 color sensor for sensing the different color objects. The authors use the L293D motor driver IC to control the linear actuator by microcontroller. A servo controlling circuit was made on a PCB using mainly Arduino UNO. A laser diode and LDR sensor are used for detecting the presence of the blocks in the slot. A transistor is used to control the conveyor motor. When the block is presence in the slot, the whole is working continuously. If the blocks are gone in the slot, the whole system will be stop.

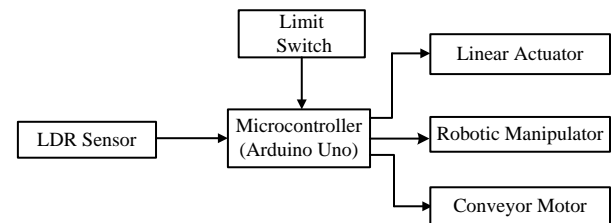


Figure. 3 Block Diagram of LDR Sensing System

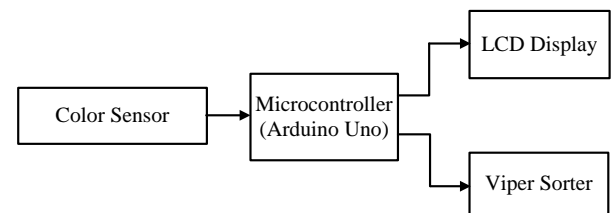


Figure. 4 Block Diagram of Color Sensing System

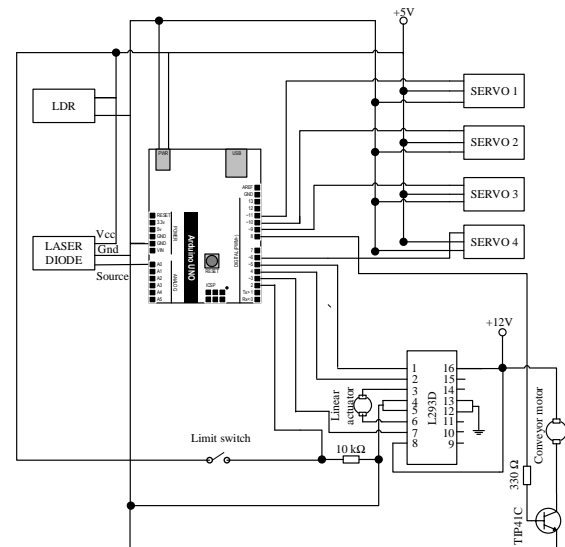


Figure. 5 Circuit Diagrams for the System (board 2)

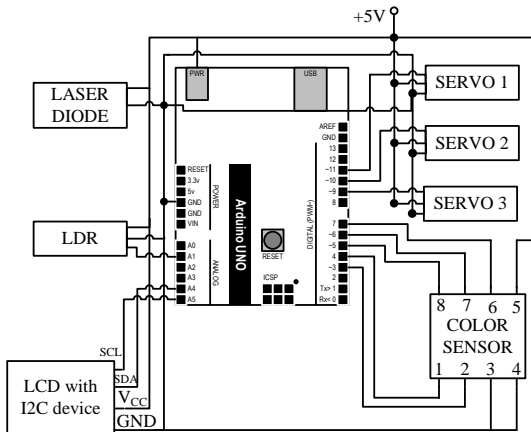


Figure. 6 Circuit Diagrams for the System (board 1)

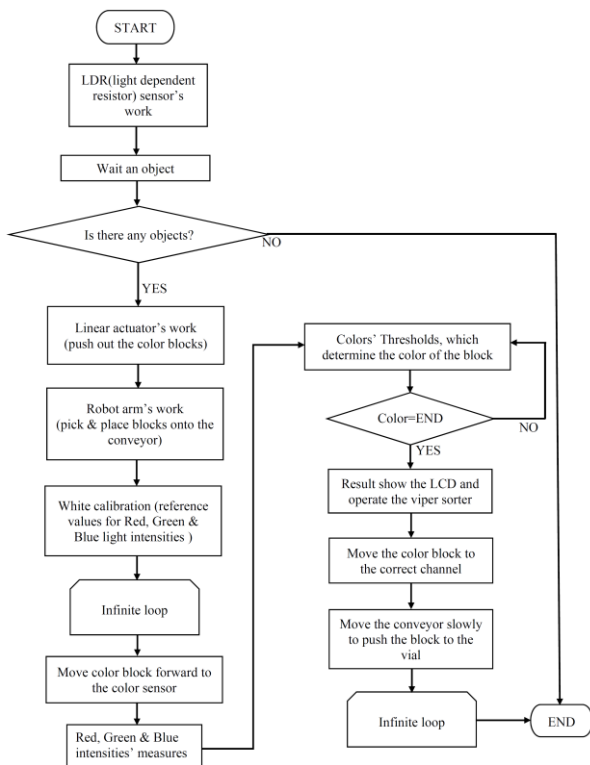


Figure. 7 Flow Chart for the System

### 2.3 Application

It has application in material handling systems and manufacturing industries like

1. Food industry.
2. Agricultural products scaling and grading.
3. Pharmaceutical industries.
4. Handling biomedical waste.
5. Assemble all color products in one packing box.

Actual application of this project can be done in various industries where distribution of product of different color in one single box is required; these can be done by our mechanism.

### 3. EXPERIMENTAL RESULTS

All the components are in connected with each other. The main appliances are placed next to each other. The Arduino board is about to be mounted and connected to the external power supply for the flow of current. All the appliances are going to be connected to the Arduino board. All the wirings with the breadboard are installed.

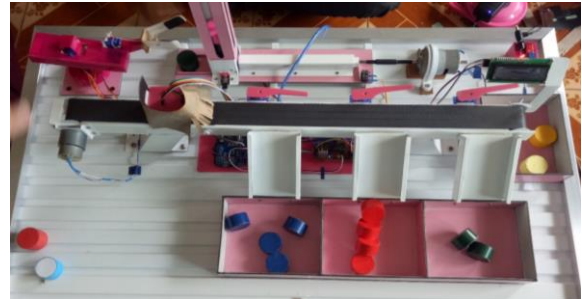


Figure. 8 Color Sorting Machine

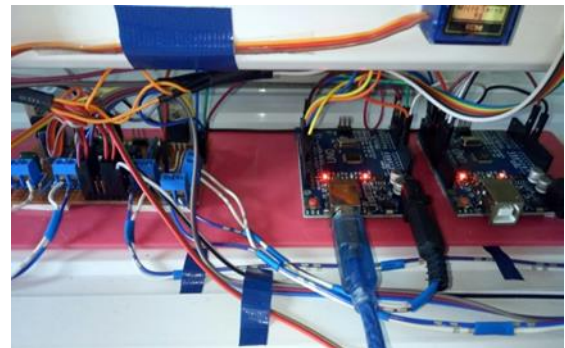


Figure. 9 Circuitry Arrangements for Sensing the Object and Controlling the Motor

The Figure 10 depicts the initial operation when power is supplied to the Arduino at the laser blocking condition. Thus, LDR circuit detects laser light from laser diode and LDR works as an insulator, does not allow the current to pass through the circuit. If there is no object, the laser beam is directly through the LDR. So, that signals sends to the controller and stops the operation.

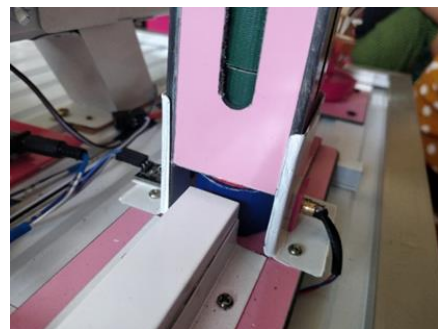


Figure. 10 Actuator with Limit Switch

The gripper arm is made up of four servo motors. Each servo motor is connected with Arduino and it drive with different degrees. The combination of this servo motor is called gripper.

The authors use 12 V DC motor as an actuator and it driven by an 7805 voltage regulator IC. The cylinder is made up of composite and the color blocks are put it in. The basement of the cylinder is setup with LDR sensor. This sensor detect if there an object or not. If there is an object, the actuator will

start to work. The actuator moves forward and pushes the color block to the allocating position. In this condition, the gripper arm will pick up that block from allocating position to the conveyor belt and then the conveyor belt will send to their identify container.

In Linear Actuator, 12V DC motor, driven by L293D motor driver IC, is used. Arduino is used to control the motor forward and reverse directions. These motor directions make the actuator in forward and backward directions. The color block is placed in the color slot stand. The color stand is located in front of the actuator. The actuator performs to move the color block in the stand. A time is set the actuator to move the block in order to reach the pick-up point of the robot arm. The distance is not reached the way the authors want after several working time. So, Limit Switch is used to reduce the distance error.

Color sensor is used to separate color blocks. The authors will separate Red, Green, Blue and other color blocks. Color sensor is very sensitive according to the light intensity. So the authors cover the sensor with black curtain. The authors try their best to stable the color reading.

#### 4. CONCLUSION

This project of automatic color sorting is excellent one because of its working principle and wide implementation. By applying the idea of this project an industry can easily sort the required product according to its color. Through it has some limitation, but by having done some modification this concept can be implemented in wide range of application.

The authors can conclude that time and human effort can be reduced by implementing such project in industries like chemical, food, chip manufacturing and so on.

#### 5. ACKNOWLEDGMENTS

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