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# Design and Fabrication of Automatic Weight, Color and Height Based Sorting System

**Arafath Al Fahim[1*], Dr. Mohammad Mizanur Rahman[2], Homayun Kabir[1], Samiul Bari[1]**
[1]Department of Mechatronics and Industrial Engineering, Chittagong University of Engineering and Technology, Bangladesh
[2]Department of Mechanical Engineering, Chittagong University of Engineering and Technology, Bangladesh

***Abstract***
*Sorting is a necessary task that is frequently performed in daily life. Manual sorting is an expensive, difficult, and drawn-out operation. Additionally, it slows down manufacturing operations. To solve these issues the sorting system now uses Low-Cost Automation which aims to decrease labor costs, manufacturing times, and processing complexity while also enhancing product quality, boosting output, etc. In this research, an efficient technique for automatically sorting the object based on color, height, and weight has been devised. The objects are recognized, separated, and collected using a collection bin along with a conveyor belt, strain gauge load cell, TCS34725 RGB color sensor, ultrasonic sensor, extra channel path, etc. according to their colors. The Arduino Uno controls the entire operation of this system. Here, three types of products are sorted based on their weight, color, and height. These three colors are red, blue, and green. Firstly, the weight is measured using strain gauge load cells. Then the color of the product has been detected by the color sensor at the same stage, and according to the color collecting bin rotates to the desired angle. Finally, the height is measured by an ultrasonic sensor. An extra channel is used at the end of the conveyor belt. At the end of the channel, a three-portion collecting bin is kept. The bin can be rotated at the desired angle by a servo motor after detecting the specified color object, and objects are being collected from this bin. Thus, the objects are sorted out based on their weight, color, and height. The experimental results show that the system fits the design requirements, is dependable, and has high sorting accuracy.*



***Keywords:***
*Arduino Uno;*
*Color Sensor;*
*Servo Motor;*
*Strain gauge load cell;*
*Ultrasonic sensor;*

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***Corresponding Author:***
*Arafath Al Fahim*
*Department of Mechatronics and Industrial Engineering, Chittagong University of Engineering and Technology, Bangladesh*
*Email:*
*u1609025@student.cuet.ac.bd*

## INTRODUCTION

Manufacturing organizations are increasingly transitioning to industrial automation, which is becoming a global trend. Packaging and sorting procedures are among the most common in business. Automation of production is a result of control system development in industry. Production automation aims to run the entire system automatically and computerized, in addition to increasing productivity and lowering labor expenses. An industry's growth mostly hinges on how effectively it uses new, cutting-edge technologies. Every industry aspires to a higher rate of output. For this reason, every industry's key objective in order to advance in the cutthroat market is mass production. It is simple to make when the entire production process is totally automated [1]. The industry is working to increase output rates in today's modern society. To achieve speedy production, everything is becoming automated. Economic growth, a more efficient division of labor, and a shift from relying on uncontrollable external forces to problem-solving through technical innovation are all characteristics of industrialization. Every sector is experiencing an increase in automation as the daily industry develops. The manufacturer now creates products of a similar style with little variety in terms of color, weight, size, height, and shape [2]. So, sorting plays a vital role here to separate the desired weight, color, and height-based product together. When a product is sorted using three different parameters, the accuracy of the actual product is increased. When counting multiple parameters for sorting purposes, the accuracy and precision will increase. Without sorting, it is difficult to gather the same weight, color, and height products together. So, sorting is important in every production system. Sorting by hand is an extremely challenging and drawn-out process. When sorting is done mechanically, it takes a lot of time to complete the whole sorting process, and there is also a chance of sorting the wrong product. So bringing automation to the sorting sector is more important. An automated sorting method is also more effective. When sorting is done automatically rather than mechanically, the sorting time is decreased, which also increases the sorting accuracy for accurate products. For this reason, an Automation System is created and implemented in this project to categorize things according to their color, height, and weight. Due to taking these three parameters into one frame, sorting time will be decreased as well as the accuracy of sorting actual weight, color, and height products.

The objectives of this system are to develop a system that can simultaneously sort objects according to their color, height, and weight and gather objects according to their color, height, and weight into a collecting bin. Here, a cell is introduced in which three different types of work are combined. The main goal of this cell is to reduce the overall processing time and increase production capability with the highest sorting accuracy and precision. To increase the sorting accuracy and precision, an object is checked in three different ways. The weight and color sensors and servo motor have been set at the conveyor belt's commencement. Here, a servo motor is utilized to push objects backwards and forwards while a weight sensor measures the weight of the objects. The color sensor measures the actual color of the object, and the ultrasonic sensor measures the height of the object. When three sensors work together, the accuracy of sorting actual sized products will be increased. Due to combining three different types of work in one cell, it finally reduces the whole production time as well as increasing the sorting accuracy and precision, which is the main purpose of this study. By using an Arduino UNO controller, the whole system will be controlled.

## MATERIALS AND METHODS

### Previous Studies

The rate of production has significantly grown today in order to run the industries quickly. The majority of the time, industrial businesses produce the same kind of goods with little variation in their weight, color, height, and shape. The sorting system is essential in this. Industries in this situation cannot accept sorting system faults caused by human error. Low-Cost Automation cells must now be developed in order to categorize these products more correctly. The sorting systems based on color, height, and weight are the main focus of this research. A higher loss results from less precise results, hence it is imperative to obtain more exact results. About this work, researchers have accomplished a lot. Some of them have used a weight sorting approach, while others have used a color sorting system. The researchers' performance done in the past in sorting is given below in short.

Sandesh Prajapati *et al.* [3] developed sorting of objects based on height, weight and color on a conveyor line. In the project, force resistive, ultrasonic, and TCS 230 color sensors were used. The entire apparatus was controlled by a microcontroller. S. V. Rautu *et al.* [4] have developed sorting of objects based on color, weight, and type on a conveyor line using PLC.

Here two types of sorting systems included, color and weight. The load cell is used for weight sorting and the TCS34725 color sensor is used for color detecting purposes. Overall process control by Siemens 300 series PLC.

Algitta *et al.* [5] developed a PLC-based automatic packaging process which is currently being employed in the manufacturing industry. This project's major objective is to develop a simple, compact conveyor belt system to automate the packaging of small cubic components. Data was provided to the controller using inductive and photoelectric sensors. Driven by electrical DC motors, the conveyor belt moves products. A ladder logic diagram is used to automate and manage the entire system using a programmable logic controller (PLC). S. N. Kulkarni *et al.* [6] put up a model for an automated system for sorting objects using a Raspberry Pi. This study uses a Raspberry Pi, a servo motor driver, a USB webcam, a MySQL database, a robotic arm, and an ultrasonic sensor. In this study, sorting operations are carried out using a Raspberry Pi.

Amin Nasiri *et al.* [7] developed an idea about sorting unwashed eggs using deep learning This paper suggests an innovative and accurate way for evaluating egg sorting using a deep convolutional neural network (CNN), a cutting-edge technique for performing classification problems in computer vision. Several layers, including a global average pooling layer, dense layers, a batch normalization layer, and a dropout layer, were added to the VGG16 architecture to help categorize photos of unwashed eggs. The modified model was trained using eggs that were clean, intact, bleeding, and fractured (having a break, crack, or hole in the eggshell). It was determined through 5-fold cross-validation that the CNN model outperformed conventional machine vision-based models.

Eied, simran *et al.* [8] developed an idea named development of automatic sorting conveyor belt using PLC .Here, the object is sort based on height and the sensor used for sensing the height is a diffused beam type photo-electric sensor. The development of a ladder logic program for the PLC that drives the pneumatic actuator used to sort the items is explained in the paper. Dezaki *et al.* [9] developed a pneumatic conveyor robot for color identification and sorting. Here, an autonomous, intelligent mechatronic conveyor system is developed to place and move circular goods in the manufacturing and packaging industries. The operation is run by a PLC, a color sensor, and an electronic switch. Ramachandran Natarajan *et al.* [10] developed the automatic weight sorting system by using a Load cell and Microcontroller. Here a feeding mechanism was used to feed the objects into the container according to their weight.

H. Hassan *et al.* [11] developed a prototype named A Low-Cost Automated Sorting Recycle Bin powered by an Arduino Microcontroller. Sorting is done in this location in order to recycle waste items like aluminum, paper, and plastic. A recycle bin is created that automatically separates various types of rubbish using an Arduino microcontroller. Varma *et al.* [12] an idea named Automatic Pneumatic Power Based Object Sorting System by Using MITSUBISHI PLC. Here, a MITSUBISHI PLC is used to create an automatic pneumatic power-based object sorting system. The primary goal of this project is to push the thing onto the conveyor belt once IR detectors determine its size. K. M. C. Babu *et al.* [13] developed a paper about Design and Development of a Cost Effective Arduino based Object Sorting System. The Arduino NANO served as the hub of this study's color sorting system, bringing all the other parts together and allowing them to work together. A UV sensor is used to identify the object's presence. In this instance, objects are sorted using a TCS3200 sensor's color identification feature.

Harshita Borkar (2022) *et al.* [14] did the work on A Review on Arduino Based Color Sorting Machine. Here Arduino is the core element and, in this work, they showed by using

Arduino a more feasible output is found easily. Nilima Bargal *et al.* [15] have developed a project about object sorting system using PLC. They have created an LCA system that uses DC geared motors to sort light things according to height difference. The Programmable Logic Controller (PLC) passes the object in front of the sensors, which subsequently detect it and decide the sorting logic. M.M. Sofu *et al.* [16] developed an idea name design of an automatic apple sorting system using machine vision. This study suggests a real-time processing-based automated apple sorting and quality checking system. Apple cultivars such as Granny Smith, Golden and Starking Delicious are divided into many classes based on their size, weight, and color. Additionally, it can identify apples with rot, taint, and scab. The suggested system consists of conveyors for rollers, transporters, and classes along with an enclosed cabin that has load cell, control panel, and machine vision units.

Suresh S. Shendage *et al.* [17] developed a weight based fruit sorting machine on a conveyor belt. Here, a conveyor belt and load cell are used for the sorting system. Image processing system is used here for segregating the fruits item. Yingqi Lu *et al.*[18] developed an idea named an automatic sorting system for electronic components detached from waste printed circuit boards. This study looked at the recycling of ECs from WPCB in order to identify and categorize them into separate groups, which would be helpful for achieving correct recovery and boosting the efficiency of the complete recycling activities. Suchada Sitjongsataporn *et al.* [19] developed an idea about small and medium-sized enterprise cockle size sorting machines using PLC system. This study proposes a pneumatics system and programmable logic controller (PLC)-based cockle size sorting machine for small and medium-sized enterprises (SME). The objective is to develop a machine that can replace humans in SME-level enterprises that can sort cockles while keeping expenses, assets, or personnel counts below a preset level. Tripathi *et al.* [20] developed an idea named smart industrial packaging and sorting system. The identification and sorting of CLDs or RSCs along a retractable conveyor are accomplished in this study using an Arduino Mega 2560 employed as a decision-making device, a barcode sensor enhanced with a load cell, and programmable logic controllers (PLC). To help reduce the requirement for human labor in CLD packing, a compact taping mechanism and a spinning disc type lid closing system have been included in the packaging solution. The GSM module's location in the microcontroller's feedback means that any deviation from the default settings will be promptly noticed and that the area where the problem first appeared (AOC) may be easily found.

Sattom Halder *et al.*[21] developed an automatic color sorting system using sensor and PIC Microcontroller. In this system two colors are sorted such as Red and Green. Prof. S. K. Latad *et al.* [22] invented a project for automatic sorting of objects based on color. On this project, they utilized a conveyor belt, a DC motor, a PIC 16F628A, and a TCS230 color sensor. The belt, which has various sections to keep the things separate, is used to hold the products that will be evaluated by a color sensor. Jyothi H S *et al.* [23] developed a project about separating objects based on color and size on conveyor belts. Here, they created a wireless monitoring system in addition to using an Arduino Uno to control the entire operation. Atanassov *et al.* [24] studied about controlling the speed of Coding Line Conveyor using fuzzy logic. Here, a system of color and size sorting is created for automatic inspection and path planning. The principal sensor in this system is a camera. To specify the multiple degrees of parcel size, fuzzy logic is used. Nuva *et al.* [25] worked together for Design and fabrication of Automatic Weight and color based sorting system. Here, an automatic sorting system is developed based on weight and color. Arduino UNO is the main controller of this project.

## Method

A RGB color sensor, Arduino UNO, load cell, conveyor belt, servo motor, DC motor, collecting bin, etc. are used in this project. For the movement of objects from one place to another, a conveyor belt is used. The belt must be simple in design, have an easy path, have high load capability, be low cost, and have the highest reliability during the operating time. Here, an extra channel and rotation-based collecting bin are used to finally separate objects. The conveyor belt is operated by a DC motor that is mounted over rollers. Firstly, by measuring the weight, objects will be divided into two categories. If the object fulfills the accepted weight range, then using a servo motor, it will be transferred on the conveyor belt; otherwise, it will go into the rejected bin. RGB color sensor set up under the load cell. After the weight measurement, color will be detected. When color is detected, the collecting bin will rotate automatically according to the object's color. After reaching the object on the Conveyor belt, it will start to rotate with a DC motor. The object will move forward on the conveyor belt. In the height sensing stand, if the product fulfills the accepted height criteria, it will go forward through the conveyor belt; otherwise, it will be transferred into the rejected bin by a servo motor. An extra channel is located at the end of the conveyor belt. Finally, the object will be placed into the collecting bin through the channel. The rotation of the servo motor under the collecting bin is controlled by an Arduino UNO. Above these, sorting is completed. Figure 1 shows the whole process.

## Construction of a mechanical structure

Here, the Load cell is used for weight measurement. Figure 2 shows the weight sensor & Servo adjustment with conveyor belt. When the load cell measures the weight of the product range between 3.5 to 9gm the servo pushes the product into the conveyor belt. If the product weight is about 1g-3.49g or >9g, then servo will push the product into the rejected bin. The TCS34725 color sensor is used for red, green, and blue color objects detection. Figure 3 shows color sensor adjustment with a conveyor belt.

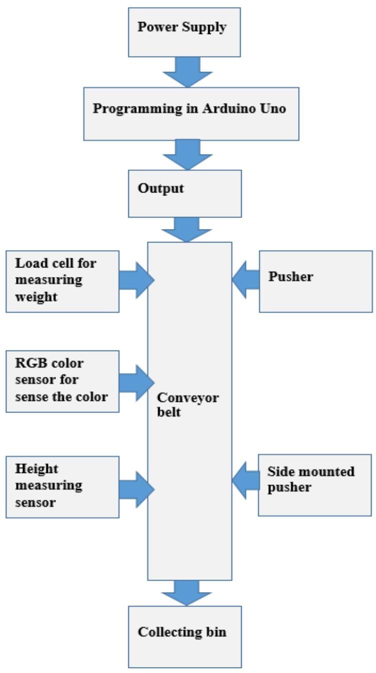


Figure 1. Block diagram of sorting system

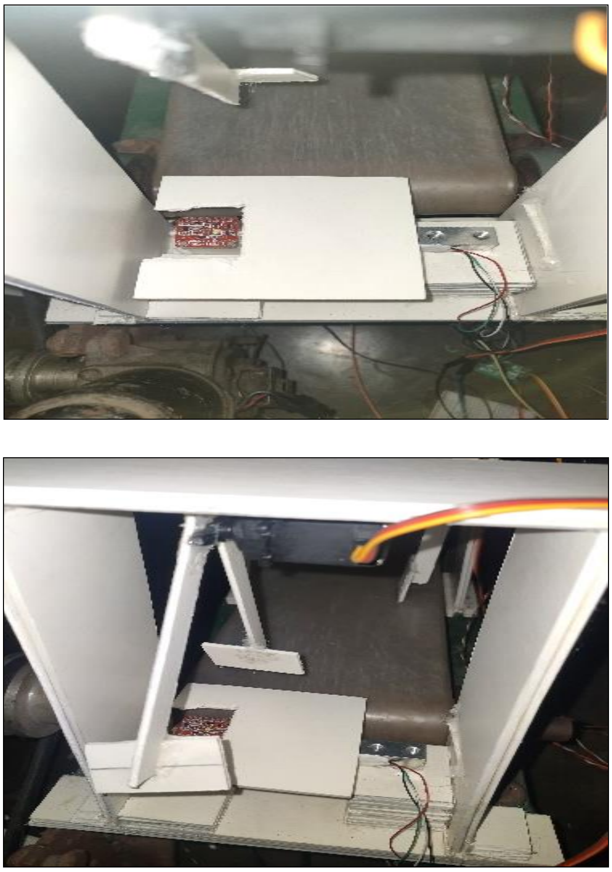

Figure 2. Weight sensor & Servo adjustment with conveyor belt

Figure 3. Color sensor adjustment with conveyor belt

For height measurement Ultrasonic sensor is used. Figure 4 shows the height sensor & Servo adjustment with conveyor belt. The height sensor measures the height of the object is between 4 cm to 7cm. If the product height is about <4cm & >7cm then servo will push the product into the rejected bin. Servo motors are used for collecting bin's rotation & pushing undesired objects into the rejected bin which is shown in Figure 5. DC motor & BTS7960 motor driver is used for controlling the conveyor belt. Finally, objects are kept into the collecting bin according to their colors. The collecting bin was placed at the end of the conveyor belt. This bin was used for the collection of required objects. This bin is divided with three portions for three different weight, color and height. The 3D model of sorting machine with conveyor belt shows in Figure 6 .This 3D model is designed by using Solidworks software. Figure 7 shows the complete sorting machine.

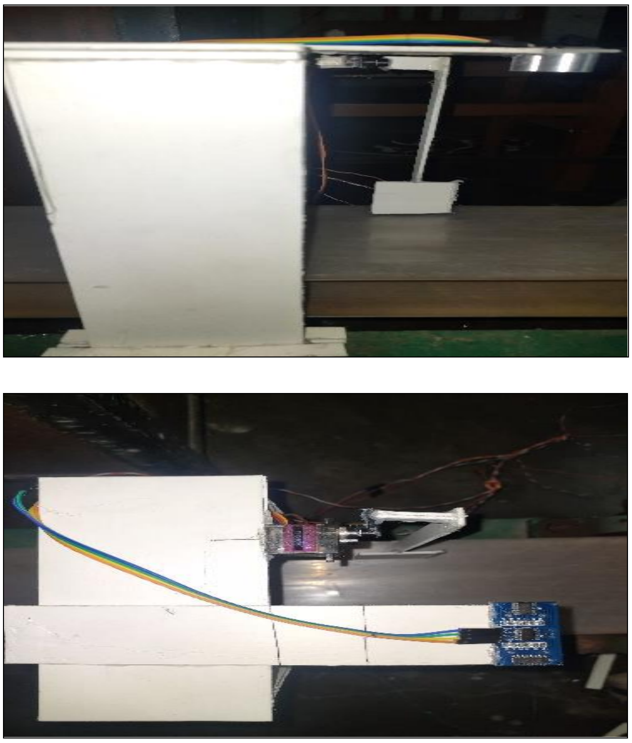

Figure 4. Height sensor & Servo adjustment with conveyor belt

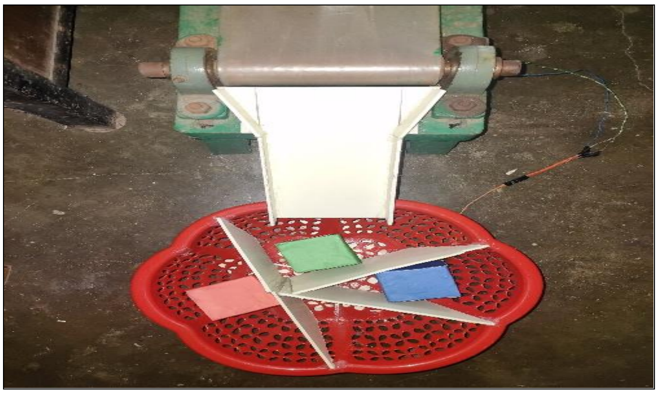

Figure 5. Collecting bin & Servo adjustment with conveyor belt

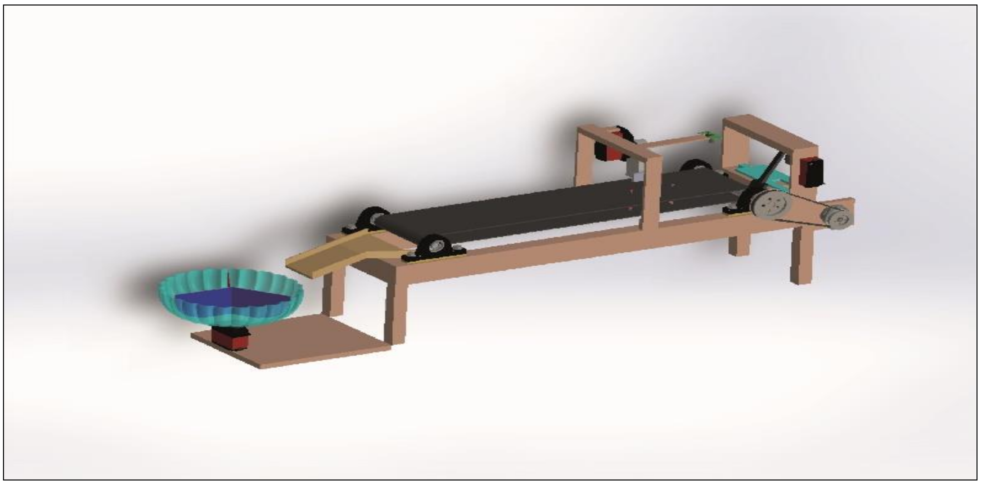

Figure 6. 3D model of sorting machine with conveyor belt

Figure 7. Implemented sorting machine with conveyor belt

**Circuit diagram of the sorting system**

The sorting system has been powered on using a 220V AC power supply through a power adapter. A 12V DC supply was created by the converter out of a 220V AC source. Then, a buck module changed a 12V DC supply into a 5V DC supply. Then, the Arduino, sensors, LEDs, and motors received 5 volts of power. For measuring the weight, the weight sensor is connected to Arduino analog pins A2 and A3. The VCC is connected to the Arduino 5V pin, and ground is connected to the Arduino GND pin. To detect the color of the product, the TCS34725 color sensor is connected to Arduino pins A4 and A5. For measuring the height, the ultrasonic sensor is connected to the Arduino's digital I/O ports.

The trig pin is connected to pin 13, and the echo pin is connected to pin 8. The VCC pin is connected to Arduino 5V, and ground is connected to the GND pin. A servo motor for weight measurement is connected to Arduino digital I/O pin 9. The servo motor for height measuring is connected to Arduino digital I/O pin 7. The servo motor for color measuring is connected to Arduino digital I/O pin 6. Here, motors for Arduino are output and sensors are input. Figure 8 shows the proposed system's circuit diagram.

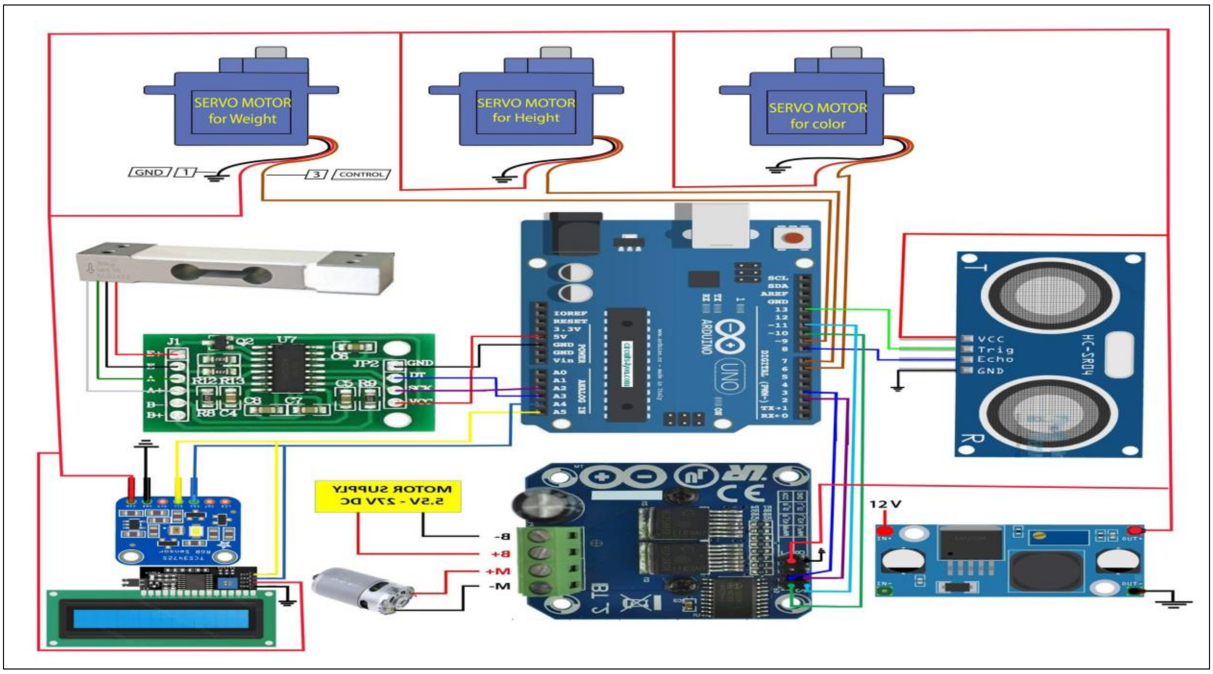

Figure 8. Circuit diagram of sorting system

**Flow chart of the sorting system**

Here, the power supply was given through the adapter, and pressing the button for initialization of the system. First, put the object on the load cell, and the load cell will measure the weight of the product. If the product weight is between 3.5 and 9 g, then the servo pushes the product to the next part for sensing the color. If the weight of the product is about 1g-3.49g or >9g, then the product is rejected and collected from the rejected bin. When a color sensor senses the color of the product, the collecting bin rotates automatically according to the color of the object. Then, ultrasonic sensors measure the height of the product. If the height of the product is between 4 cm and 7 cm, then the product is passed through the conveyor belt. But if the product height is about <4 cm or >7 cm, then the servo pushes the product into the rejected bin, and the product is collected from the rejected bin. The flow chart of these systems can be seen in Figure 9.

**Working Procedure**

Here, the power supply was given through the adapter, and pressing the button for initialization of the system. Then, LCD started to display this project. Secondly, objects of different colors, heights, and weights are put on the weight sensor for measuring the weights. If the range of weight of the objects is 3.5 to 9 g, they would be pushed into the conveyor belt. And the measured weight is shown on the LCD. The range of weights of 1g-3.49g or >9g was pushed outside the conveyor belt through the servo mechanism and collected from the rejected bin. Figure 10 shows the object rejected due to being overweight. After performing the weight measurement operation, the objects were then sensed by a color sensor for three colors blue, Red, green, and an unknown color. And the detected color showed on the LCD. For example, if the sensor detects the color red, the red portion of the bin comes forward to collect the desired object. The green and blue objects are detected by color sensors in the same manner.

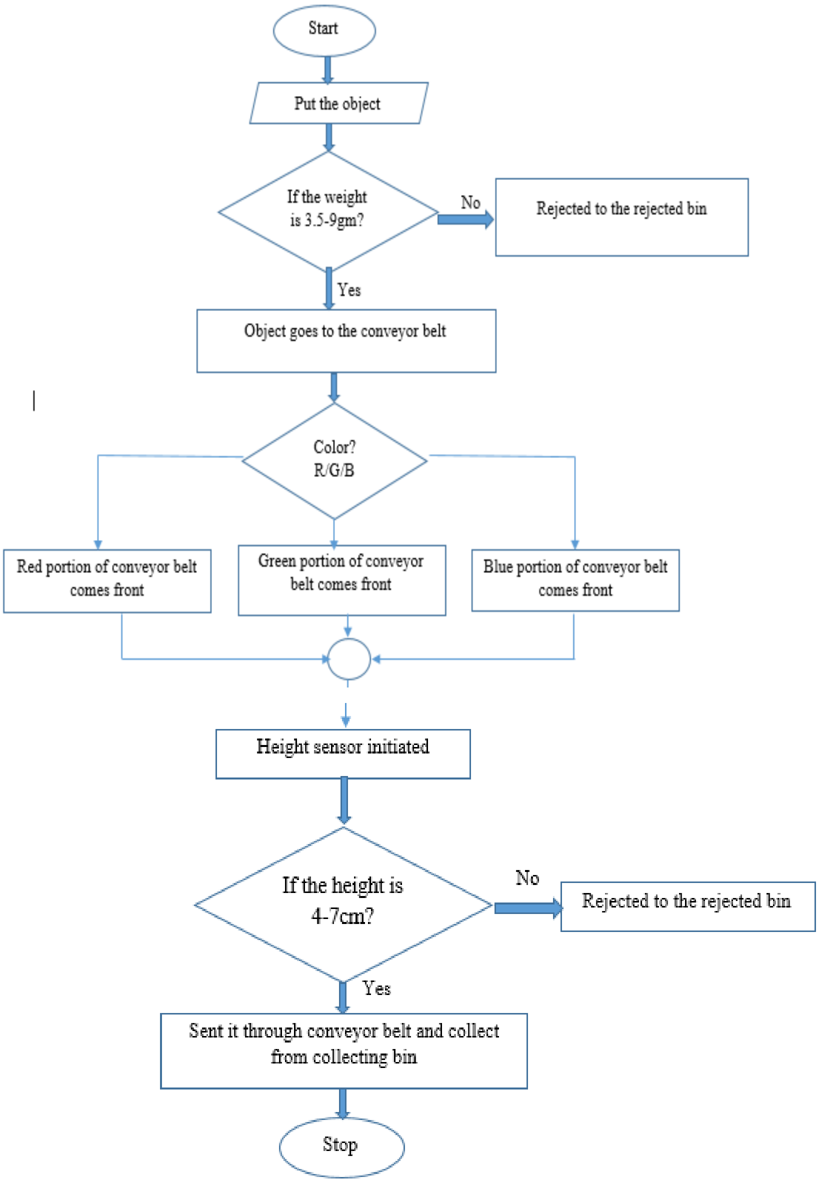


Figure 9. Flowchart of the sorting system

The bin is fronted for both green and blue color objects as well as red color objects. After finishing the color sensor operation, the ultrasonic sensor starts measuring the height of the object. In this project, the accepted height range of an object is 4 cm to 7cm. On the other hand, the rejected height range is <4 cm to >7cm. In the height sensor stand, if measured height is detected at the rejected range, a servo will push this undesired object into the rejected bin. Figure 11 shows the object rejected due to over height. On the other hand, the servo will remain silent to allow the object to move forward. Figure 12 shows weight, color and height-based sorting for both red and green color objects and finally Figure 13 shows the sorted object collected from the collecting bin.


Figure 10. Object rejected due to overweight


Figure 11. Object rejected due to over height

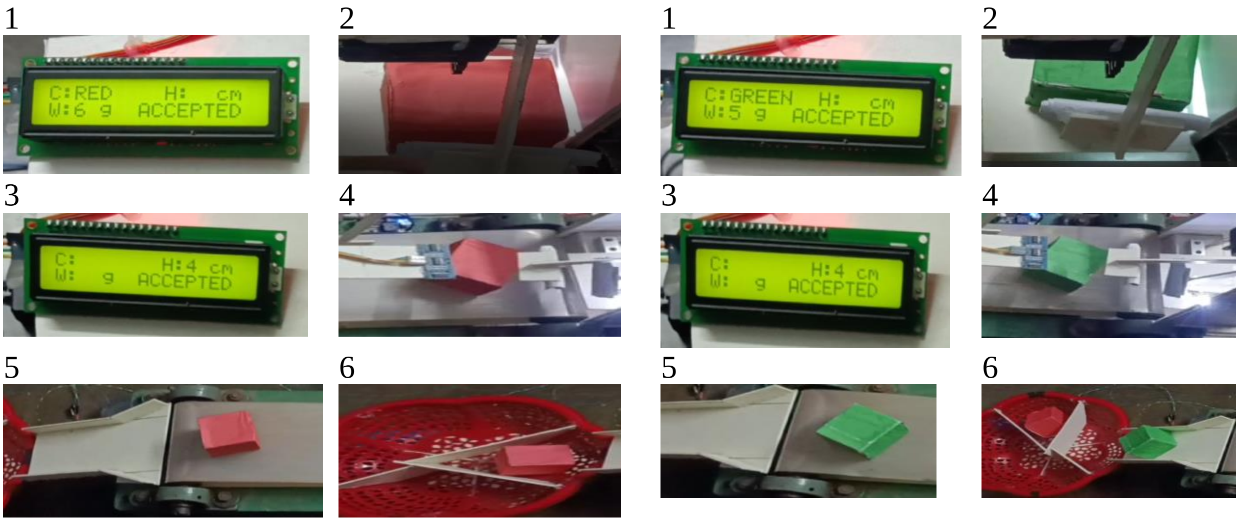


Figure 12. Weight, color and height-based sorting for both red and green color object

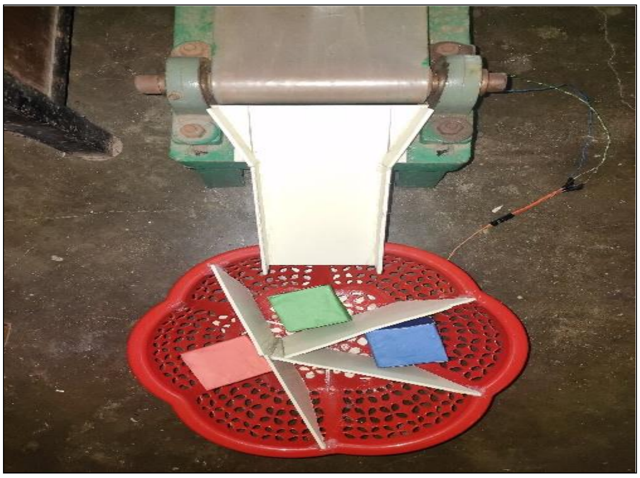

Figure 13. Sorted object collected from bin

## RESULTS AND DISCUSSION

The predicted changes or outcomes that will occur after the project is implemented are known as project results. The project's results are both satisfactory and achieve the anticipated outcome. The weight & color sensor and servo motor have been set at the conveyor belt's commencement. Here, a servo motor is utilized to push objects backwards and forwards while a weight sensor measures the weight of the objects. Additionally, a color sensor picks up the color of this stand. The object's height is measured by an ultrasonic sensor. This section will examine the results of expected color, height, and weight sorting operations. The topics of accuracy and precision have also been covered for objects of different colors.

### Accuracy and Precision

### Weight measurement with Accuracy and Precision

Table 1 shows if the weight of the load is in the range of 3.5-9gm then move the conveyor in the same direction. However, if the load weight is in the range of 1-3.49 g or more than 9 g, the feeding conveyor moves in the opposite direction. For example, the actual weight of the product is 3.5 grams. The weight sensor measures the weight of the product and repeats the measurement three times. It takes three values of the weight, like 3.4 g, 3.43 g, and 3.48 g, and every value of the weight is close to the actual weight of the product. So, the accuracy for a 3.5gm weight product is about 98.19%, and the precision is also high. The results of Weight calibration of strain gauge load cells in this test are shown in Table 2.

Table 1. Weight sorting parameter

| Weight (gram) | Movement Direction |
|---|---|
| 3.5-9 | Conveyor |
| 1-3.49 & >9 | Opposite to conveyor |

Table 2. Weight calibration of strain gauge load cell

| Actual Weight (g) | Strain Gauge Weight (3 Values) | | | Accuracy (%) | Precision |
|---|---|---|---|---|---|
| | 1st value | 2nd value | 3rd value | | |
| 3.5 | 3.4g | 3.43g | 3.48g | 98.19 | High |
| 5 | 4.96g | 4.94g | 4.987g | 99.24 | High |
| 6 | 5.93g | 5.96g | 5.98g | 99.27 | High |
| 7 | 6.87g | 6.91g | 6.89g | 98.42 | High |
| 9 | 8.94g | 8.967g | 8.988g | 99.61 | High |

### Color detection with Accuracy & Precision

Table 3 shows that if the color sensor detects the color red, blue, or green, the system moves forward. Otherwise, the system moves backward. For example, the actual color of the product is RED, and the color sensor measures that the color of the product is also RED. So, the accuracy of the RED color product is 100%, and precision is also HIGH. It is the same for both GREEN and WHITE color products. Table 4 shows the color calibration of photoelectric color sensors shows the color calibration of photoelectric color sensor.

### Height measurement with Accuracy & Precision

If the height measuring sensor measures the height at about 4-7 cm, then the conveyor moves in the forward direction. Table 5 shows if the sensor measures the height between 4to 7 cm then there is forward movement. If the sensor measures the height between <4 and >7 cm, then a side movement occurs by pushing a servo. Table 6 shows the Height calibration of ultrasonic sonar height sensors. For example, if the actual height of the product is 5 cm, the ultrasonic sensor that measures the height of the product is also 5cm. So, the accuracy is 100%, and the precision is also HIGH. This measurement is also the same for 7cm, 9 cm products. In tests, the calibration accuracy of the weight, height, and color sensors performed fairly well. In all tests carried out up to ten times, the accuracy of the color sensor and height sensor calibration had a 100% result.

Table 3. Color sorting parameter

| Color | Movement direction |
|---|---|
| RED, GREEN, BLUE | Forward movement |
| Without RGB color | Backward movement |

Table 4. Color calibration of photoelectric color sensor

| Actual color | Color sensor reading (3 Values) | | | Accuracy (%) | Precision |
|---|---|---|---|---|---|
| | 1st value | 2nd value | 3rd value | | |
| RED | RED | RED | RED | 100 | High |
| GREEN | GREEN | GREEN | GREEN | 100 | High |
| BLUE | BLUE | BLUE | BLUE | 100 | High |
| WHITE | NONE | NONE | NONE | 100 | High |

Table 5. Height sorting parameter

| Height (cm) | Movement direction |
|---|---|
| 4-7 | Forward movement |
| <4 & >7 | Side movement by pushing servo |

Table 6. Height calibration of ultrasonic sonar height sensor

| Actual height (cm) | Height sensor reading (cm) | Accuracy | Precision |
|---|---|---|---|
| 5 | 5 | 100% | High |
| 7 | 7 | 100% | High |
| 9 | 8 | 80% | Acceptable |
| 5 | 5 | 100% | High |
| 7 | 7 | 80% | High |
| 9 | 9 | 100% | High |
| 4 | 4 | 100% | High |

Table 7. Sorting sample chart based on weight, color and height

| Sl. | Actual Color, Weight (gm) and Height (cm) | Weight from straingauge (gm) | Height from Ultrasonic sensor (cm) | Color from RGBsensor | Accuracy for weight (%) | Accuracy for Color (%) | Accuracy for heigh (%) |
|---|---|---|---|---|---|---|---|
| 1 | Blue-4.8(4) | 4.4 | 4 | BLUE | 91.67 | 100 | 100 |
| 2 | Red-4(5) | 3.7 | 5 | RED | 92.5 | 100 | 100 |
| 3 | Blue-5(5) | 4.8 | 5 | BLUE | 96 | 100 | 100 |
| 4 | Green-4.5(6) | 4.2 | 6 | GREEN | 93.3 | 100 | 100 |
| 5 | Red-5(4) | 4.7 | 4 | RED | 94 | 100 | 100 |
| 6 | Blue-4.8(4) | 4.5 | 4 | BLUE | 93.75 | 100 | 100 |
| 7 | White-4(6) | 3.8 | 6 | NONE | 95 | 100 | 100 |
| 8 | Red-5.5(6) | 5.4 | 6 | RED | 98.18 | 100 | 100 |
| 9 | White-4(7) | 3.8 | 7 | NONE | 96 | 100 | 100 |
| 10 | Blue-5(4) | 4.8 | 4 | BLUE | 95 | 100 | 100 |
| 11 | Red-4.5(4) | 4.2 | 4 | RED | 93.3 | 100 | 100 |
| 12 | White-7(6) | 6.8 | 6 | NONE | 95 | 100 | 100 |
| 13 | Blue-4.2(5) | 4.1 | 5 | BLUE | 98.18 | 100 | 100 |
| 14 | White-5(7) | 4.7 | 7 | NONE | 93.3 | 100 | 100 |
| 15 | Red-5(4) | 4.6 | 4 | RED | 92 | 100 | 100 |
| 16 | Green-4.5(6) | 4 | 6 | GREEN | 88.88 | 100 | 100 |
| 17 | Red-4.8(4) | 4.3 | 4 | RED | 89.58 | 100 | 100 |
| 18 | Red-5(7) | 4.7 | 7 | RED | 92.5 | 100 | 100 |
| 19 | Green-6.5(6) | 6.4 | 6 | GREEN | 98.18 | 100 | 100 |
| 20 | Blue-5.5(5) | 5.4 | 5 | BLUE | 98.18 | 100 | 100 |

Meanwhile, Table 7 shows the test results of the sample sorting chart on the basis of color, height, and weight. Overall, the results of this test show 100% accuracy for color, 100% accuracy for height, and 99% accuracy for weight.

## Discussion

The final output of this project is that the sorting accuracy is increased due to combining three parameters like weight, color, and height in one frame. When an object is passed through the belt, it is measured using these three parameters. So there is less chance of sorting different weight, color, and size products. There was previous work on a sorting system that was done by calculating only two parameters, like color and weight. But in this project, sorting is done by calculating three parameters, like weight color and height. So, compared to the previous work, the sorting accuracy and precision are increased in this work due to counting three parameters in one frame. The project's results are both satisfactory and achieve the anticipated outcome due to counting three parameters in one frame. The weight and servo motor have been set at the conveyor belt's commencement. Here, a servo motor is utilized to push objects backwards and forwards while a weight sensor measures the weight of the objects. Additionally, a color sensor picks up the color of this stand. The object's height is measured using an ultrasonic sensor. This section will examine the results of expected color, height, and weight sorting operations. The topics of accuracy and precision have also been covered for objects of different colors. And the results of the accuracy test for color are 100%; the results for height are 100%; and the accuracy for weight is about 99%.

## CONCLUSION

The production process is becoming more difficult and competitive in today's world. Supply chain management strives for excellent quality and pinpoint accuracy in their production system, from raw materials to completed goods. Therefore, automatic sorting systems based on color, height, and weight are essential in many sectors. This suggested solution will speed up production, lower labor costs, reduce human error, and shorten labor-intensive material handling. The objects will automatically be sorted into groups based on their weight, height, and color. The fundamental elements required to finish the process include an Arduino, a load cell, sensors, a conveyor belt, a collection bin, and motors, among others. This system will rapidly and accurately sort the products. Finally, this system of classification will be quite important. Finally, the manufacturing sectors that drive economic growth in any country will greatly benefit from this sorting mechanism.

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