Development of a Smart Identification and Sorting System

Shubham Kumar, Ashi, Pradeep Khanna

***Abstract* - Sorting of the components on the basis of their features is an important process extensively required in industries mainly on assembly and production lines. Such systems are of significant importance in selective assembly processes where the part to be delivered is decided on the basis of real time requirements. This not only does away with the requirement of manual labor, but also addresses the issue of mistakes arising from fatigue and negligence of human worker, plus there is definitely an increase in productivity by the use of such systems as they offer the advantage of complete automation of the process. The present system has been developed with a view to provide an effective, simple and low cost solution to identification and sorting system applications. The system has been developed by using less costly and robust sensors and actuators such that the electronic circuitry involved is also simple and can meet the demands where flexibility of a concern because the present system can quickly be reprogrammed to meet any changed circumstance within the operating range of the system. System presently developed is based on sorting on the basis of component color. The system does not need to hit its home position each time it makes a delivery, rather it takes its present position as the reference and can make a quick move to the next delivery, saving a significant time. The system has successfully been tested and is found to give an error less than 1% in total number of trials conducted.**

***Keywords* -Selective Assembly, Automation, Robust, Operating Range**

I. INTRODUCTION

The sorting applications based on the color of the components are widely visible in many industrial setups. To name a few are the fruit sorting where grading is done on the basis of color, candy packaging, ball packaging etc. The system primarily consists of following two sub systems

1. The actuation and feeding part.
2. The control part.

An extensive Survey was carried out to study the sorting systems presently available in industries. References 1-9, explain the various available systems used for color based identification and sorting. In most of these systems the actuation system was primarily the conveyer or robotic arm and the control system was generally based on servo motors, PLCs and Arduino and were based on closed loop control system, apart from the advantages listed in the referred articles. The investigators felt that the existing systems were requiring more floor area, alignment issues of the conveyer and speed ranges on the actuation side of the system and complexity, more cost, difficult troubleshooting and lack of flexibility issues on the control part side of the system.

Keeping in view the above aspects, a need to develop a simple cost effective and reliable solution was felt and prompted the investigators to develop the system under consideration. The system offers the advantage of a simple open loop control system, low cost and simplicity of a stepper motor with comparable stopping accuracy. The feed system in this case is a vertical channel instead of a conventional conveyor, saving on floor space and eliminating the need of prime mover bringing down the overall running cost as well. Fig. 1and Fig. 2 shows the setup developed for the present investigation.

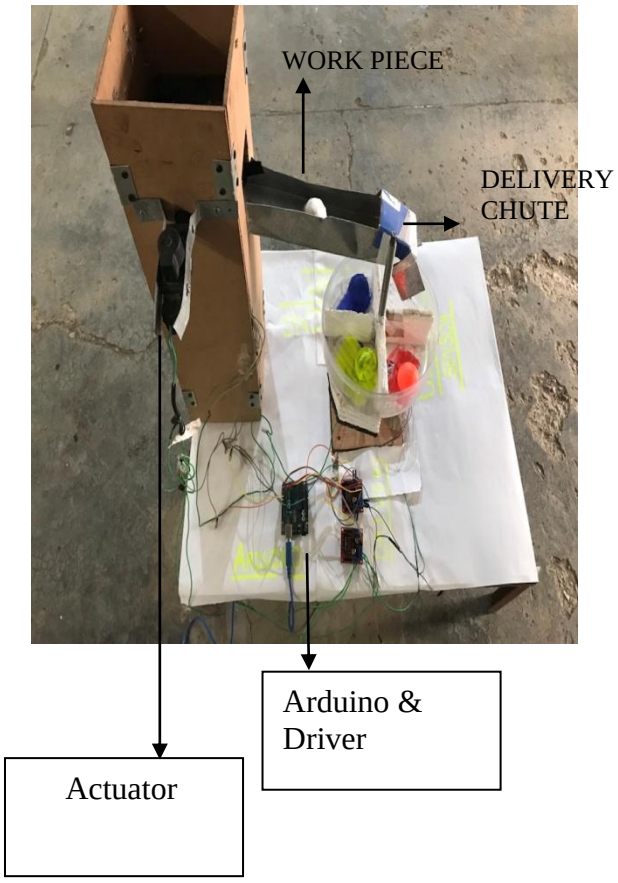

Fig.1 Identification and sorting setup

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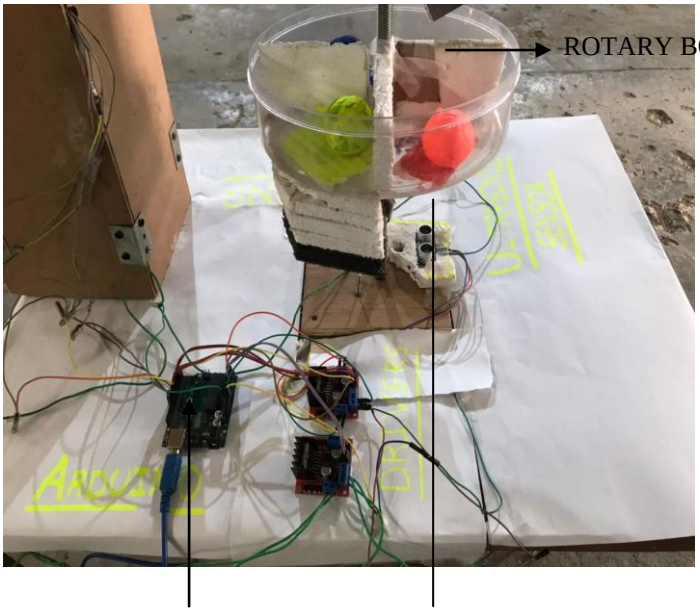

Fig.2 Developed Setup

II. THE DEVELOPED SETUP

As mentioned earlier, the developed setup has been divided into the actuation part and the control part, both of which are explained as follows.

A. THE ACTUATION AND FEEDING PART

This part of the system consists of a vertical feeding channel 150 mm x150 mm and 450 mm height. On top of this feeding column is fixed a funnel through which the components which are colored balls in this case, enter the system. The column houses RGB sensor (TCS3200) as shown in Fig 3, [7]and a solenoid actuator of 12 volt DC rating and 30 mm stroke length shown in Fig 4. After detection, the ball comes out of the column and moves on a delivery chute to be finally fed to a rotary bowl having four compartments with each compartment dedicated to a specific color. This bowl is mounted on a vertical output shaft of a stepper motor 12 volts DC and step angle 1.8 . The rotary bowl is programmed to position itself in such a way that the correct compartment aligns itself with the delivery point to ensure the incumbent falls into the correct compartment.

Fig.3 TCS3200 Color Sensor

Fig.4 Actuator

B. THE CONTROL PART

This part of the system consists of an ultrasonic sensor (HC-SR04) fig. 5, it decides the position of color compartment of rotary bowl to be positioned below the delivery point for a particular ball. The different compartments have been given different thicknesses for this purpose. The next component is RGB sensor whose function has already been explained in section-A. The final part of the control systems is Arduino Uno controller (as shown in fig. 6) which serves as Brain of the system. It receives information from the RGB sensor, compares it with the input of the ultrasonic sensor and generates an output corresponding to the difference between the two. This difference corresponds to the angle of rotation of stepper motor required for correct positioning of color compartment of the bowl.

Fig.5 Ultrasonic sensor (HC-SR04)

Fig.6 Arduino UNO Microcontroller board

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III. WORKING

The process starts with a ball of any color entering the vertical column from funnel. It first stops momentarily at an opening currently closed by the solenoid actuator. During this short haul, the RGB sensor senses its color and sends this information to the micro controller. Micro controller compares this input with the current position of the rotary bowl through the input received from an ultrasonic sensor. The rotary bowl is actually divided into four compartments with each one of them having different base thickness. The ultrasonic sensor is already calibrated with these four values. The micro controller, based on this combination of inputs fetches out an output instruction from the already designed program and generates an output corresponding to the difference between the present position and the predicted new position for matching the right compartment with the color sensed by RGB sensor. This output then rotates this stepper motor accordingly to position correct compartment exactly under the ball delivery point. At the same time, the solenoid actuator retracts and allows the ball to reach its correct destination via delivery chute. The process is repeated every time a new ball enters the system.

The control program is shown in figure 7 and the process flowchart is shown in figure 8 at the end of the paper.

IV. CONCLUSION

The developed system has been successfully tried over the large number of runs with different color combinations of ball. It was found that the system gave a minimal error of less than 1% when measured over a large number of runs. The authors hope that the simplicity low cost and effectiveness of the developed system can be of significant use in the industry with potential future scope.

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```
// this code describes working of only one color as home
position
// for motor to stop

if(whitefrequency>=520)
{Serial.println("motor stops");
  mystepper.step(0);
delay(500);
}
// for red as home position

else if(distance<=15&&distance>=12)
{

 if((bluefrequency<=220&&bluefrequency>=100)) // for
white colour object
{
  Serial.println("rotates 90 degrees");
  mystepper.step((stepsPerRevolution/4)); // rotates motor
  delay(500);
}

 else
if(redfrequency<greenfrequency&&redfrequency<bluefrequ
ency) // for red colour object
 {
  Serial.println("rotates 0 degrees");
  mystepper.step(0);
  delay(500);

 }

else if
(redfrequency>greenfrequency&&greenfrequency<bluefreq
uency) // for green colour object
 {
  Serial.println("rotates -90 degrees");
  mystepper.step(-(stepsPerRevolution/4));
  delay(500);}


else
if(bluefrequency<greenfrequency&&redfrequency>bluefreq
uency) // for blue colour object
{
  Serial.println("rotates 180 degrees");
  mystepper.step((stepsPerRevolution/2));
  delay(500);}

// after rotation of motor, actuator retracts and extends

    digitalWrite(A1,HIGH);
  digitalWrite(A0,LOW);
  delay(400);

 digitalWrite(A0,HIGH);
  digitalWrite(A1,LOW);
  delay(400);
}
```

Fig.7 Control Program

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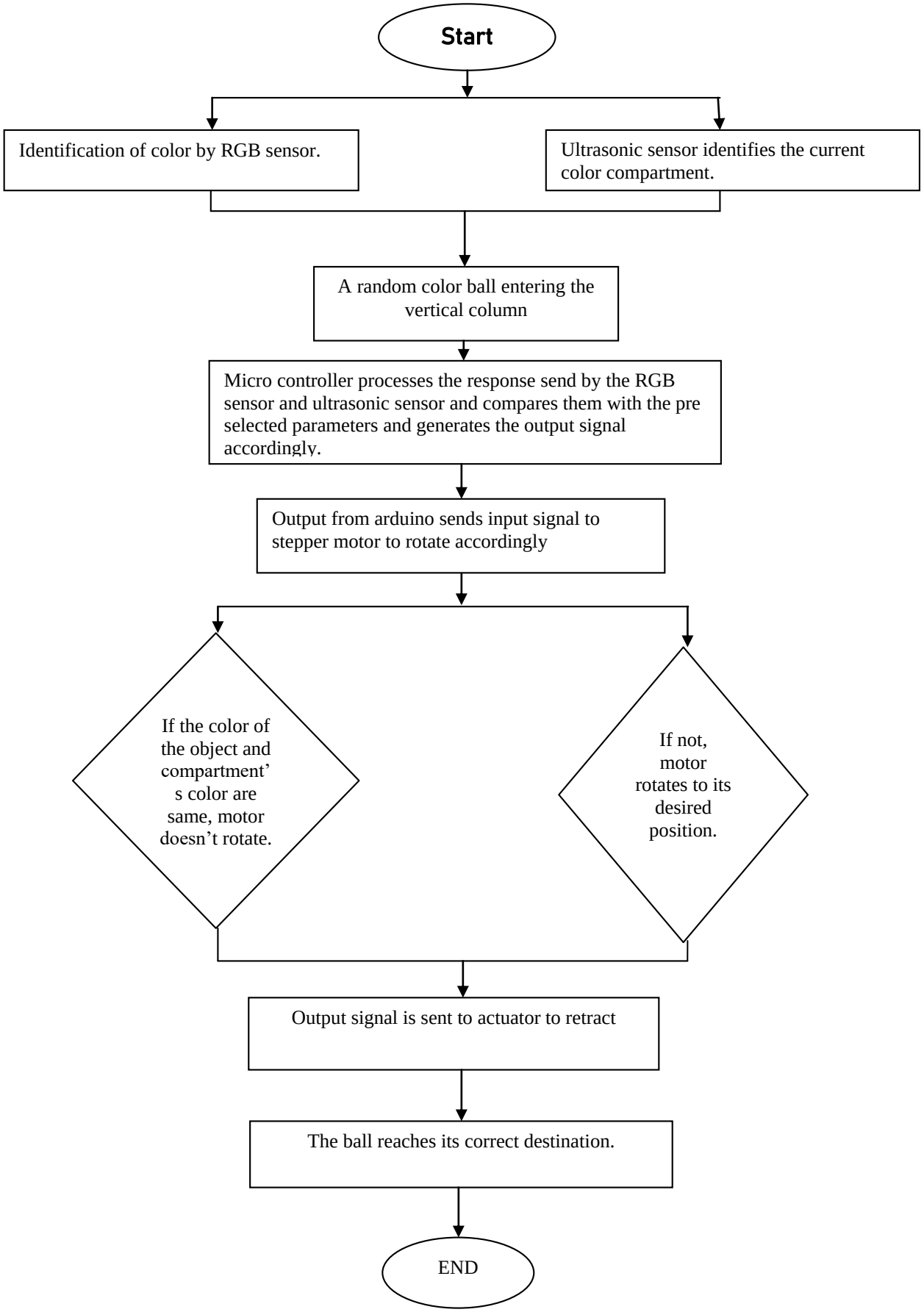

Fig.8 Process Flowchart

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