Color Sorting Robotic Arm

Rahul Krishnan V[1], Sumukha S[2], Tarun Prasanna[3], Tejas N Reddy[4], Dr. PN Sudha[5]

ECE, KSIT, Bangalore, India[1-4]

HOD, ECE, KSIT, Bangalore, India[5]

Abstract: Color sorting is a labor-intensive process that can be automated using a robotic arm. This paper presents the design and implementation of a color sorting robotic arm that can detect the color of an object and then pick it up and place it in a designated bin. The robotic arm is controlled by a microcontroller board, which receives input from a color sensor. The color sensor is used to detect the color of an object, and the microcontroller board then controls the servo motors in the robotic arm to pick up the object and place it in the correct bin. The robotic arm has been tested with a variety of objects, and it has been shown to be able to accurately sort objects by color.

Keywords: color sorting, robotic arm, microcontroller, color sensor, servo motors

I. INTRODUCTION

Technology is a very big part of our day-to-day life has a very important role. This increases the high level of mobility in developing more efficient machines. A robotic arm has human hands like arm, shoulder, wrist and elbow and for pick and places a gripper. This project is used to design and implement a pick-up machine that is based on a colour sensor. Basically the robotic arm is programmed to pick up the object from one place and drop accordingly into respective coloured box. The colour sensors are used to sense the colour of the object to be picked and dropped. The voltage and intensity of the colour sensed is converted into the frequency which is given as input to the microcontroller. The microcontroller enables the motors of robotic arm to grip the objects and drop them in the specified location according to the colour.

II. LITERATURE SURVEY

Colour Sorting Robotic Arm[1].

In this paper presents the design and development of a robotic arm with the application of colour sorting of spherical objects using advanced sensors. Basically, the robotic arm is programmed to pick the spherical object from one place and drop accordingly into the respective coloured box. Here, the colour sensors are used to sense the colour of the object to be picked and dropped, and the voltage i.e., the intensity of the colour sensed is converted into frequency which is given as input to the microcontroller. The microcontroller enables motor driver circuit which drives the motors of the robotic arm to grip the objects and drop them in the specified location according to the colour.
The disadvantage of the given report is that the robotic arm can sense only 3 colours (Red, Blue and Green) and if any other colour is encountered, the arm won't function as desired.

Development of Colour Sorting Robotic Arm Using TCS3200 Sensor[2].

 In this paper sorting objects or products is done manually in industries using human labour consumes time and energy, especially when it involves large volume of products. Human sorting operations could be replaced with robotic implementation, which would save time and effort while producing better results. Robotic arm is a type of programmable mechanical arm, almost similar to the human arm which is programmed to faithfully carry out repetitive actions with a high degree of accuracy. However, creating an artificial sense of touch that is comparable to human's has been challenging. One of the challenges is the detection of objects with different colours. In this work, a light intensity to frequency converter method is used to detect colour. The robotic arm is controlled by a DC servo motors microcontroller-based system. An IoT platform is being used to monitor the detection process, especially the counting for each sorted colour block. Furthermore, the study also performed a comparison of the robotic arm indoor and outdoor efficiency. The chosen TCS3200 sensor operates by distinguishing different generated frequencies for different light intensities. It could distinguish the colours at 95% in a bright condition and 91% in a dimmer condition, based on object detection at 5 cm away from the sensor. The disadvantage of the above paper is that the robotic arm travels only in *180°* direction.

Detection & Distinction of Colours using Colour Sorting Robotic Arm in a Pick & Place Mechanism[3].

In this paper the proposed system is an embedded system which will increase the speed of colour sorting procedure, provide the accurate colour sorting process, decrease the cost of colour sorting process and optimize the productivity of an industrial object. The system comprises of colour sensor, stepper & servo motors and microcontroller. Colour sensor detects the specified colour of the object and microcontroller reads this from the data at its input ports. The microcontroller conveys its decision to the station that been programmed. Since a microcontroller is used as a heart of the system, it makes the set up low cost and effective nevertheless. The significance of a project can be estimated from its current utilization and future prospects of advancements. Industry utilization and manufacturing also defined the significance of this project.

The disadvantage of the above survey paper is that the movement of the robotic arm is restricted and it does not move as freely as one would desire. The angle of the shoulder, elbow and wrist of the arm is limited.

Development of Robotic Arm for Colour Based Goods Sorter in Factory Using TCS3200 Sensor with a Web-Based Monitoring System[4].

The system designed in this paper is for large industry that has the function to process the object like overseeing the processing machine from one product into another useful product, so the product will become more valuable. One of the tools that used is a robotic arm that has functions like a human arm that consist of elbow, wrist, and part for hold goods. With this, the goods that produced can be placed correctly to the container. Nowadays, errors in the calculation of manufactured goods happen frequently due to the lack of workers level of accuracy in performing the calculation manually. This issue could be solved by using TCS3200 sensor that can identify the colour of goods based on the colour that has adjusted. The use of this sensor can be a solution to help a company increases their productivity [1]. With this device, the robot will separate items based on the colour that has been adjusted to identify goods that can be processed. If the container experienced over capacity, the goods will be transferred to the warehouse. The media that store and record any incoming goods through the display interface using the Web. Problems are limited after the used of TCS3200 sensor with colour that already registered into the controller that are red, yellow, and blue for separating items based on colour that has been adjusted. This device generates the movement of the servo motor that designed into robotic arm to move items to the container based on the colour with the Web as monitor and database media. Servo itself can pick up a little weight thing to 0.32oz (0.9 grams). And for the lighting the servo uses 4 pieces of LED that surround and radiate the goods that falling to the sensor. This paper is a way to find a solution to reduce the risk of human error in calculation and placement of goods perform. This device will be used to assist the employee to calculate and selecting the factory goods.

The disadvantage of the above paper is that the sensor senses only limited colours. If any other colour is encountered by the sensor, it won't be able to recognise it and will give an error.

Object Sorting Robotic Arm Based on Colour Sensing[5].

This paper briefs about the 21st century new invocation almost on a daily or weekly basis so technology is a very big part of our day-today life has a very important role. Technology used in various field in various machines also. This increases the high level of mobility in developing more efficient machines. Now a day's mostly this type of technology is used in an educational environment, in this one of them is the Robotic Arm, which is now a very much important part of human lives today. The robotic arm is in a standing position so it can't move from one place to another place but is shaped like a hand so it can pick things and then drop them on the designated area.

A robotic arm has human hands like arm, shoulder, wrist and elbow and for pick and places a gripper because robotic arm can't move his place so arm have a limited amount of space to work on. Arduino which is a very helpful microcontroller, Arduino has advantages that can make the automotive field very useful. This project is used to design and implement a pick-up machine that is based on a colour sensor. The TCS 3200 colour sensor is used to sense RGB colours. Light from the LED will emit light onto the object and it will reflect. Photodiode will receive the light from an object, the intensity of the object affects the values of resistances the colours R, G & B have different intensities it gives different resistances values, therefore, Arduino gets a different reading and according to that it will work. The power supply is used to provide the required voltage of input power of 12v.

The disadvantage of the above paper is that that the movement if the arm is not as free as we want. It moves only in limited and specific direction and angle. Changing of the angle is not feasible.

Review on Sensor based Colour Sorting Robot for Candy Manufacturing[6].

Automation is very important task for control systems for handling different process station, for improving the product quality. With help of automation humans working in the hazardous areas can be reduced and it brings safety for humans. The error caused due to human negligence can be prevented with the help of automated system for classifying the various colour. In this work the main components involved are conveyor belt. Colour sensor, and dc motor. Input and output from this modules are easily accessed by using various controllers like Arduino, Raspberry Pi, IOT and PIC controllers. In this work various operating methods are compared for colour recognizing, sorting and motor with microcontroller. Colour sorting are used in various application for sorting of rotten fruits and defected products.

The disadvantage of the above paper is that the colour sensing of the sensor is limited. It senses only 3 colours i.e; Red, Blue, and Green. The sensor can 't detect other colours and is one of the shortcomings of this survey paper.

III.   METHODOLOGY

A.   Proposed Method

A color sorting robotic arm is a type of industrial robot that uses advanced sensors and software to sort products by color. It is commonly used in manufacturing industries where products need to be sorted quickly and accurately based on their color. The robotic arm is designed to pick up products from a conveyor belt or other input source and then sort them into different bins based on their color. The way it works is quite simple - the robotic arm first scans the product using a TCS32000 Color Sensor and then analyzes the image to determine the color of the product. Once the color has been identified, the robotic arm moves the product to the appropriate bin based on the pre-programmed instructions. This process is repeated continuously, allowing for high-speed and accurate sorting of products. The sorting criterion of the system is colour and so a photodiode is used as a colour sensor. The microcontroller is an integral part which controls the rest of the blocks of the unit. The colour sensor module consists of TCS3200 RGB sensor chip and 4 white LEDs. The sensor converts the readings from the photodiode into a square wave by using the light to frequency converter. This chip can recognize a wide range of colors and it gives the output in the form of frequency. Along with this module we also use servo motor which plays an important role. Just like we have joints and muscles in our arms that help us move and position in a certain way, in the same way a robotic arm needs something to help it move and perform tasks. We use 5 servo motors, the base motor runs the rotation of the motion , servo motor at shoulder runs the shoulder movement, elbow controls its angle movement, while wrist is used to orient the parts and grippers are the part that enables robots to pick and hold the object. After sensing the colour of the object, picks the object using a gripper. This requires controlling the gripper motor. The controller now moves the arm to the dropping location where the gripper motor is again controlled to drop the object.
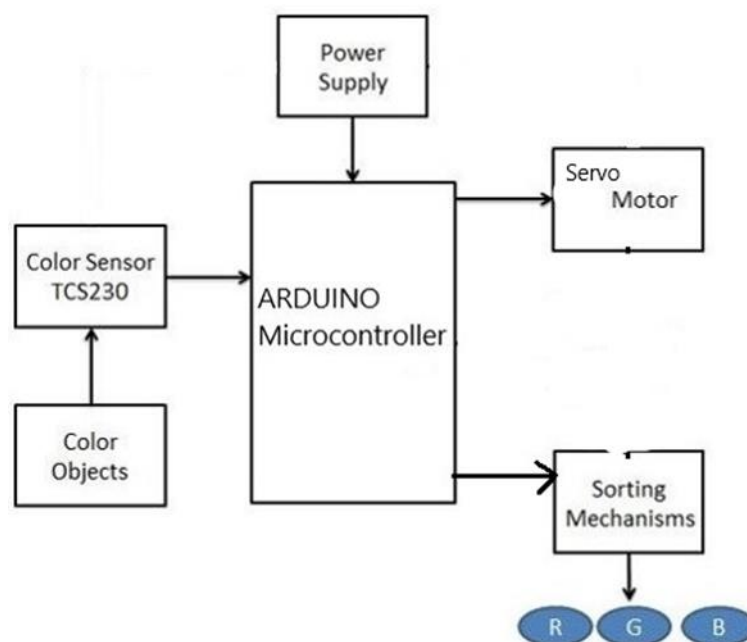

Figure 1: Block diagram

The components used are:

a) MICRO SERVO MOTOR : A micro servo motor is a type of servo motor that is small in size and has a high torque-to-weight ratio. Micro servo motors are typically used in applications where precision and accuracy are required, such as robotics, CNC machines, and medical devices.

b) SERVO MOTOR : A servo motor is a type of motor that is used to control the position or speed of a rotating shaft. It is a closed-loop system, which means that it uses feedback to ensure that the shaft is rotating to the desired position.

c) TCS3200 COLOR SENSOR The TCS3200 is a color sensor that uses a photodiode array and a current-to-frequency converter to measure the intensity of red, green, and blue light. The sensor has an 8x8 array of photodiodes, with 16 photodiodes each for red, green, and blue light. The photodiodes are covered with filters that allow only the corresponding color of light to pass through.

d) JUMPER WIRES: A jumper wire is a short piece of electrical wire with connector pins at each end. It is used to connect two points in a circuit without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

e) ARDUINO UNO BOARD : The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller (MCU). It has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.
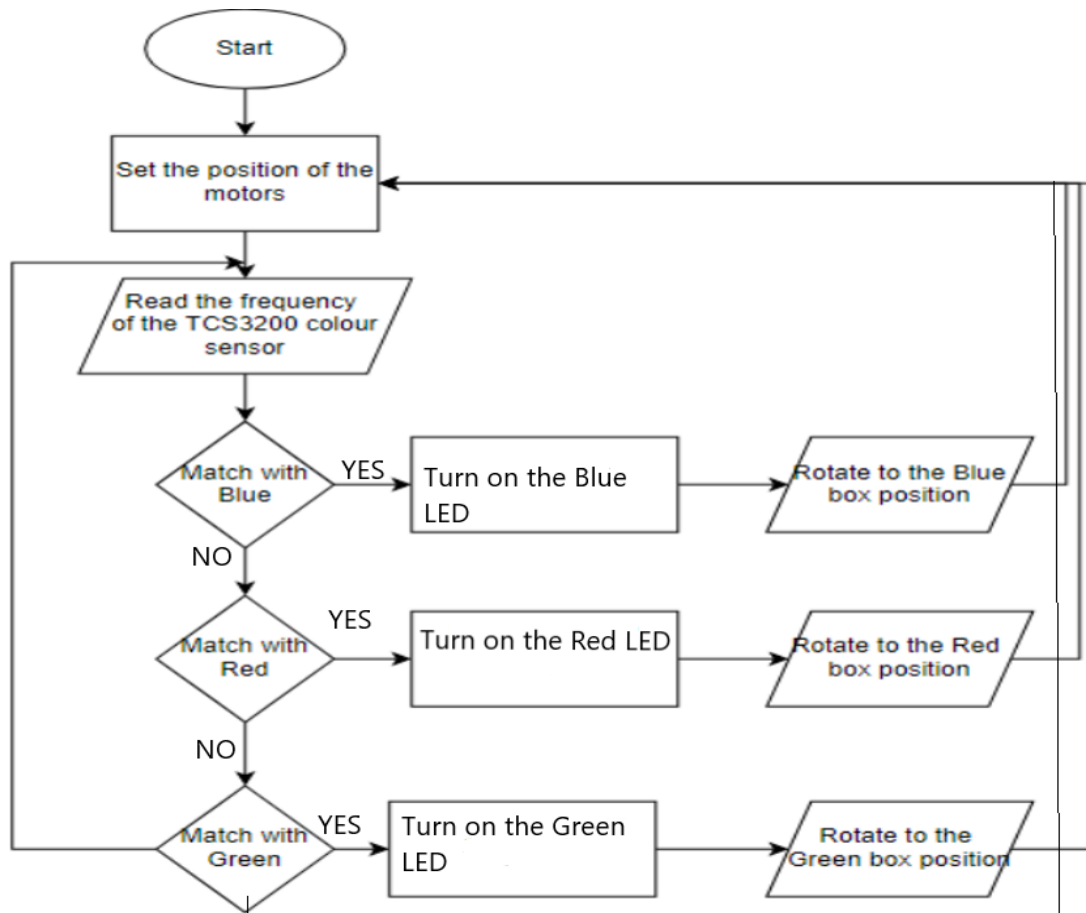
B.   Flowchart

Figure 2: Main Flowchart

IV. RESULTS

The main operation done in the sensing section is detection of objects, identification of colour is compared. The project will achieve a system to sort objects with colour and is suitable to be implemented in different types of machines. The colour sensor can distinguish the colour frequency in any condition. The robotic arm has been developed and built using TCS3200 color sensor and servo motors. The robotic arm built is successful in effectively identifying the object colors and sorting them. The robotic arm reduces the man-power and also produces more accurate & high quality of work. Robotic Arms have a wide scope of development. Shortly the arms will be able to perform every task as humans and in a much better way. The system can work in the same way as a human arm. They can produce a greater quantity in a short amount of time. Robotic arms can work at a constant speed with no breaks , days off or holiday time. Robotic arms can offer increased productivity, efficiency, quality and consistency.
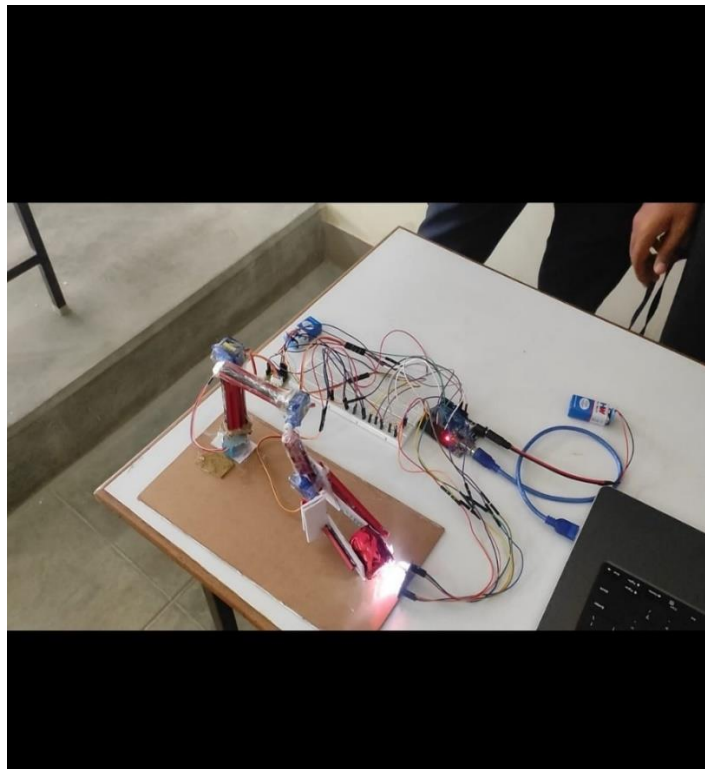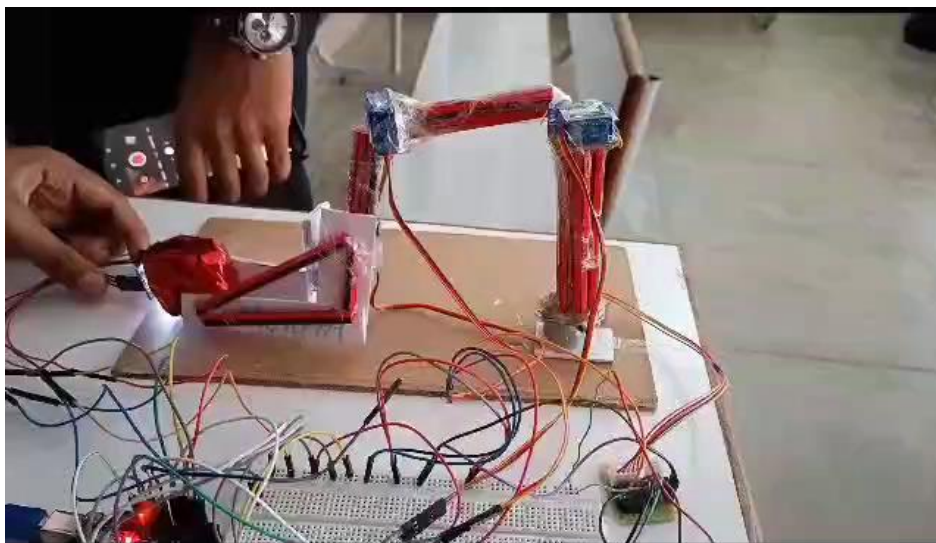

Figure 3: Setup
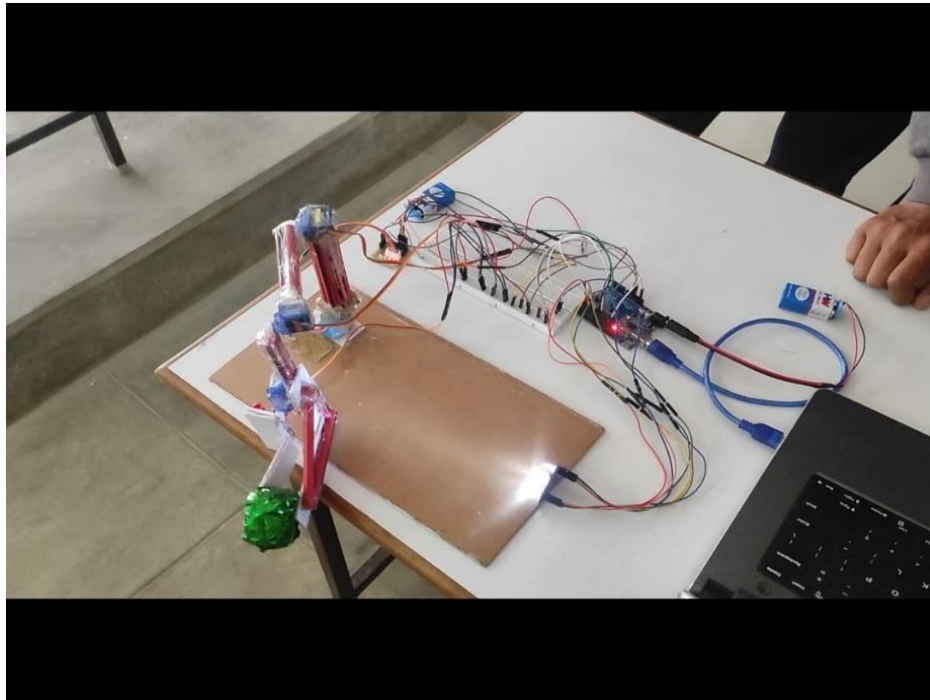

Figure 4: Robotic Arm Picking up an object

Figure 5: Robotic Arm dropping an Object

REFERENCES

[1] https://ijarcce.com/upload/2017/march-17/IJARCCE%2092.pdf

[2] https://www.irjet.net/archives/V4/i10/IRJET-V4I10180.pdf

[3] https://iopscience.iop.org/article/10.1088/1757-899X/1084/1/012094

[4] https://www.researchgate.net/publication/358456382_Development_of_Colour_Sorting_Robotic_Arm_Using_TCS3200_Sensor

[5] Lim Jie Shen, Irda Hassan "Design And Development Of Colour Sorting Robot" Journal of Engineering Science and Technology EURECA 2014 Special Issue pp.71 – 81, January 2015

[6] Rudresh.H.G, Prof. SHUBHA.P" Colour Sensor Based Object Sorting Robot" International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 08 , Aug -2017