

# Object Sorting EYE-BOT based on Color Sensing Using MATLAB for Industrial Applications

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**Abstract**—In many packaging industries, color object counting and sorting is the major task that needs to be done at final dispatch section. Manual sorting is the tradition approach that preferred by industries. In this approach, visual inspection performed by human operators. This traditional approach is tedious, time consuming, slow and non-consistent. Therefore the efforts are made to design and implementation of automatic technique to determine color of object, color based object counting and sorting using image processing technique. Color is the most common feature to distinguish between objects, sorting, recognizing and tracking. Generally robot is mounted with a camera or the camera is mounted in the workspace to detect the object. This technology can be used in material handling in logistics and packaging industry where the object moving through a conveyer belt can be separated using a color detecting robot. The 'Objrec' algorithm is executed to identify the object and send the appropriate commands to the microcontroller using wireless communication for the robot to perform the sorting operation.

**Keywords:** Industrial logistics, Color object counting, Image processing, wireless communication, Object sorting and Arduino.

## I. INTRODUCTION

Industrial automation and robotics are at a high demand in the industry as both of them directly affect the growth of the industry. Automation has had a notable impact in a wide range of industries beyond manufacturing. Automation is the use of machines, control systems and information technologies to optimize productivity in the production of goods and delivery of services. Quality and flexibility of the product is the important criteria of the industry. Use of industrial robots is leading automation industry to another transition. Robotics is the branch of technology that deals with the design, construction, operation and application of robots, as well as computer systems for their control, sensory feedback, and information processing. Today, robotics is a rapidly growing field, as technological advances continue, research and design. The most common technology used at present in the industry is image processing. Due to the advent of powerful cameras, computer, controllers for controlling the machines and sophisticated tools image processing has become the most

powerful emerging technology. Image processing is basically improving and enhancing the images taken in daily life using cameras considered as vision sensors for various applications. MATLAB is the most powerful tool box for image improving, enhancing and categorizing different images using different features such as color, dimensions and texture of the object. Generally signal processing is used in the analysis of the color of an object. In this paper the detection of different colors is done through image processing technique using MATLAB and conveyer belt with object sorting assembly has been designed using microcontroller circuitry. Sorting of various products in industries is accomplished based on appearance i.e. color, shape and sizes.

The goal of the project is to develop Eye-Bot. Eye-Bot is a typical model used to pick and place the desired color objects from one location to another. This robot is used in sorting the objects in a mixture of different color objects. An 'objrec' algorithm was developed in MATLAB to recognize the color and send command to the controller using serial communication. The controller that was used is Arduino 2560. RS232 communication was used for MATLAB to communicate with the microcontroller.

## II. LITERATURE SURVEY

Object Sensing and sorting is very important task in various packaging and logistic industries at final packaging unit. Till today many efforts are made to design sophisticated systems fulfill object color recognition and sorting mechanism using various color sensors, image processing software's like MATLAB and necessary mechanical assembly to sort object has been developed in the form of either conveyer belt or robotic arm using arduino and microcontroller.

To reduce human efforts on mechanical maneuvering different types of robotic arms are being developed. These arms are too costly and complex due to the complexity and the fabrication process. Most of the robotic arms are designed to handle repeated jobs. In design of the robotic are different parameters are to be taken care. The design of mechanical structure with enough strength, optimum weight, load bearing

capacity, speed of movement and kinematics are important parameters. In electronic design the specification of the motors, drives, sensors, control elements are to be considered. In the software side the re-configurability, user interface and implementation and compatibility are to be considered.

The 'Objrec' algorithm is written in MATLAB for performing the operation object recognition operation is presented in [1]. The 'Objrec' algorithm is executed to identify the object and send the appropriate commands to the microcontroller using serial communication for the robot to perform the sorting operation.

A mechatronics color sorting system presented in [2] based on application of image processing. It aims in classifying the colored objects by color, size, which are coming on the conveyor by picking and placing the objects in its respective pre-programmed place. Thereby eliminating the monotonous work done by human, achieving accuracy and speed in the work.

Aashik Chandramohan et al. [3] presented an application to sort objects based on its color using a robotic arm. In which computer vision is carried out with the aid of OpenCV and the robotic arm is powered by Arduino microcontroller. The eBox-3300MX is used as the hardware to integrate OpenCV with robotic arm.

IK model of Deter ER2 robot arm was developed and implemented using wireless embedded system in the ref. paper [4]. IK model developed has provided correct joint angles to place the robot arm end-effector in the desired position. The simulation results have been compared with actual motion of the robot arm. It was found that the robot arm end-effector position precision was within  $\pm 1$ cm. This deviation is due to the mechanical coupling of the joints

In the paper [5] calibration routine was able to adequately account for slight translations of the camera mount when the system was taken down and set up again to ensure accurate object location. Though the test objects were only red, green and blue, the system was capable of sorting other objects as well, as long as their base colors were distinguishable.

### III. SYSTEM DESIGN AND IMPLEMENTATION

#### A. Hardware Implementation

The hardware board as shown in figure 1 consists of:

- Power supply
- Arduino 2560
- MAX 232
- Web cam

- RF Tx & Rx
- Motor drivers (L293D)
- Geared DC motor
- Robotic arm
- Conveyer belt

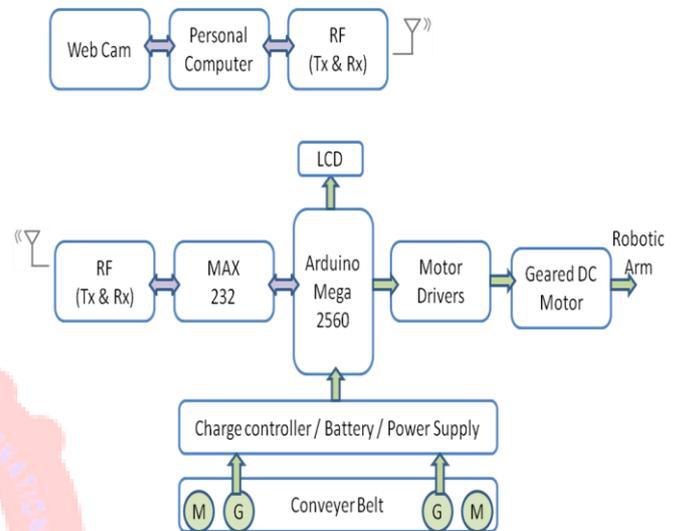


Figure 1: Block Diagram

The power supply supplies the power of 5V to the Arduino. The Arduino has microcontroller ATmega 2560. ATMEGA 16 which receives the commands from the MATLAB and sends the commands to the L293D for driving the motors. MAX 232 IC is used for serial communication in order to communicate with the PC. A pair of Tx and Rx is used in between MAX232 and PC for the flow of data.

Once the color is detected, the microcontroller will initiate the following actions on the robot.

- Gripper open
- Gripper close
- Left
- Right

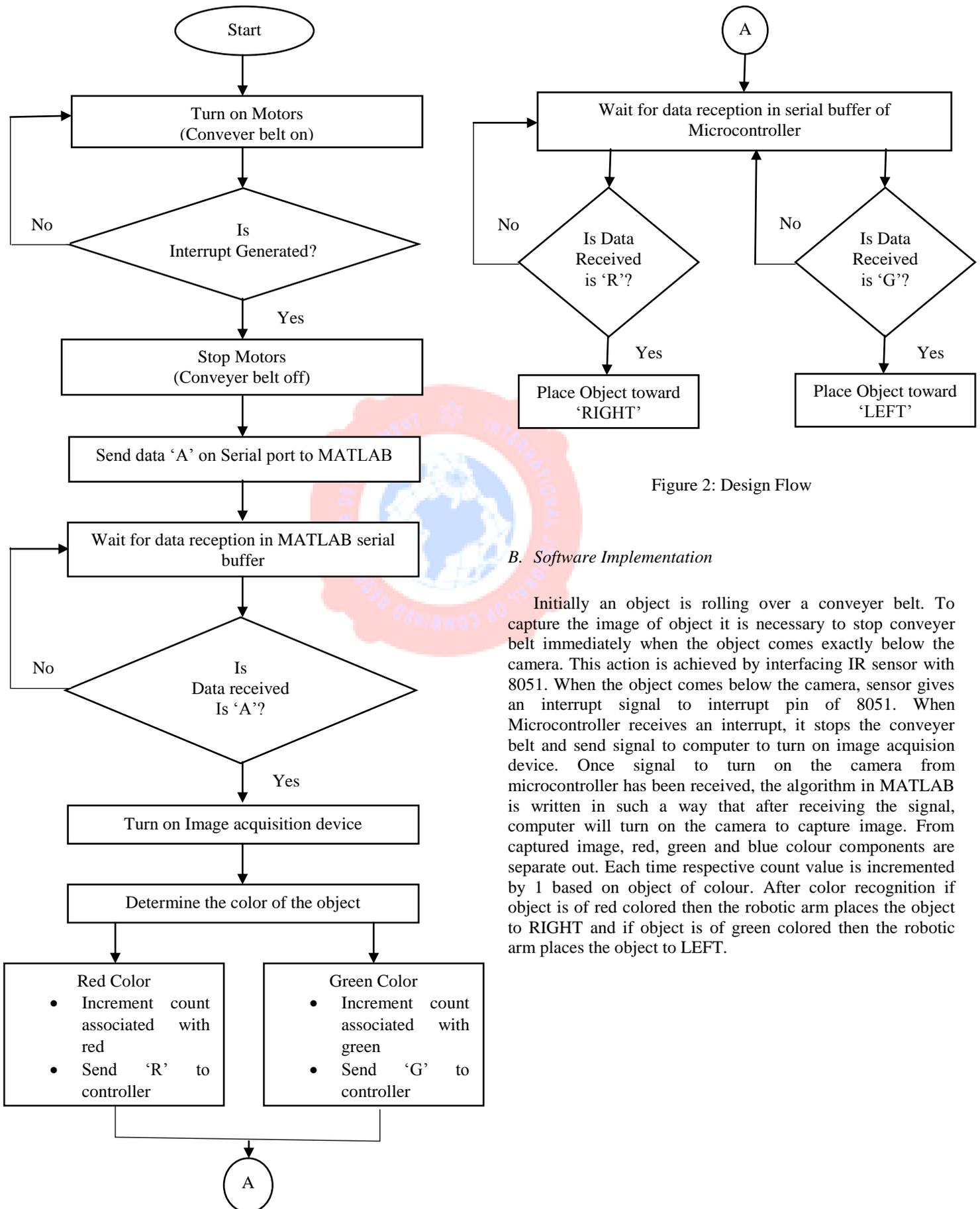


Figure 2: Design Flow

*B. Software Implementation*

Initially an object is rolling over a conveyer belt. To capture the image of object it is necessary to stop conveyer belt immediately when the object comes exactly below the camera. This action is achieved by interfacing IR sensor with 8051. When the object comes below the camera, sensor gives an interrupt signal to interrupt pin of 8051. When Microcontroller receives an interrupt, it stops the conveyer belt and send signal to computer to turn on image acquisition device. Once signal to turn on the camera from microcontroller has been received, the algorithm in MATLAB is written in such a way that after receiving the signal, computer will turn on the camera to capture image. From captured image, red, green and blue colour components are separate out. Each time respective count value is incremented by 1 based on object of colour. After color recognition if object is of red colored then the robotic arm places the object to RIGHT and if object is of green colored then the robotic arm places the object to LEFT.

#### IV. APPLICATIONS

**Waste Management Applications:** - It is used in garbage classifier to separate bio-degradable, non-degradable, metal pieces, and plastics based on color. It can also be used to segregate and separate dry waste and wet waste based on color.

**Automotive Agro Applications:** - The Pick and Place robot is used in agriculture for collecting ripened fruits based on the color. The ripe fruits have a different color compared to the unripe fruits. For example, ripened tomato is bright red in color and the unripen one is green. So the pick and place robot can pick the fruits according to their necessity by identifying the color.

**Industrial Applications:** - As the assembly of the machine parts involving color is a tedious task for execution, the robots are conveniently used to pick and place the parts. It can be used in packing fruits and vegetables of only specific quality in industries like the good quality apples which will be bright red in color.

**Auto industry:** - The auto industries are the largest user of robots, which industrialize the production of various components and assemble the body of the finished vehicle based on colours. Car production is one primary example of the employment of complex and large robots. Pick and place robots based on color identification are used in that process for the picking and placing the components for assembly of the body of the automobiles.

#### V. RESULT

The experimentation work is mainly focused on basic colour detection of various objects; colour objects count calculation and sorting to avoid wastage of time and manpower. The objective is met by sorting the objects based on the color feature from a group of objects.



Figure 3: picking the object

The connection is made the camera detects the object and using serial communication the robot picks the object and places in the desired location.



Figure 4: Placing the object

The robot gets the signal about the position of the object in the work space through the serial communication. Once the color of the object is known the Eye-Bot picks the object. Then robot reaches the desired location to place the object in the appropriate position, according to the microcontroller commands.

The desired operation is met and the robot gets back to the home position in order to fetch the other objects, once the current operation is performed.



Figure 5: Displaying count of objects

## VI. CONCLUSION

The conclusions drawn from results given by algorithms used for automatic colour object counting and sorting in prototype system design to implement automation in automatic technique to determine colour of object ,object count and sort object based on colour using image processing approach are as follows,

1. An image processing approach for object colour detection, count calculation and object sorting has been implemented.
2. Implemented system gives accurate result for purely Red, Green and Blue coloured objects.
3. With some software changes this system can be used for different shades of basic specified colour.
4. Due to use of automation in colour determination and count calculation process, manual efforts are reduced which leads to improving accuracy as well as saves money and time.

## VII. FUTURE SCOPE

The color detection capability can be increased to many colors along with red and green which can sort out wide range of objects. Colour detection along with pattern recognition and Speech recognition will play a vital role in many industries and also will increase the accuracy of the task in logistic and packaging industry. With slight software changes this system can be integrated to determine shape of different objects as well as fault finding in different jobs.

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