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Colour Object Counting and Sorting Mechanism Using Image Processing Approach

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Abstract: In many packaging industries, colour 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 colour of object, colour based object counting and sorting using image processing technique. In implemented system, image of a coloured object which is rolling over a conveyer belt has been captured using suitable image acquisition device. Using image processing technique, the colour of an object which may be red, green or blue has been determined. Once the colour of an object is determined, implemented system will automatically count and sort the objects as per its colour. The algorithm for object colour determination, colour based object counting has been developed in MATLAB and object sorting assembly has been designed using Microcontroller circuitry.
Keywords: Colour object counting, Object sorting, MATLAB, Microcontroller.

I. INTRODUCTION

In many packaging industries, colour object counting and sorting is the major task that needs to be done at final dispatch section. Sorting of various products in such industries is accomplished based on appearance i.e. colour, shape and sizes. Manual sorting is the tradition approach that preferred by industries that involves visual inspection performed by human operators. This traditional approach is tedious, time-consuming, slow and non-consistent. It has become increasingly difficult to hire personnel who are adequately trained and willing to undertake the tedious task of inspection. A cost effective, consistent, superior speed and accurate sorting can be achieved with machine vision assisted sorting[5].
The implemented system deals with automatic counting and sorting of coloured objects rolling over a conveyer belt. The algorithm for colour object counting and sorting has been developed using MATLAB and conveyer belt with object sorting assembly has been designed using Microcontroller circuitry. In implemented work Image processing procedure senses the objects in an image captured in real-time by a webcam and then identifies color and information out of it. This information is processed by image processing for object colour recognition, sorting and counting mechanism.
The implemented work involves sensor assembly interfaced with microcontroller that senses the position of object. When object is exactly below the camera, sensor sends the signal to the microcontroller. The microcontroller sends signal to circuit which drives the various motors of conveyer belt and object sorting mechanism. Based upon the colour detection, the motors rotate to sort the object.

II. LITERATURE SURVEY

Object colour sensing and sorting is very important task in various packaging industries at final packing unit. Till today many efforts are made to design sophisticated systems to fulfill object colour recognition and sorting mechanism using various colour 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 ARM processor, Arduino and Microcontroller.

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 objects moving through a conveyer belt can be separated using a colour detecting robot [6].

A system proposed in [1] separates the objects from a set according to their colour. It mainly works on the objects which move on a conveyer belt. The proposed method of categorization is based on colour of the object. These system categories balls of three different colours. The detection of the particular colour is done by a light intensity to frequency converter method. The robotic arm is controlled by a microcontroller based system which controls DC servo motors. As the system is working with open loop, the system responses are a little bit slower than expected.

A mechatronics color sorting system presented in [2] based on application of image processing. It aims in classifying the colored objects by colour, 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.

The 'Objrec' algorithm is written in MATLAB for performing the operation object recognition operation is presented in [3]. 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.

Aashik Chandramohan et al. [4] presented an application to sort objects based on its colour 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.

III.SYSTEM DESIGN AND IMPLEMENTATION

3.1 Hardware Implementation:

3.1.1 Image Acquisition Device:

While developing a prototype model for automatic counting and sorting of coloured objects rolling over a conveyer belt, images have been captured using INTEX IT-105WC, USB web camera having 1/7" CMOS sensor, 8.0 mega pixels capacity. Images are captured at a data rate of 30 frames per second. Further processing is carried out using functions available in image acquisition toolbox of MATLAB.

Figure 3.1 INTEX IT-105WC USB web camera used to capture image

3.1.2 L293D & IR sensor interfacing with 8051:

To drive the conveyer belt & Red coloured object sorting, motor M1 and M2 are used whereas for yellow and green coloured object sorting motor M3 has been used in implemented work. To drive these motors L293D motor driver IC has been used to which controlling commands are given through 8051. Hardware controlling unit which is designed using 8051 microcontroller is as shown in figure 3.2(a).

Figure 3.2 (b) and 3.2 (b) shows IR sensor pair used in implemented system, L293D motor driver with necessary configuration respectively.

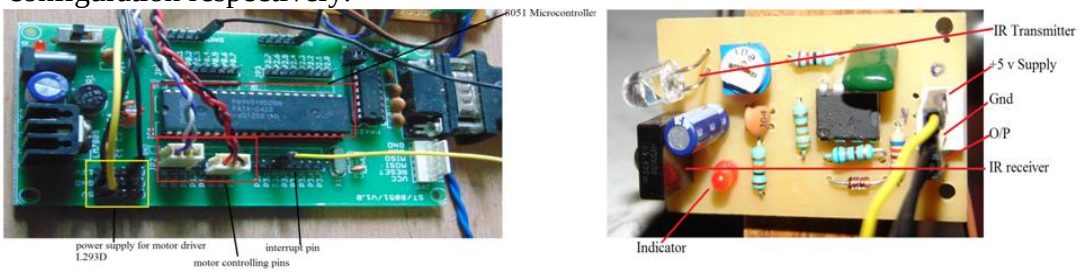

Figure 3.2 (a) 8051 based Controlling unit *(b) IR sensor used for object sensing*

Complete hardware view of implemented work is as shown in figure 3.3

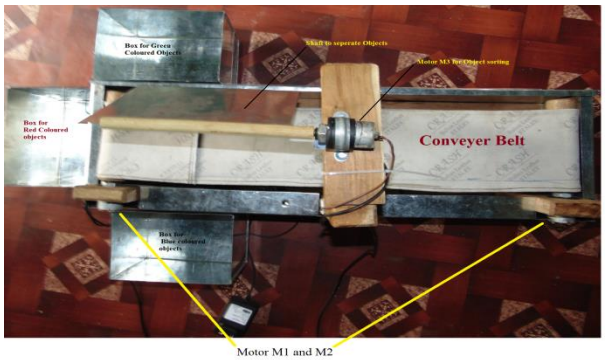

Figure 3.3 Complete hardware view of implemented system

3.2 Software Implementation:

3.2.1 Interfacing IR sensor with 8051 to sense an object:

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 acquision device. The work flow for interfacing IR sensor with 8051 microcontroller to sense presence of object is as shown in figure 3.4.

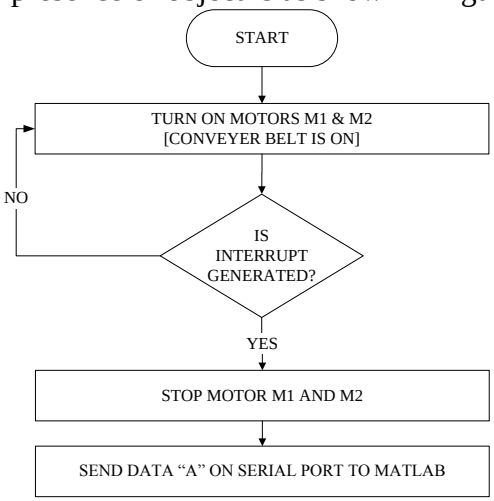

Figure 3.4 flow diagram to sense presence of object

3.2.2 Image Acquisition, Object colour recognition and count calculation:

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 which are *cr1*, *cg1* and *cb1* respectively. The intensity values of each colour are compared together. From comparison depending upon the greater intensity value, the colour of object has been determined. For each object colour count variable *'cr'*, *'cg'* and *'cb'* are initialized with zero as initial value. Each time respective count value is incremented by 1 based on object of colour. The work flow for colour recognition and count calculation is as per figure 3.5.

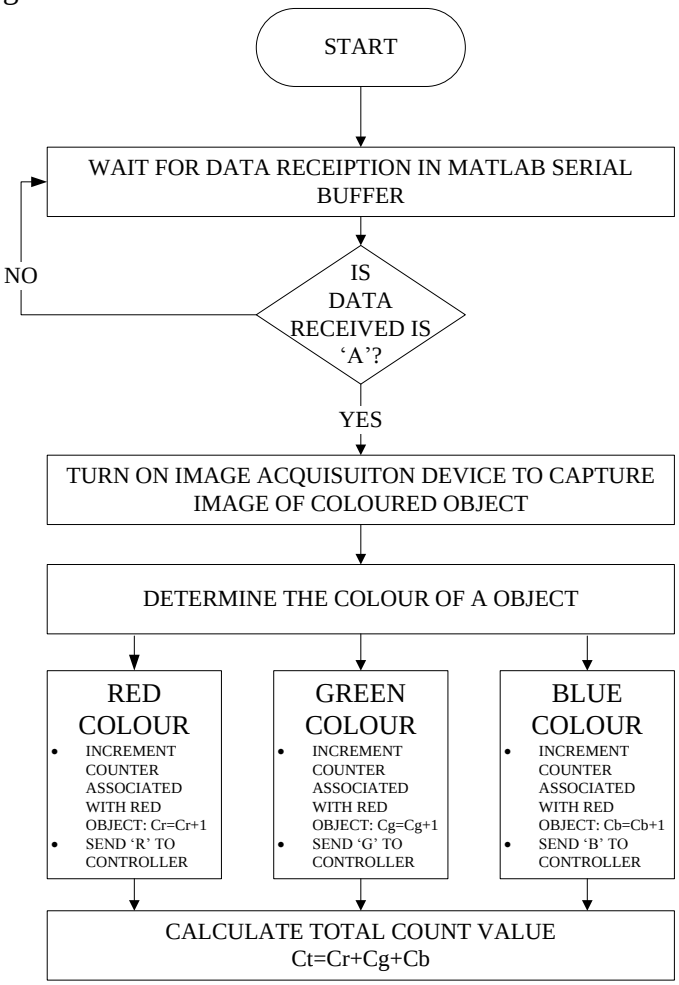

Figure3.5 work flow for object colour and count determination

Once the individual object count as per colour is determined, all are added together to get the total count value of objects.

4.2.3 Object sorting Mechanism

As stated motor M1 and M2 are used to run the conveyer belt as well as to sort red coloured object whereas motor M3 is used sort the green and blue coloured object. After colour recognition if object is of *red* coloured then conveyer belt will automatically turn on which will push the object into a box placed in front of the system.

For *green* coloured object, motor M3 will rotate in clockwise direction to push object into a box which is placed on left side of system and for *blue* coloured object motor M3 will rotate in anticlockwise direction to push object into left side box.

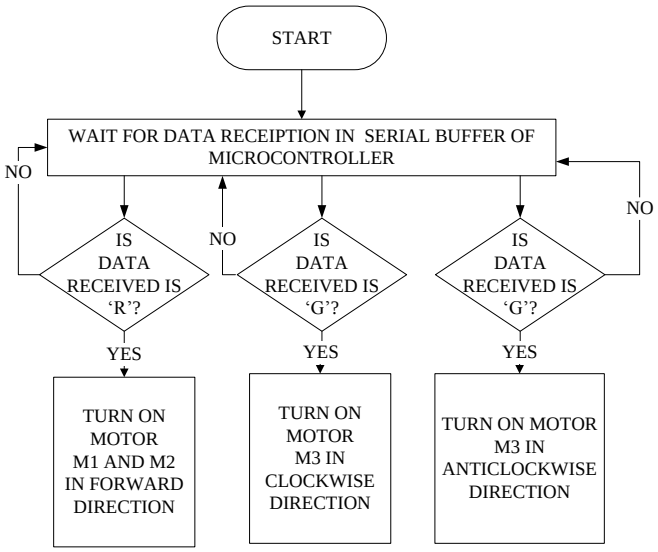

Figure 3.6 flow diagram for object sorting Mechanism

IV GUI WITH RESULTS

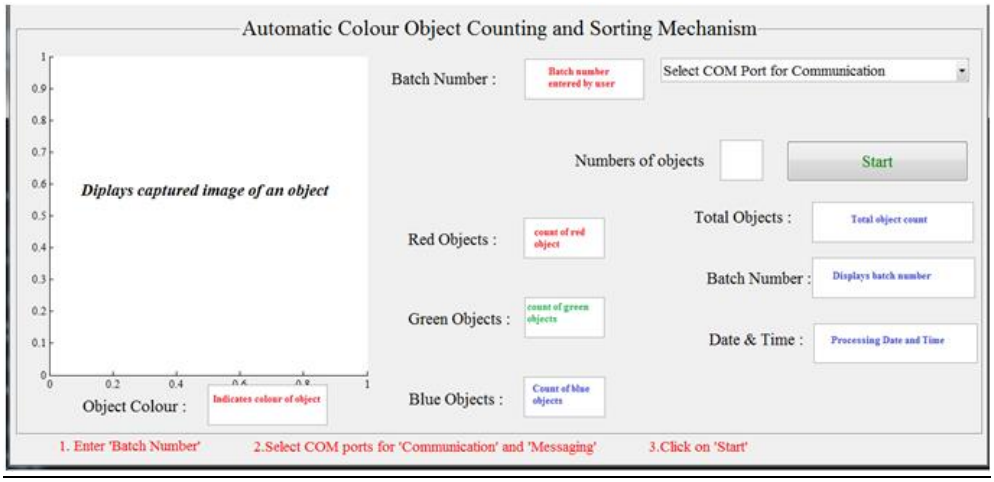

Figure 4.1 GUI of implemented system

Figure 4.1 shows the Graphical User Interface of implemented system. Table 4.1 gives details about various fields of designed GUI.

Table 4.1 Details of different fields of GUI

Sr. No	Title	Use in implemented system
1	1	Displays Image of captured object
2	Batch number	Accepts Batch number from User
3	Red Objects	Displays count of Red coloured Objects
4	Green Object	Displays count of Green coloured Objects
5	Blue Object	Displays count of blue coloured Objects
6	Object Colour	Display colour of captured object
7	No of Objects	No of objects after which result will be displayed
8	Total Object	Displays count of total Objects
9	Batch number	Display batch number
10	Date & Time	Displays processed date and time

Figure 4.2, 4.3, 4.4 and 4.5 shows the result of object colour detection and count calculation which has been obtained with implemented system. As shown in these figures, initially Batch no and no of objects after which result is supposed to be displayed is entered by user in GUI. Communication between 8051 Microcontroller and computer has been done via COM port 3/4. When image of object through camera is captured, it get displayed on GUI.
After processing captured image of object, it was processed by designed algorithm in MATLAB and shows colour of object and corresponding count in different field.

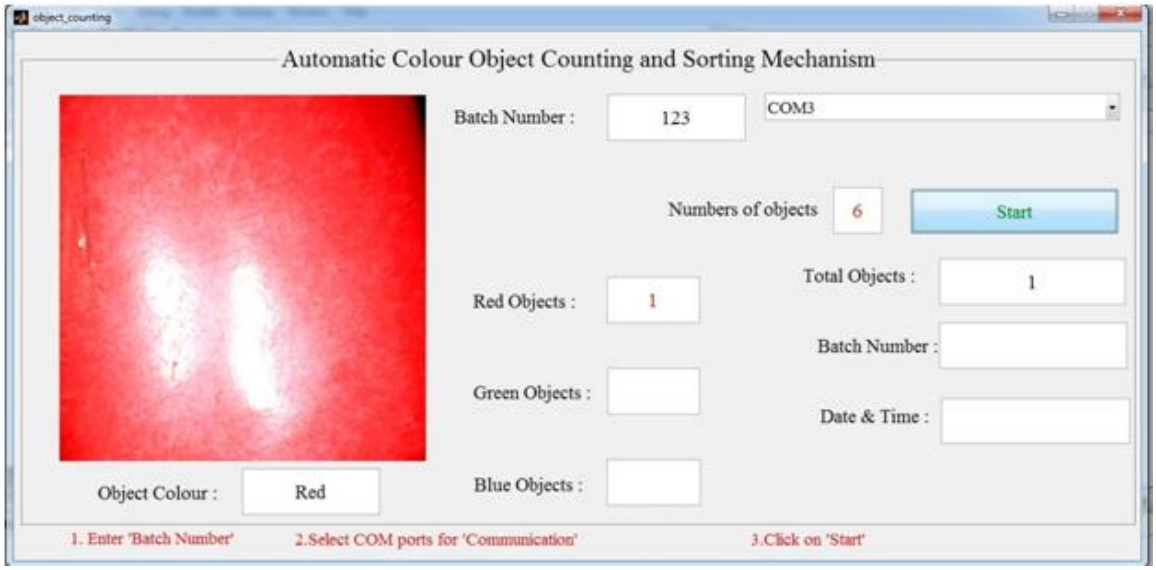

Figure 4.2 Colour object detection for red colour

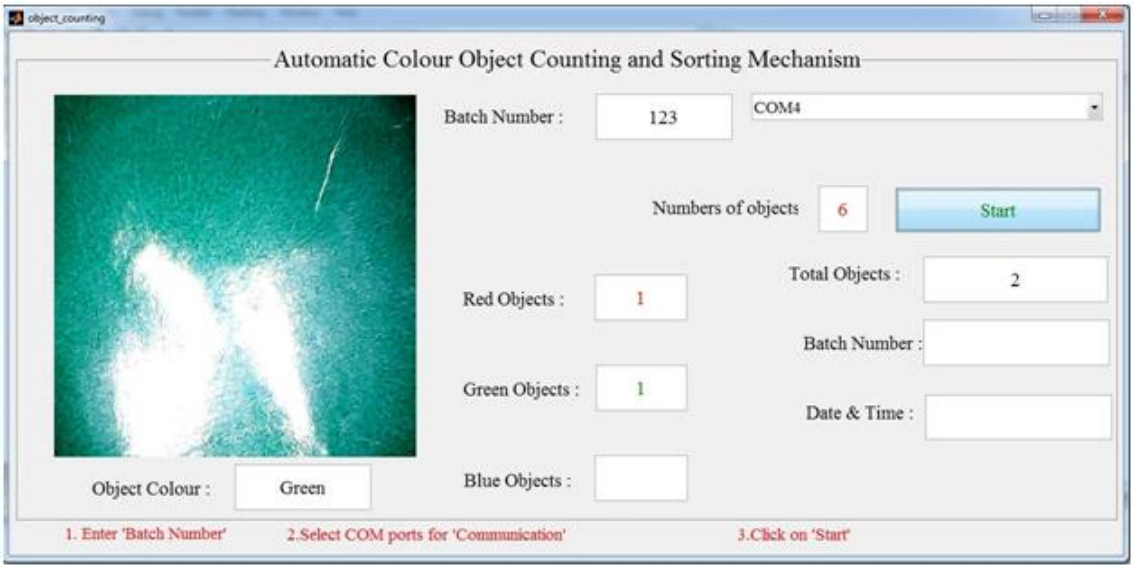

Figure 4.3 Colour object detection for green colour

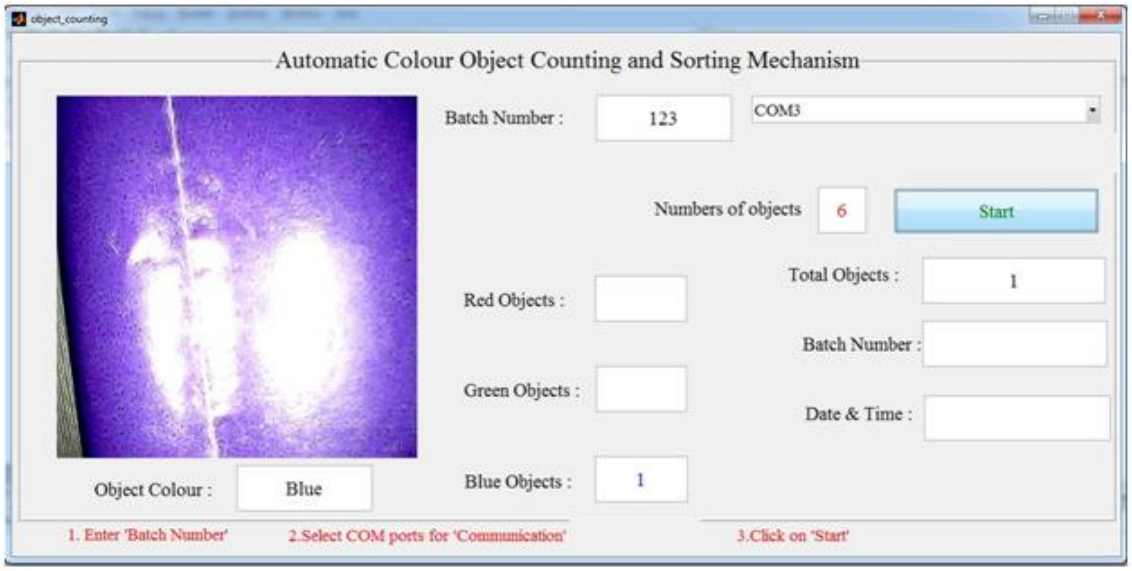

Figure 4.4 Colour object detection for blue colour

As shown in figure 4.5, after completing colour recognition and count calculation for 6 objects, automatically entered batch number and date and time at which processing is done is displayed in GUI After processing captured image of object, it was processed by designed algorithm in MATLAB and shows colour of object and corresponding count in different field.

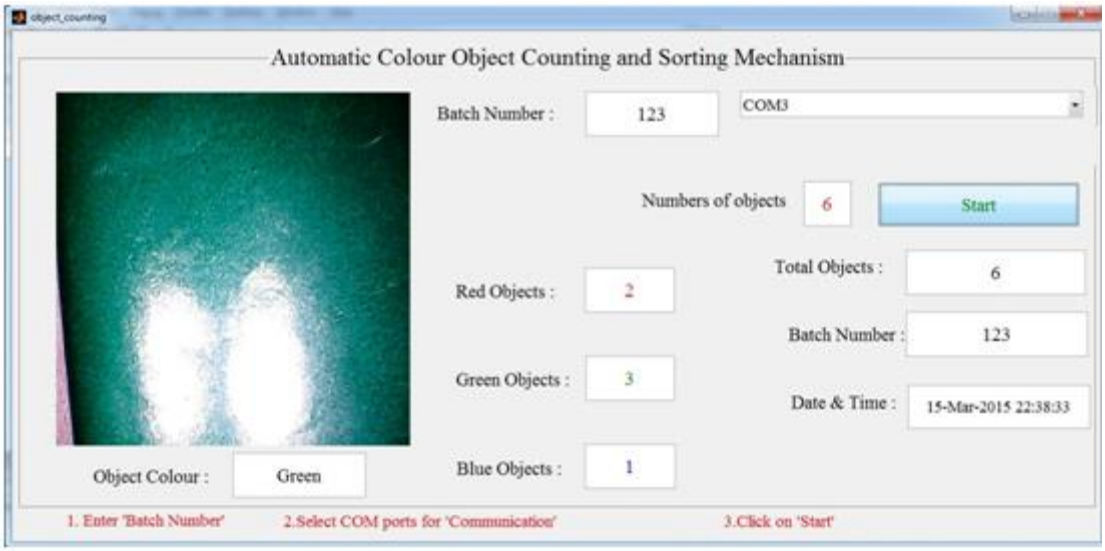

Figure 4.5 Colour object detection for green colour

V. CONCLUSION AND FUTURE SCOPE

5.1 Conclusive Remark:

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.

5.2 Future Scope:

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. This system can be implemented in any mechanical industry at dispatch unit for colour based object packing. 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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