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# APPROACH TOWARDS OBJECT IDENTIFICATION WITH DIGITAL IMAGE PROCESSING

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**ABSTRACT**

Nowadays the importance of process automation has been increased as the growth of any industry is directly dependent on it. For precise output and accuracy of industrial process robots with sophisticated sensors are used. In modern era, application of image processing in many industrial processes has proven its prevalence and dominance. This paper deals with Mechatronics, shape and size sorting system solution with the application of image processing. Image processing procedure senses the object and the image is captured in real-time by a camera and then identifies size and information of it. The work is mainly an automated material handling system. It aims in sorting the undesired objects which are coming on the conveyor by moving the unqualified objects to a rejection bin. Thereby eliminating the monotonous work done by human, achieving accuracy and speed in the work. This work involves sensor that senses the object's shape, size and sends the signal to the microcontroller. The microcontroller sends signal to circuit which drives the motor of the robotic arm to move the object to its specified location.

**Keywords:** Object sorting, Image processing, MATLAB, conveyor belt, shape, mechatronics



## INTRODUCTION

In today's highly advanced and automated industries, efficient methods are used for various production and inspection processes [1]. There was a time when repetitive jobs such as quality inspection, sorting, assembling, painting and packaging etc. were done manually. But after the rapid involvement of robotics, the automation industry has undergone a complete makeover. Large image databases are used in multimedia applications[2]. Digital Image Processing has found many applications in the field of automation. Cameras acquire live video feed or image of the objects moving on the conveyer belt. The video or image is then used to recognize the object, or in some cases, compare the object with a predefined, flawless and expected object and a decision is made based on the degree of similarity between the two images. Segmentation of moving objects is done[3]. A controller controlling a robotic arm then either allows the qualified object to pass or

picks and places the unqualified object into the rejected bin. The software development is the vital task in this project development. The software is entirely coded in MATLAB to compare the objects moving on the conveyer belt with the expected object. Motor in robotic arm controlled through microcontroller is used for sorting according to the result obtained by image processing.

**Materials and Methods**

***A. System Model Description:*** Initially, an IR sensor detects when an object is moving placed on the conveyer belt. The IR sensor output triggers the camera to take an overhead image of the object[4]. The camera acts as the main input sensor. The image is subsequently processed in MATLAB. MATLAB communicates with the microcontroller, sending a decision based on the processing done by it [5]. Another IR sensor detects the object when it reaches the robotic arm. If the object moving on the conveyer belt does not match the expected object, the arm moves it to the reject bin. Otherwise the object moves forward on the conveyer belt. A smart proposal is given in the paper written by for automated material handling system with color and shape determining mechanism VISHNU R. KALE et al[6]. For ceramic industry the mechanical structure of Robo-arm design is approached to be able to work at furnace division for saving time and expenditure in the paper written by Bhavesh Kaila et al[7]. An intelligent idea is presented with color sorting system using image processing in the paper written by Mr. Deepak L RAJNOR et al[8].

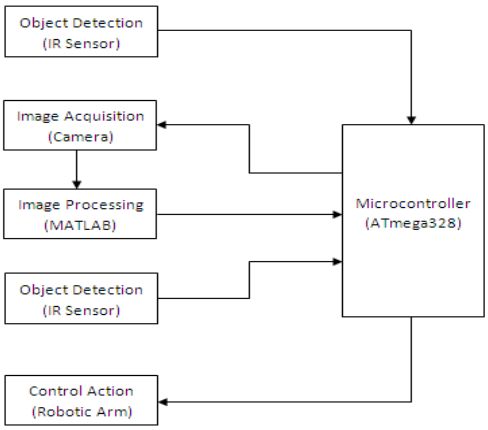


**Fig 1: Flow diagram of the System**

***B. Image Processing Algorithm using MATLAB:*** MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming environment.

***i. Read/capture image:*** The image is first acquired from a live video feed or an existing image can be loaded from the memory. It is considered that the acquired image is in RGB format which is a true color format for an image. In MATLAB, the captured or imported RGB image is three dimensional and each pixel is represented by an element of a matrix whose size corresponds to the size of the image.

***ii. Conversion of RGB image to Black and White image:*** The RGB image is first converted to a two dimensional grayscale image. The grayscale image is nothing but a matrix that holds the luminance (Y) values of the image. The luminance values of the image are obtained by combining the RGB values using the NTSC standard equation (1) that multiplies the primary colors (red, green and blue) with coefficients based on the sensitivity of human eyes to these colors as shown:

$$Y = 0.3 * R + 0.59 * G + 0.11 * B \quad (1)$$

The luminance image is then converted to black and white (binary) image by a process called thresholding. A threshold is set and the luminance of each pixel is compared with this threshold. All values that are greater than this threshold are replaced with a logical one (white) and the values below this threshold are replaced by a logical zero (black). The threshold can be calculated either by determining the luminance values of pixels that correspond to object regions in a sample image (i.e., by machine training) and then averaging these values resulting in the threshold, or by using an algorithm that evaluates the histogram of the image and maximizes the variance of intensity between objects.

***iii. Calculating the area of black and white image:*** 'bwarea' estimates the area of all of the pixels in an image by summing the areas of each pixel in the image. The area of an individual pixel is determined by looking at its 2-by-2 neighborhood.

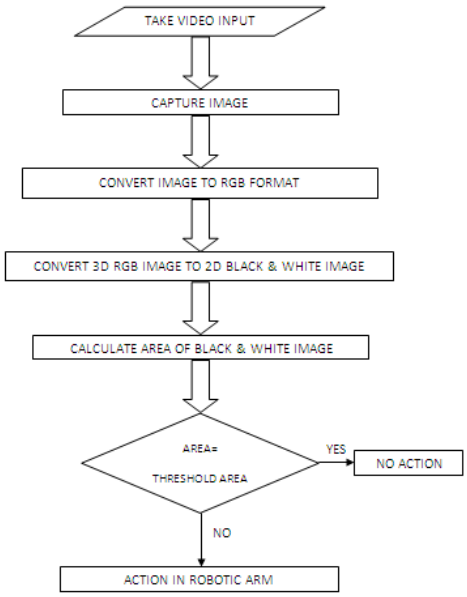


**Fig 2:Image Processing Algorithm**

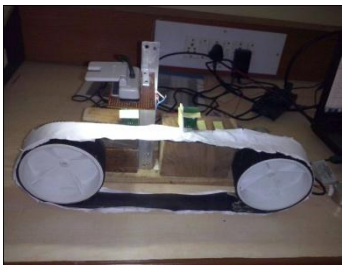

**Fig 3: System model**

```
%enable video input
vid=videoinput('winvideo',1,'YUY2_160x120');
vid.FramesPerTrigger=1;
start(vid);
preview(vid);
pause(5);
%setup arduino
a=arduino('COM6');
a.stepperSpeed(1,50);
a.pinMode(13,'output');
a.digitalWrite(13,1);
i=a.digitalRead(13);
a.pinMode(19,'input'); %camera ir sensor
a.pinMode(20,'input'); %arm ir sensor
%set control value
area1=7e003;
while i==1
    %trigger(vid) if object incoming
    irsensor=a.digitalRead(19);
    if (irsensor==1)
        tic
        im=getsnapshot(vid);
        im=ycbcr2rgb(im);
        %calculate binary area
        im_bw=im2bw(im);
        area2=bwarea(im_bw);
            %reject if area~=control value
            if (area2~=area1)
                irsensor2=a.digitalRead(20);
                if (irsensor2==1)
                a.stepperStep(1,'forward','single',50)
                pause(1)
                a.stepperStep(1,'backward','single',50)
                end
            end;
```

**Fig 4: MATLAB program for image conversion**

## III. Results & Discussion

TABLE I. **TEST RESULT**

| Sl. No. | Black & white area |
|---|---|
| 1. | 7.3489e+003 |
| 2. | 7.4125e+003 |
| 3. | 7.3589e+003 |
| 4. | 7.6253e+003 |
| 5. | 7.3546e+003 |
| 6 | 7.6879e+003 |
| 7. | 8.1109e+003 |
| 8. | 7.2165e+003 |
| 9. | 7.6546e+003 |
| 10. | 7.1587e+003 |

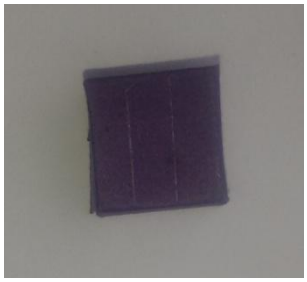

**Fig 5: RGB image of object**

**Fig 6: Black & white image of object (after processing in MATLAB)**

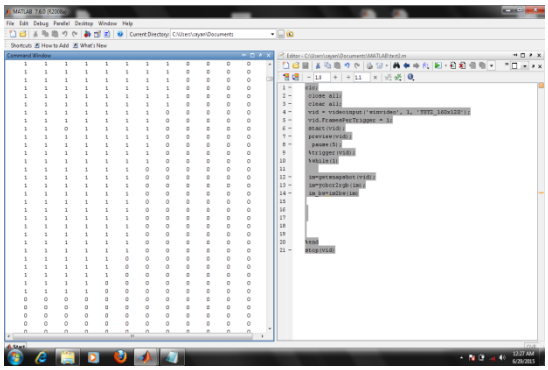

**Fig 7.a: Intermediate matrix generated for Black & white image conversion**

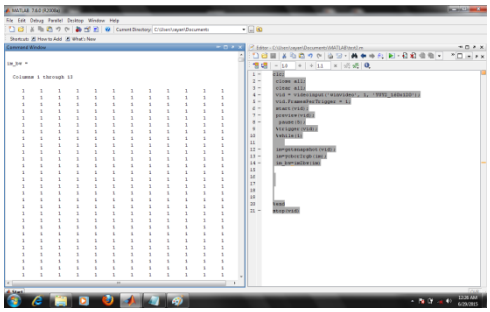

**Fig 7.b: Intermediate matrix generated for Black & white image conversion**

**Advantages**

The main advantages of this approach is based on the high discriminatory capacity of the object classes and on the high degree of parallelism, capable of processing large amounts of material on production lines. The use of modern electronic systems also allows high operative speed, easy calibration and flexibility (due to a programmable sorting algorithm) to the required classification features. It has high efficiency with higher quality of sorting. It has high sensitivity and ability to distinguish between the objects. It will be always better than human sorting. Some of the prominent advantages are-

- High efficiency: the sorting speed can be very high.
- High precision: the margin of error can be reduced to great extent.
- This type of sorter can be used for various objects or vegetables of different colors. Also suit to select pears, orange and other fruits of this kind.
- Good quality and low failure rate with long life.
- Reliable operation and maintenance.

**Applications**

The system has many applications in various fields, as this system provides the sorting of objects, in flow of objects by multi sensing. Mainly this finds the important application in agriculture field where it can be used to sort the different agriculture products like grains, lemons, almonds, grapes, and many more. For human beings it becomes comber sum task to sort out the objects with high quality also the possibility of accuracy is less. In industry it can be used for sorting of various objects, tools, with high degree of accuracy and quality with an automation.

## V. Conclusion

Fully functional sorter machine can be implemented by using a structure of parallel and independent channels in order to increase the overall throughput which results with a forecasted performance.

There are two main steps in sensing part, objects detection and recognition. The system can successfully perform handling station task, namely sorting mechanism with help of sensor. Thus a cost effective mechatronics system can be designed using the simplest concepts and efficient result can be observed.

**Acknowledgment**

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