# USMAN INSTITUTE OF TECHNOLOGY

Affiliated with NED University of Engineering & Technology, Karachi

## Department of Electrical Engineering

(Computer Systems Engineering)

## CE430 – Digital Image Processing

## Lab Project Report

Title: **2D GEOMETRIC SHAPE AND COLOR RECOGNITION USING DIGITAL IMAGE PROCESSING**

**GROUP NUMBER 06**

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# ABSTRACT:

*This report discusses the method for recognition of 2D images such as square,circle,rectangle and triangle and their color as well.The methods involved are conversion of 3D RGB image to 2D black and white image.color pixel classification for object-background separation, area based filtering and use of bounding box and its properties for calculating object metrics. Then the object metrics are compared with predetermined values that are characteristic of a particular object's shape.*

# INTRODUCTION:

In today's highly advanced and automated industries, highly efficient methods are used for various production and inspection processes. Sensors play an important role in these industries, these sensors have to be more precise and accurate. Digital image processing has many applications in this field of automation, as these sensors input live images and to determine the objects that's why the processing should be fast and accurate. This paper determines the recognition of the objects by using an algorithm by extracting information from the image and making decisions according to the algorithm that will be described in this paper.

# DIP IMPLEMENTATION AND PROCESS:

Object recognition can be done in two ways:

- Comparing every pixel in the image to the pixels of a number of other images stored in memory.
- Extracting information from the image and then calculating it's metric according to the information and then comparing the values of these metrics to the predetermined values.

## ALGORITHM:

The research paper which we studied follows the second method of object detection. The algorithm of this method is:

### Read/Capture Image:

An RGB image is taken as input.The image should be in RGB format which is true color format for an image

### Converting RGB image to Black and White:

This process is done in two steps:

1. First the RGB image is converted into 2D grayscale image, this 2D image contains the luminance value of the image. It is obtained by combining the RGB values using the NTSC standard equation that multiplies the primary colors (red, green and blue) with coefficients based on the sensitivity of our eyes to these colors.
    - The luminance image is then converted to binary image by thresholding.The threshold can be calculated either by determining the luminance values of pixels that correspond to object regions in a sample image and by averaging these values or by using an algorithm which evaluates a histogram of the image and maximizes the variance of intensity between foreground and background.

## Recognize boundaries of objects:

In the 2D image obtained boundaries are recognized by first selecting a pixel and then searching other pixels by moving in a clockwise or counter clockwise direction for other objects or they can also be searched diagonally or edge-adjacent pixels. Hence, by searching object pixels in a fixed direction boundaries can be recognized.

## Finding areas of objects and area filtering:

After the boundaries are recognized, the area can be calculated just by summing the pixels within the boundary.Some of the pixels are noisy pixels which are removed just by using an if-else statement that if area is less than the threshold value they are converted to background pixels by this way small and isolated noisy pixels are filtered.

## Finding inclination of object:

The algorithm must be able to recognize the shape by inclination of object in the plane perpendicular to the x-axis.It is done by enclosing the object in an ellipse and then measuring the counter clockwise between the major axis and the x axis then the object is rotated clockwise by same angle.

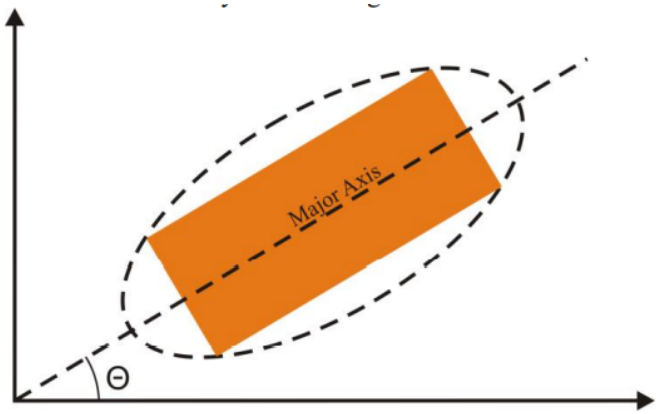



Fig. 2 Measurement of inclination of object with respect to X-axis.

## Finding bounding box of the object:

The bounding box is an imaginary rectangle to enclose the object.It is used for shape recognition and it is independent of rotation of the object as the dimension of the bounding box is kept constant. The area of the bounding box classifies the shape of the object.

## Finding ratio of areas for given object:

The next step is to find the ratio between the area of the object and area of the bounding box which is known as extent.

$$Extent = \frac{Area\ of\ the\ object}{Area\ of\ bounding\ box}$$

The extent values of the shapes are fixed for e.g if it's a circle the value is 0.75283.When this value of extent comes the shape is circle.

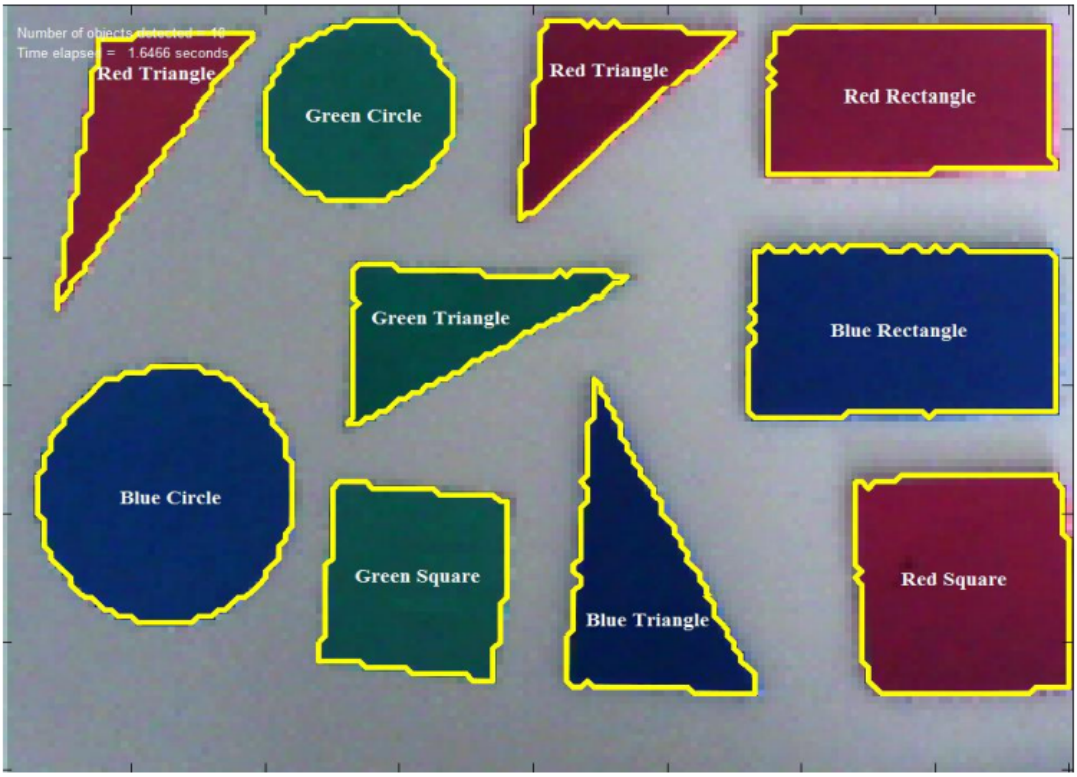
### Color recognition:

Then the object can also be evaluated by colors. The RGB content of the object is averaged and if the object has a high average value of any of the colors(RED,GREEN,BLUE), the object may contain that shade.

# CONCLUSION:

When this algorithm was tested it was proved to be 99% accurate. The database consists of four shapes and three colors with various inclinations.The results were:

| Shape of Object | Color of Object | No. correctly recognized/ No. of images tested |
|---|---|---|
| Circle | Red | 15/15 |
| | Green | 15/15 |
| | Blue | 15/15 |
| Rectangle | Red | 15/15 |
| | Green | 15/15 |
| | Blue | 15/15 |
| Square | Red | 15/15 |
| | Green | 14/15 |
| | Blue | 15/15 |
| Triangle | Red | 14/15 |
| | Green | 15/15 |
| | Blue | 15/15 |




# FUTURE WORK:

The future work for this report would be to detect the objects and its color from a very complex background. In this paper we used a clear image to detect its shape and color but if the background color resembles the object's color, it becomes hard to distinguish the object in image or its color so what should we do at that time?

So, there must be a technique which can help us to detect any object or shape through a very complex background and if the number of objects are in greater quantity then must give us the total count of those objects. And this future enhancement can be used in many cases, like in crime scenes or in daily life for example to count the number of fruits on trees, or to count the number of vehicles in parking areas etc.