



Activity Recognition System

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Abstract— *Activity recognition is a vital part of computer vision. The aim of activity recognition is to recognize the action and goals of one or more objects such that to develop a system for the Human Computer Interaction purpose. In this paper, we developed an approach using Color extraction technique and object tracking where we can virtually perform mouse operation e.g. move, left click, right click, etc. These mouse operations are performed on the basis of a number of objects. Connected component labeling algorithm has been used to count objects. This application has been implemented in Matlab environment.*

Keywords— *Activity recognition, Color extraction technique, Object tracking, Human Computer Interaction and Connected component labeling algorithm.*

I. INTRODUCTION

In modern world computer vision technology is growing up as well as the scope of HCI is also increasing. HCI today greatly focus on developing more automatic and natural interfaces. Computer vision is the very wide field, which is related to the processing of image, video etc. Image processing is a very important part of computer vision. In generally "computer vision is a discipline that studies how to reconstruct, interpret and understand a 3D scene from its 2D images in terms of the properties of structures present in the scene". In the present day scenario, the interaction with most of the devices is done with the help of mice, trackpad, sensors, and gloves etc like in mobile, television, laptop etc touch screen technology has been used. These technologies constitute purchase cost as well as maintenance cost.

So our objective is to create an alternative technology which is much cheaper than the above mentioned. In activity recognition system, we will develop a virtual mouse using web camera and color pointer (Red) to interact with the computer in a more user-friendly manner. The virtual mouse is software that allows users to give inputs to a system without using any hardware device (actual mouse). This paper presents a method in which the mouse cursor movement and click events are controlled using a real-time camera and color extraction technique. Real-time video has been captured using a Webcam. The user uses colored tapes (Red color) on fingertips to provide information to the system. Once the color is extracted, then the cursor movement can be controlled and various mouse operations can be performed.

II. RELATED WORK

A number of literature surveys have been done on virtual mouse. Our paper work has been inspired by these papers.

Anupam Agrawal et al. have developed vision-based multimodal Human Computer Interaction using hand and head gesture. The objective of this paper is thus to use two important modes of interaction hand and head to control any application running on the computer using computer vision algorithm[1].

Sung Kwan et al. have developed color based hand and finger detection technology for user interaction. This technology can be used to control the home devices such as curtain and TV [2].

R. Lulu¹, Vanshri Kurhade², Neha Pande³, Rohini Gaidhane⁴, Nikita Khangar⁵, Priya Chawhan⁶, Ashwini Khaparde⁷ et al. have developed Web Camera Based Mouse Controlling Using RGB Colours . The objective of this paper is finger tracking based a virtual mouse application has been designed and implemented using a regular webcam. The paper deals with the enhancement of human interaction with the digital world computing devices allow us to be in continuous touch with the digital world [3].

Shital M. Chavan¹, Smitha Raveendran² et al. have developed Hand Gesture Movement Tracking System for Human Computer Interaction. The objective of this paper is making a system prototype that can track the movements of the hand as well as to recognize the meaning of simple hand gestures command as a replacement of the mouse device [4].

Abhik Banerjee¹, Abhirup Ghosh², Koustuvmoni Bharadwaj³, and Hemanta Saikia⁴ have developed Mouse Control using a Web Camera based on Colour Detection. The objective of this paper is to create a virtual mouse system using the Web camera to interact with the computer in a more user-friendly manner that can be an alternative approach for the touch screen. In this thumb and index finger was used to perform clicking actions [5].

Heera Lal Bhadrech et al have proposed a Finger Gesture Control Computer Mouse with image Processing. Finger gestures were acquired using a camera based on skin detection algorithm with different angle detected images. This method mainly focuses on the use of Web-Camera to create a cost effective virtual mouse using the webcam with image processing [6].

Siddhartha S. Rautaray et al. have proposed the real-time hand gesture recognition system for dynamic applications. The research effort centralizes on the efforts of implementing an application that employs computer vision algorithms and gesture recognition techniques which in turn results in developing a low-cost interface device for interacting with objects in the virtual environment using hand gestures. Hand gesture recognition technique aims to substitute the use of the mouse for interaction with the virtual objects. This will be useful to promote controlling applications like virtual games, browsing images etc in the virtual environment using hand gestures [7].

III. INTRODUCTION TO TOOL

A. Introduction To MATLAB

Matlab is signifying MATrix Laboratory. Matlab is used for technical computing which is a high-performance language. Also, powerful graphic tools have been provided by Matlab. It can provide a quality picture in both 2-D and 3-D.

B. Image Processing

It is used for converting an image into the digital image. In image processing, we apply operation on image like filters to remove noise from image, adjust to enhance the image or perform various operations to extract some useful information from it.

C. Webcam and Color Pointer

A webcam is a hardware device which is used for acquiring images. These images are in raw form i.e. unprocessed.

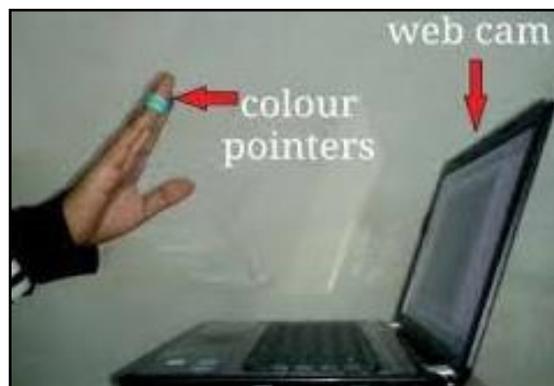


Fig. 1. Webcam and color tape

Color tape has been used at the fingertip of the user. We are going to use red color tape to track finger tip movement based on which cursor on the screen moves.

IV. INTRODUCTION TO SYSTEM

In this paper, we have tried to control cursor movement by virtually performing mouse operation e.g. left click, right click, and scroll using webcam and color tape in real-time. A webcam has been used to capture real-time video. Red color tape has been used by the user to interact with the system. A color extraction algorithm has been used to detect red color. In fig.2 flowchart of system is shown.

A. Image Acquisition

Webcam of a computer is a hardware device which is used to capture the real-time video, for capturing real-time video we should know about device_id, device_name, and format. The movement of the hand of a user is detected by webcam.

B. Object Detection

This is a very important step. In this step, we detect the object using color extraction algorithm. We deal with only red color objects. From webcam, we capture the video and track only red color objects in the video. To detect a red color object in an image we subtract red channel of the image from grayscale of the same image.

$$| \text{Frame Ir} - \text{Frame Ig} | > T \quad (1)$$

In (1) Frame Ir is the red channel of captured image, Frame Ig is the grayscale image of the same image and T is the threshold value.

In the resultant image, the red color object is highlighted as a white object or pixel and rest of the objects become black pixel. After tracking the red object, by using median filter we check any noise is present or not in resultant image. Salt and pepper noise are removed by the median filter.

$$f(x, y) = \underset{(s,t) \in S_{xy}}{\text{median}} \{g(s, t)\} \quad (2)$$

In (2) S_{xy} is set of coordinates in rectangle sub image window of size $m*n$, centered at point (x, y) , $f(x, y)$ is the median computed using pixels in the region.

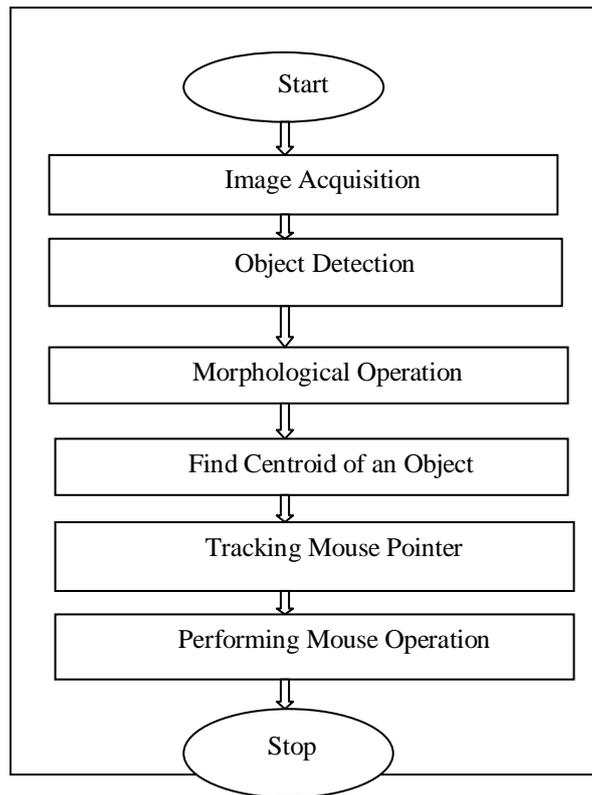


Fig. 2. Methodology

C. Morphological Operation

In Morphological Operation the first step is to convert the resultant image into its binary form so that we get a binary image by applying a threshold value. On this binary image, we apply morphological operations to fill the holes. Morphological operations like as `bwareaopen` (Remove small objects from binary image), `imfill` etc.

To remove all connected objects that has fewer than 'P' pixels from a binary image.

$$\text{Find } ([S.\text{Area}] \geq P) \quad (3)$$

In (3) P is the number of pixels, S is the structure of array which consist the area of all object. `bwlabel` is an inbuilt Matlab function which can be applied only to the binary image. It uses connected component labeling algorithm which uses 4, 8 or 16 connectivity. A matrix is returned by this function which contains label for each object as shown in fig.3.

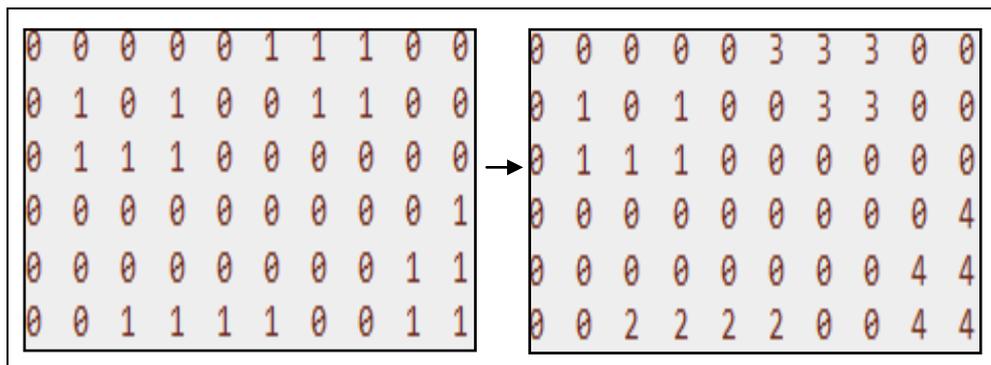


Fig. 3. Conversion of binary image into labeled matrix

D. Find Centroid of an Object

We perform labeling on this morphologically operated binary image. By using this labeled image we find the objects and then bound them inside a bounding box and find their centroid. To perform mouse operation virtually by the user it is required to find position of cursor on the screen i.e. coordinates of cursor. The movement of the cursor is controlled by the system using these coordinates. An inbuilt function in MATLAB has been used to find the centroid of detected objects. A matrix has been returned as the output function which consists of coordinates of the centroid. These coordinates changes their position with the movement of object.

E. Tracking Mouse Pointer

First of all we find coordinates of centroid for each object, and these coordinates are then sent to the cursor. With the help of these coordinates, the location of the cursor is determined. For each frame, we have to find a new centroid

position. An effect of tracking has been made as we assume continuous movement of an object on the screen. We determine a new centroid each time and a new position of the cursor is obtained for each frame. So that when the user makes any movement from the red object in front of the camera, the mouse pointer will move in relation to a red object across the screen of the device. The mouse drivers of the computer cannot be accessed directly as there is no inbuilt function available in Matlab. Other languages like c, c++, and java can be integrated with Matlab. Java is preferred over the others as it is a machine independent language. To access mouse drivers a java object is created. Based on the detection of red color the system performs the click events of the mouse.

F. Performing Mouse Operation

We have used Centroid tracking to control mouse position and motion. The centroid of the red object is passed to a class mouse.mouseMove(x, y). According to the object's centroid motion, the mouse pointer is moved. Different operations are performed by identifying the number of objects in the current frame. The mouse operations are performed on the basis of condition of object detected. We implement these conditions using JAVA. First, we import the java class to MATLAB, create an object of this type, and then execute the mouseMove method in a loop to simulate motion. Again, import the required java classes, create an object of this type, and then use the mouse Press and mouse Release functions to simulate a click. The class MouseEvent gets us the coordinates where the event occurred. Fig. 4 shows the flowchart of mouse operation.

To implement move, right, left click, and scrolling function, we use the following mouse event functions.

- If one red color object detected, move function is performed.
- If two red color objects are detected, left click is performed.
- If three red color objects are detected, the Right click is performed.
- If four red color objects are detected, scrolling is performed.

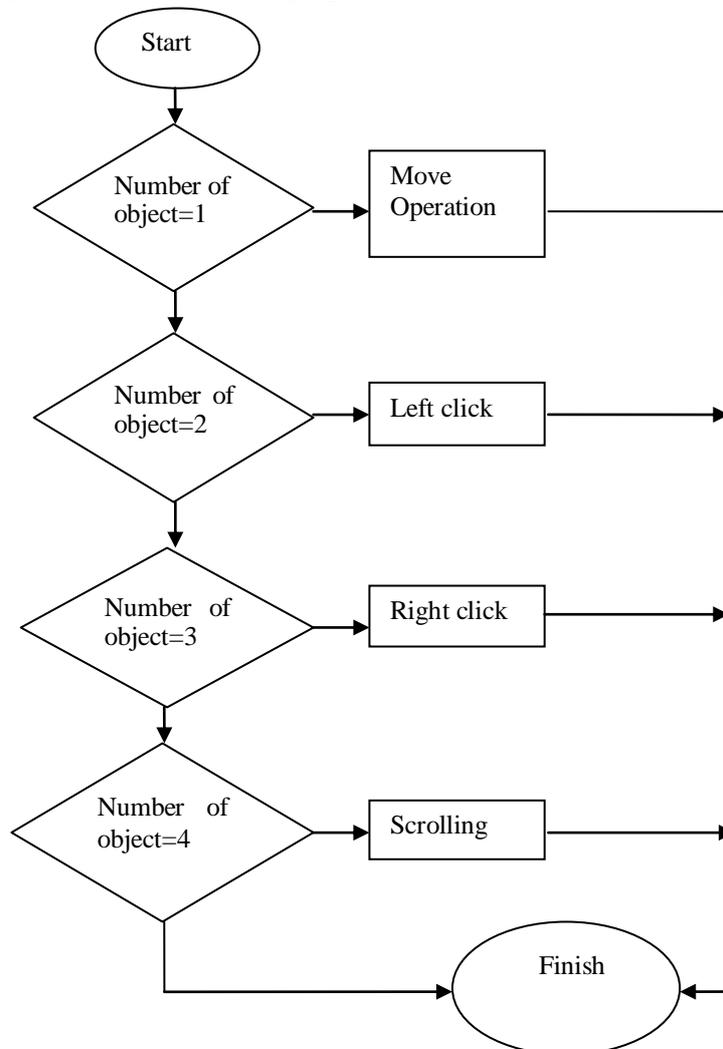


Fig. 4 Flowchart of mouse operation

V. RESULT

A. One Object Detected

By using the above methodology, if we detect only one red object then a move/click operation will be performed by user which is shown in below fig5 and fig 6.

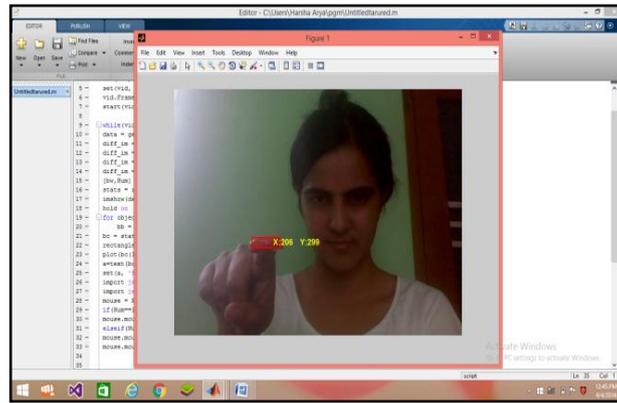


Fig. 5.Move Operation

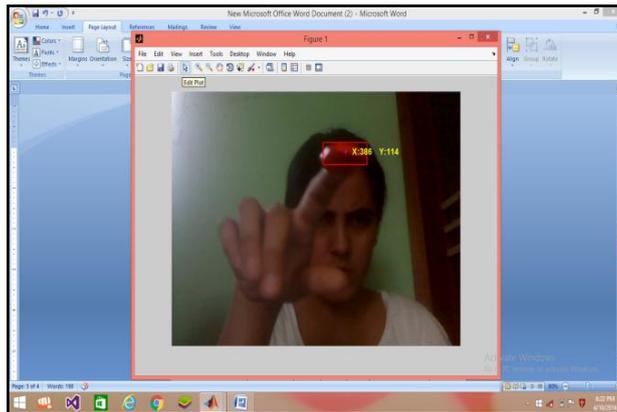


Fig. 6.Move Operation

B. Two Objects Detected

By using the above methodology, if we detect two red objects then perform left click by user which is shown in below fig7, fig8 and fig 9.

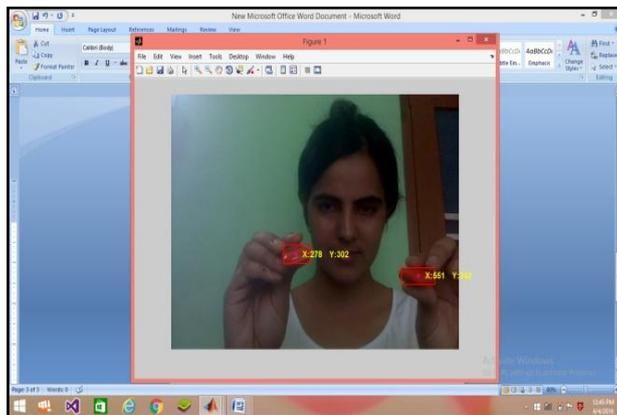


Fig. 7.Two Objects Detected

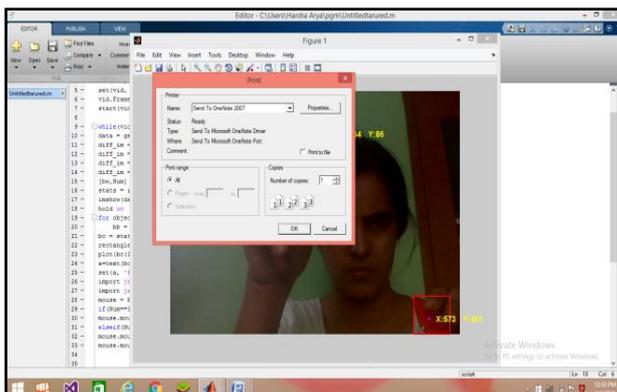


Fig. 8.Left Click

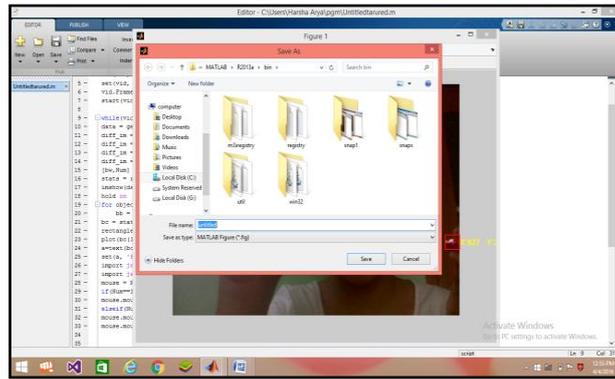


Fig. 9. Left Click

C. Three Objects Detected

By using the above methodology; if we detect three red objects then perform right click by user which is shown in below fig 10 and fig 11.

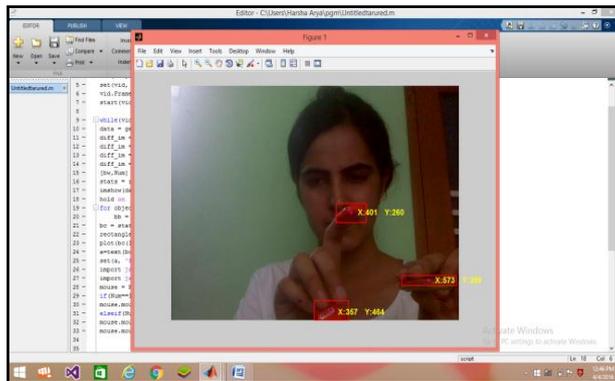


Fig. 10. Three Objects Detected



Fig. 11. Right Click

D. Four Objects Detected

By using the above methodology, if we detect four red objects in real time then perform scrolling by user which is shown as below fig 12, 13, 14 and 15.

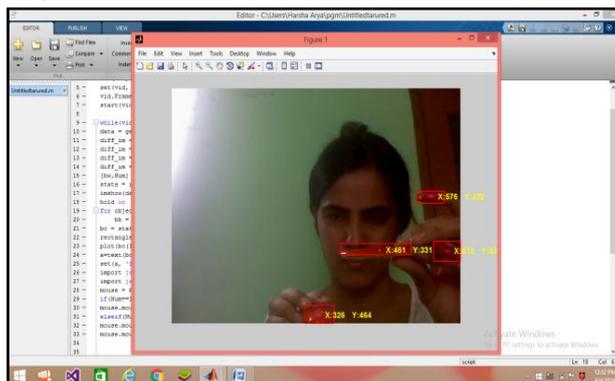


Fig. 12. Four Objects Detected

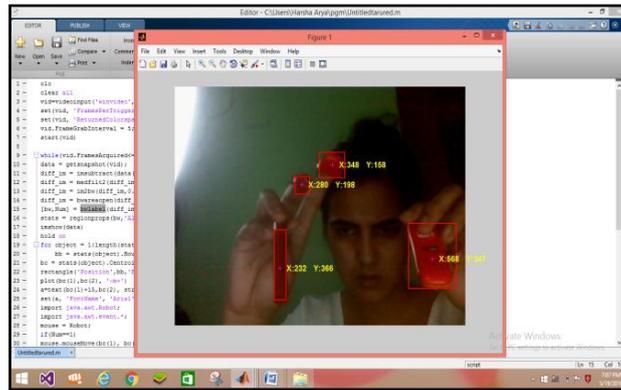


Fig. 13.Scrolling

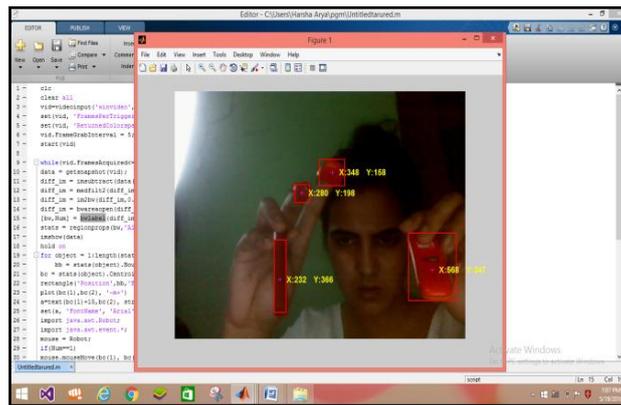


Fig. 14.Scrolling



Fig. 15.Scrolling

VI. CONCLUSION AND FUTURE SCOPE

In this paper, we developed a system to control the mouse cursor movement using a real-time webcam. In this we implemented all mouse operation like move, left and right clicking, double-click, and scrolling. All work implemented in MATLAB environment. And in this, we use MATLAB Image Processing Toolbox. We have compared our algorithm with skin color detection algorithm and we found that our method gave better result during illumination effect. This technology has wide applications in the fields of computer graphics, computer gaming, and biomedical instrumentation etc. Our motive was to create this technology in the cheapest possible way and minimize the work of hardware devices.

REFERENCES

- [1] Anupam Agrawal, Rohit Raj and Shubha Porwal, "Vision-based Multimodal Human-Computer Interaction using Hand and Head Gestures", IEEE Proceeding of International Conference on Image Information Processing (ICT 2013).
- [2] Sung Kwan Kang, Mi Young Nam, Phill-Kyu Rhee, "Color Based Hand and Finger Detection Technology for User Interaction" International Conference on Convergence and Hybrid Information Technology 2008.
- [3] Abhik Banerjee1, Abhirup Ghosh2, Koustuvmoni Bharadwaj3, Hemanta Saikia4, "Mouse Control using a Web Camera based on Colour Detection" International Journal of Computer Trends and Technology (IJCTT) – volume 9 number 1– Mar 2014.

- [4] R. Lulu¹, Vanshri Kurhade², Neha Pande³, Rohini Gaidhane⁴, Nikita Khangar⁵, Priya Chawhan⁶, “Ashwini Khaparde⁷, “Web Camera Based Mouse Controlling Using RGB Colours” International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 4 Issue 2, February 2015.
- [5] Shital M. Chavan¹, Smitha Raveendran², “Hand Gesture Movement Tracking System for Human Computer Interaction” International Research Journal of Engineering and Technology (IRJET) Volume: 02 Issue: 08 | Nov-2015.
- [6] Chavan, S.M, Raveendran, “Hand Gesture Movement Tracking System for Human Computer Interaction” International Research Journal of Engineering and Technology (IRJET) 2008.
- [7] Heera Lal Bhadrecha, “Finger Gesture Control Computer Mouse With Image Processing” IJECT Vol. 6, Issue 1, Jan - March 2015.
- [8] Goszczynska, H., 2011. OBJECT TRACKING. ISBN 978-953-307-360-6.
- [9] Bankman, I. ed., 2008. Handbook of medical image processing.