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VIRTUAL MOUSE USING COLOR DETECTION

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Abstract - *In this project an approach for Human computer Interaction (HCI) is done, where we have tried to control the mouse cursor movement and click events of the mouse using hand gestures. Hand gestures were acquired using a camera based on color detection technique. This method mainly focuses on the use of a Web Camera to develop a virtual human computer interaction device in a cost effective manner.*

Now a day's intelligent machine which can be used along with the computer are being developed, which helps in friendly Human Computer Interaction (HCI). In the recent years different technologies are used for developing the virtual mouse. In this project, we have tried to provide a review on different technologies for the virtual mouse. To work with a computer mouse and Keyboard are the very essential input devices. To solve this problem virtual keyboard and mouse is developed.

Keywords - *Human Computer Interaction, Color Detection, Web camera, Background Subtraction.*

1. INTRODUCTION

In today's technological era, many technologies are evolving day by day. One such promising concept is Human- Machine Interface. For example, in a wired mouse there is no provision to extend limit. In wireless mouse, one should have Bluetooth hardware installed in the computer and Bluetooth dongle attached. The proposed project will have no such limitations and will instead depend on gesture recognition. In this project, three technologies are mainly used: object detection, image processing and colour recognition using "Sixth sense technology". Sixth sense technology is a set of wearable devices that acts as a gestural interface between the physical and digital world.The aim is to move the mouse cursor on the screen without using hardware such as a mouse and only by moving the cursor through finger movements i.e. the process of gesture recognition.

Human Computer Interaction today greatly emphasizes on developing more spontaneous and natural interfaces. The Graphical User Interface (GUI) on Personal Computers (PCs) is quiet developed, well defined and provides an efficient interface for a user to interact with the computer and access the various applications effortlessly with the help of mice, track pad, etc. In the present day scenario most of the mobile phones are using touch screen technology to interact with the user. But this technology is still not cheap to be used in desktops and laptops. Our objective was to create a virtual mouse system using Web camera to interact with the computer in a more user friendly manner that can be an alternative approach for the touch screen.

For the Virtual mouse, mostly uses web camera works with the help of different image processing techniques in which pointer has been used for the object recognition and tracking. Left and the right click events of the mouse have been achieved by detecting the number of pointers on the images.

2. Literature Review

In Reference [1], Angel, Neethu.P.S "Real-Time Static and Dynamic Hand Gestures Recognition" The hand tracking has to be specifically adapted for each user. This system was implemented only in a restricted to the indoor environment. This system is prone to noise and sensitive to the change of the illumination.

In Reference [2], Abhirup Ghosh, Abhik Banerjee "Mouse Control using a Web Camera based on Color Detection" The presence of other colored objects in the background might cause the system to give an erroneous response. If the resolution of the camera is too high then the system might run slow.

In Reference [3], J.L.Raheja, A.Chaudhary, K.Singal "Proposed using HSV algorithm but this uses special sensor is used to capture image and processes it" User has to spend more money for the sensor.

3. SYSTEM OVERVIEW

In our work, we have tried to control mouse cursor movement and click events using a camera based on color detection technique. Here real time video has been captured using a Web-Camera. The user wears colored tapes to provide information to the system. Individual frames of the video are separately processed. The processing techniques involve an image subtraction algorithm to detect colors. Once the colors are detected the system performs various operations to track the cursor and performs control actions, the details of which are provided below. No additional hardware is required by the system other than the standard webcam which is provided in every laptop computer.

4. SYSTEM WORKING

Following are the steps in working of our project:

1. Capturing real time video using Web-Camera.
2. Processing the individual image frame.
3. Flipping of each image frame.
4. Conversion of each frame to a grey scale image.

5. Color detection and extraction of the different colors (RGB) from flipped gray scale image.

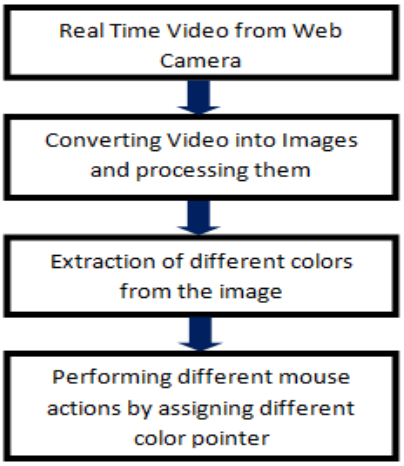
6. Conversion of the detected image into a binary image.

7. Finding the region of the image and calculating its centroid.

8. Tracking the mouse pointer using the coordinates obtained from the centroid.

9. Simulating the left click and the right click events of the mouse by assigning different color pointers.

4.1 The Basic Block Diagram of the System:



4.2 Capturing real time video:

For the system to work we need a sensor to detect the hand movements of the user. The webcam of the computer is used as a sensor. The webcam captures the real time video at a fixed frame rate and resolution which is determined by the hardware of the camera. The frame rate and resolution can be changed in the system if required.

- Computer Webcam is used to capture the Real Time Video.
- Video is divided into Image frames base on the FPS (Frames per second) of the camera.
- Processing of individual Frames.

4.3 Flipping of images:

When the camera captures an image, it is inverted. This means that if we move the color pointer towards the left, the image of the pointer moves towards the right and vice-versa. It's similar to an image obtained when we stand in front of a mirror (Left is detected as right and right is detected as left). To avoid this problem we need to vertically flip the image. The image captured is an RGB image and flipping actions cannot be directly performed on it. So the individual color channels of the image are separated and then they are flipped individually. After flipping the red, blue and green colored channels individually, they are concatenated and a flipped RGB image is obtained.

4.4 Conversion of Flipped Image into Gray scale Image:

As compared to a colored image, computational complexity is reduced in a gray scale image. Thus the flipped image is converted into a gray scale image. All the necessary operations were performed after converting the image into gray scale.

4.5 Color Detection:

This is the most important step in the whole process. The red, green and blue color object is detected by subtracting the flipped color suppressed channel from the flipped Gray-Scale Image. This creates an image which contains the detected object as a patch of grey surrounded by black space.

4.6 Conversion of gray scale Image into Binary scale Image:

The grey region of the image obtained after subtraction needs to be converted to a binary image for finding the region of the detected object. A grayscale image consists of a matrix containing the values of each pixel. The pixel values lay between the ranges 0 to 255 where 0 represents pure black and 255 represents pure white color.

4.7 Finding Centroid of an object and plotting:

For the user to control the mouse pointer it is necessary to determine a point whose coordinates can be sent to the cursor. With these coordinates, the system can control the cursor movement. An inbuilt function in MATLAB is used to find the centroid of the detected region. The output of function is a matrix consisting of the X (horizontal) and Y (vertical) coordinates of the centroid. These coordinates change with time as the object moves across the screen.

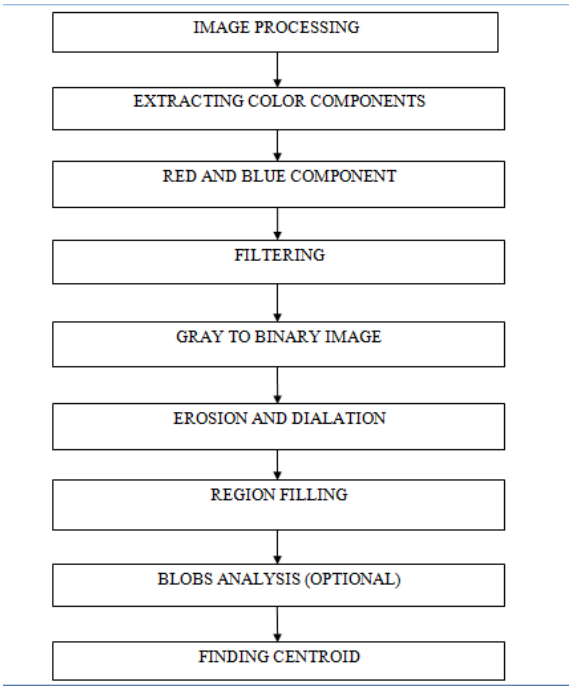
4.8 Tracking the Mouse pointer:

Once the coordinates has been determined, the mouse driver is accessed and the coordinates are sent to the cursor. With these coordinates, the cursor places itself in the required position. It is assumed that the object moves continuously, each time a new centroid is determined and for each frame the cursor obtains a new position, thus creating an effect of tracking. So as the user moves his hands across the field of view of the camera, the mouse moves proportionally across the screen.

4.9 Performing Clicking action:

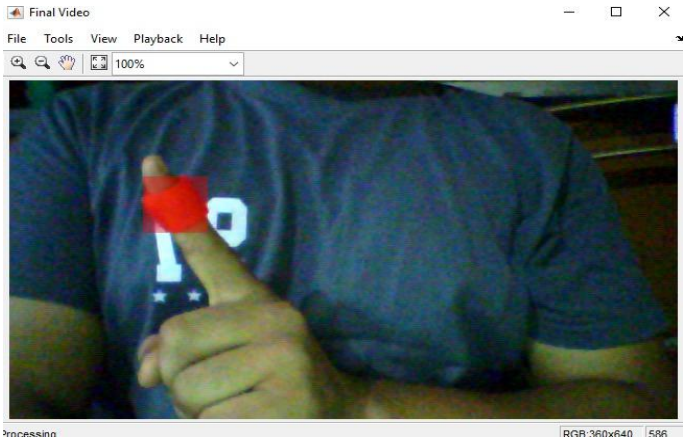
The control actions of the mouse are performed by controlling the flags associated with the mouse buttons. JAVA robot class is used to access these flags. The user has to perform hand gestures in order to create the control actions. Due to the use of color pointers, the computation time required is reduced. Furthermore the system becomes resistant to background noise and low illumination conditions.

4.10 Mouse Control Flowchart:

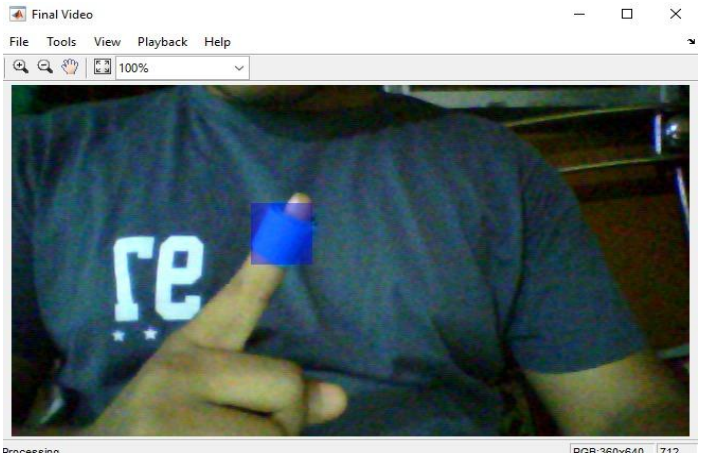


5. RESULTS

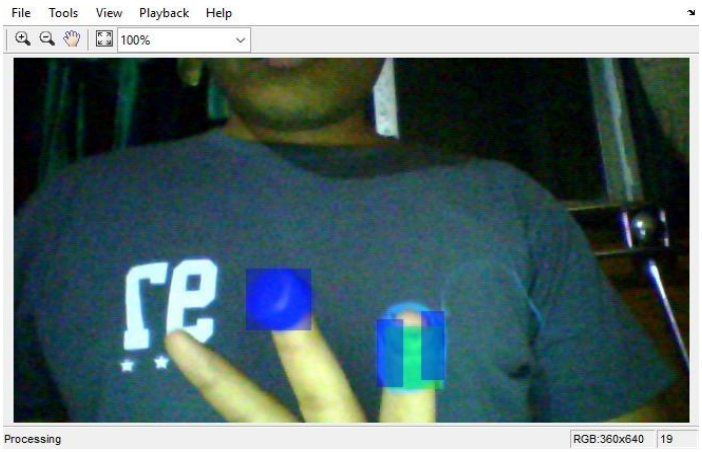
a) Movement of cursor:



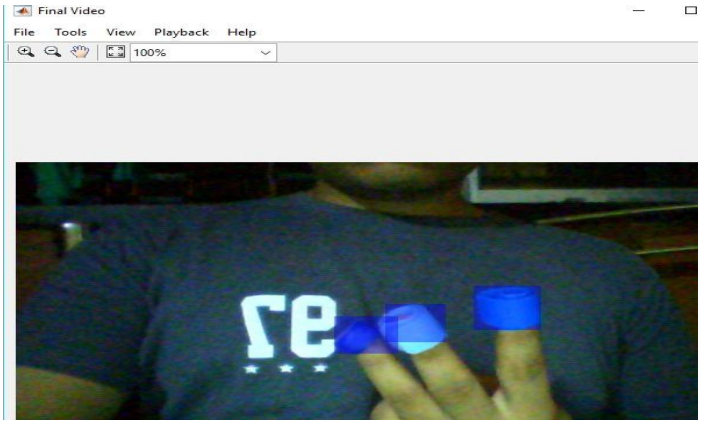
b)Left click event:



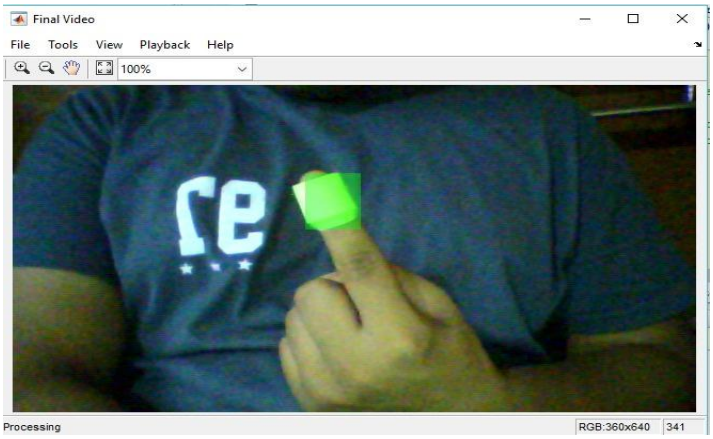
c) Right click event:



d) Double click event:



e) Cursor Scroll event:



6. PROBLEMS AND DRAWBACKS

Since the system is based on image capture through a webcam, it is dependent on illumination to a certain extent. Furthermore the presence of other colored objects in the background might cause the system to give an erroneous response. Although by configuring the threshold values and other parameters of the system this problem can be reduced but still it is advised that the operating background be light and no bright colored objects be present.

The system might run slower on certain computers with low computational capabilities because it involves a lot of complex calculations in a very small amount of time. However a standard pc or laptop has the required computational power for optimum performance of the system.

Another fact is that if the resolution of the camera is too high then the system might run slow. However this problem can be solved by reducing the resolution of the image by making changes in the system.

7. CONCLUSION

The system architecture that has been proposed will completely change the way people would use the Computer system. Presently, the webcam, microphone and mouse are an integral part of the Computer system. This project will completely eliminate the necessity of mouse. Also this would lead to a new era of Human Computer Interaction (HCI) where no physical contact with the device is required.

The use of object detection and image processing in MATLAB for the implementation of our proposed work proved to be practically successful and the movement of mouse cursor is achieved with a good precision accuracy. This technology can be used to help patients who don't have control of their limbs. In case of computer graphics and gaming this technology has been applied in modern gaming consoles to create interactive games where a person's motions are tracked and interpreted as commands.

Most of the applications require additional hardware which is often very costly. The motive was to create this technology in the cheapest possible way and also to create it under a standardized operating system. Various application programs can be written exclusively for this technology to create a wide range of applications with the minimum requirement of resources.

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