

# Virtual Mouse using Hand Gesture

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*Abstract*— The technology has been changing day by day, the significance of human and computer interaction has inspired the researchers to stimulate and utilize in various fields. Hand gesture recognition is one of the most active areas of research in computer vision. It provides an easy way to interact with a machine without using any extra devices. Focusing on the essential factors in mind a system has been created which recognize the movement of the finger and various gestures formed by them. Color caps or tapes have been used for fingers to distinguish from the background color such as skin color. Hand gestures rely upon camera based gesture recognition technique. This recognition method mainly focuses on the use of web camera to develop a virtual HCI device in a cost effective manner. The application has been created on MATLAB environment with operating system as Windows 10.

**Key words:** Hand Gesture Recognition, Human Computer Interaction, Image Subtraction Algorithm, Virtual Mouse

## I. INTRODUCTION

Human Computer interaction mainly depends on the user interface. The Graphics User Interface (GUI) on personal computer is developed, providing an efficient interface for a user to interact with the computer and access various applications effortlessly. In this paper a virtual mouse is a software that allows user to give mouse inputs to the system without using a physical mouse. Gesture recognition is based on tracking the movement of a fingertip. We have tried to control mouse cursor movement and click events using a camera based color detection technique. The idea for users to control their computer or laptop simply by moving the fingers, without any contact on realistic objects. The main purpose was to create a virtual mouse using web cam to interact with the computer in more user friendly manner. The user wears colored capes or tapes to provide information to the system. This color pointer mainly used for object recognition and tracking. The webcam is set to record the movement of colored fingertip and individual frames of the video are separately processed. This colored fingertip is detected as image pixel using MATLAB and the object detection is to map pixel position into mouse input. The processing technique involves an image subtraction algorithm to detect the colors. Once the colors are detected, the system performs various operations according to the cursor pointer and performs some controlled actions which are explained in the further sections. There is no need of additional hardware other than standard web cam which is provided in every laptop.

## II. COMPONENTS

The components used in the project can't be specified because it is the prototype of all computers. Only few

components are provided with high priority are explained below:

### A. Webcam

Web cam is the digital camera that feeds or streams its image in real time to or through a computer. Web cam is a necessary component for detecting the image. It captures the real video at a fixed frame rate and resolution which is determined by the hardware of the camera.

### B. Color tapes

The color tapes or stickers which are placed at the tip of the user's fingers. Marking the finger tips with red, green and blue tape so that it helps the web cam to recognize the gestures. The movements and arrangements of these markers are added as a gesture so that these can be used for providing some interactive instructions. Using these instructions some actions are projected on the application interface.

## III. RELATED WORKS

There are many gesture recognition techniques developed and used for recognizing various hand gesture. These techniques have their own advantage and disadvantages. The older one is wired technology, in which users need to tie up themselves with the help of wired in order to connect or interface with the computer systems. Later on some advanced techniques have been introduced like image based technique which required processing of image features like texture etc. If we work with these features of the image for hand gesture recognition the result may vary and could different as skin tones and texture changes very rapidly from person to person from one continent to other. In order to overcome the challenges and promote real time application, gesture recognition technique based on color detection has been implemented. The color can also be varied and hence obviating the need of any particular color.

## IV. SYSTEM ANALYSIS

The system analysis or study is an important phase of any software development process. During analysis phase, each problem identifies many alternative solutions which are evaluated and the feasible solution is selected.

### A. Purpose

The main purpose of the project to create virtual mouse to manage computers and other devices with gestures rather than pointing or clicking a mouse or touching the display directly and it reduce the use of hardware.

### B. Problem Definition

To develop a virtual mouse which detects hand gesture patterns instead of physical mouse. We use color caps or tapes for detection which are recorded by camera. The colored fingertip acts as an object which is recognized by web

camera. The camera position in such a way that it recognizes the hand movement and performs the operations.

## V. TOOLS USED

### A. MATLAB

MATLAB is a high performance language for technical computing. MATLAB version 2010a has been used in this project. It integrates computation, virtualization, and programming in an easy-to-use environment where problems and solutions are expressed in a familiar mathematical notation.

## VI. METHODOLOGY

The implementation has been divided into various steps and each step has been explained and the overall step involved in the implementation of virtual mouse.

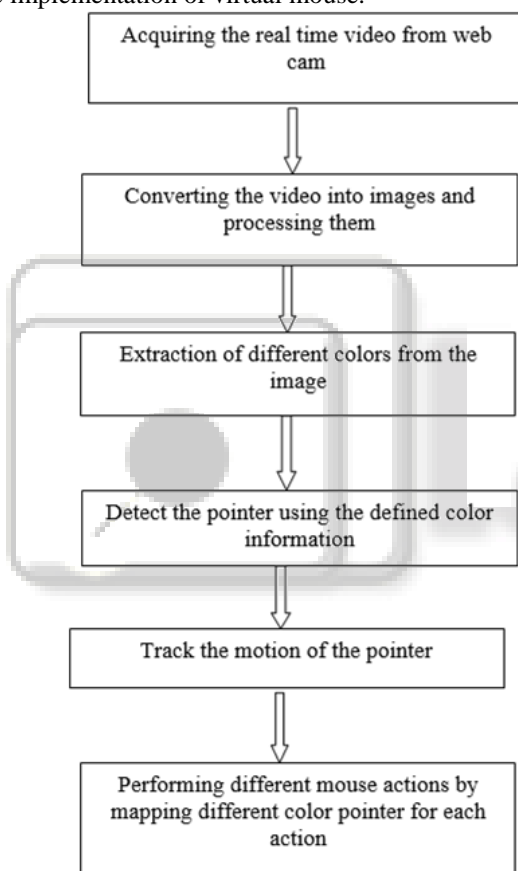


Fig. 1: Process Flow

The following steps are involved in our approach:

- Capturing the real time video using web cam.
- Processing the recorded video in the individual image frames.
- Set a particular marking in the fingertip.
- Detect the marker using the defined color information using color detection technique.
- Filtering the image of fingertip.
- Conversion of the detected image into binary image.
- Eliminating the unwanted areas in the image.
- Finding the region of the image and calculating its centroid.
- The cursor moves according to the position of the centroid point.

- Gestures are captured and used for further operation.
- Mouse events such as cursor movements, left click, right click, drag etc., are performed according to the position of the captured frames.

## VII. GESTURE RECOGNITION TECHNIQUE & ALGORITHM

### A. Color Detection

In this project, the colors are detected using the color tapes or stickers. The fingertip is colored with colors such as blue, red etc. In order to find the color of the finger, MATLAB is provided with some inbuilt functions is 'imsubtract'. The function used is  $Z = \text{imsubtract}(X, Y)$ . X and Y are real, non-sparse numerical arrays with same size.



Fig. 2: Red Color Plane Detected

### B. Filtering the IMAGE

Image filtering is useful for many applications, including smoothing, sharpening, removing noise, and edge detection. A filter is defined by a kernel, which are a small array applied to each and its neighbor within an image.



Fig. 3: Filtered Image

### C. Image Conversion

As the filtering is done over a frame, next step is to convert an image. For the conversion of image, in built function is 'im2bw'. The function used is  $BW = \text{im2bw}(I, \text{level})$ , where I is image.

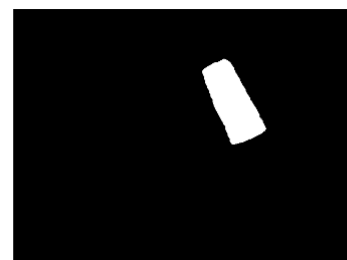


Fig. 4: Conversion of Filtered Image

### D. Removing Small Area

After the filtering and conversion the next step is to remove small areas from images. To do this one can use MATLAB "bwareaopen" function.

The Function can be used as  $BW2=bwareaopen(BW, P)$ , where BW is image and P is Pixel.

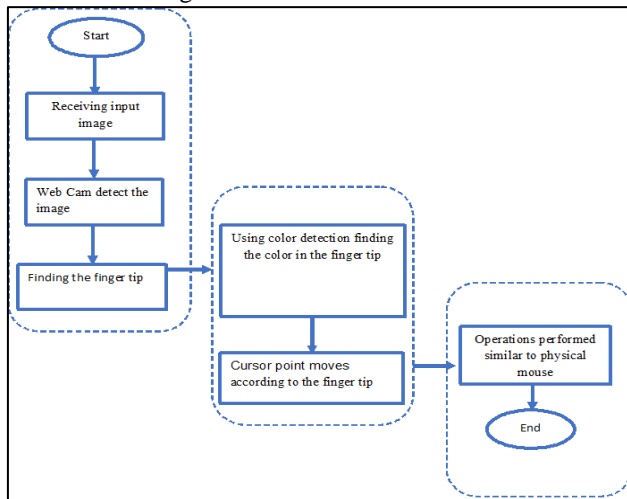


Fig. 5: Work Flow of Virtual Mouse

#### E. Finding the Center

In order to make more precise pointer of mouse finding centroid is necessary. Here 'bwlabel' MATLAB function for cropping.

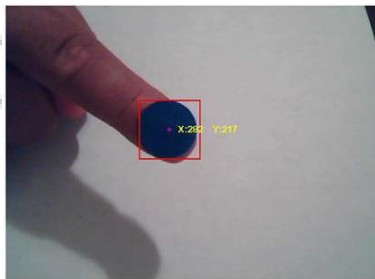


Fig. 6: Detected Center

#### F. Move the Cursor

To move the cursor to desired (X, Y) coordinates, MATLAB has a set (0, 'PointerLocation'[x, y]) function is used.

#### G. Mouse Click Event

To move the mouse and to simulate the mouse click event Java class java.awt. Robot which has all these abilities can be used.

#### H. Image Subtraction Algorithm

Image Subtraction is a process in which the digital value of one pixel or whole image subtracted from another image.

### VIII. CONCLUSION

The project mainly eliminates the necessity of physical 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 a proposed work proved to be practically successful. The movement of the mouse cursor is achieved with a good precision accuracy. This technology can be used to help patients who do not have control of their limbs. This technology is very use full for crippled people, at the time of presentation using IP camera, controlling TV channels etc and can be applied to smart

phones for numerous operations. In case of computer graphics and gaming this technology has been applied in modern gaming console to create interactive games where a person's motions are tracked and interpreted as commands. The main objective was to create this technology in the cheapest possible way and also to create it under a standardized operating system. Future works will include better methods for implementing mouse events and reducing the lag to almost zero during cursor movement.

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