

Cursor Control using Hand Gestures

Pooja Kumari

Computer Science & Engineering
IMS Engineering College,
Ghaziabad

Saurabh Singh

Computer Science & Engineering
IMS Engineering College,
Ghaziabad

Vinay Kr. Pasi

Computer Science & Engineering
IMS Engineering College,
Ghaziabad

ABSTRACT

This paper proposes a novel vision based cursor control system, using hand gestures captured from a webcam through a color detection technique. The system will allow the user to navigate the computer cursor using their hand bearing color caps or tapes and cursor functions, such as right and left clicks, double clicks, scroll up and down will be performed using different hand gestures. The proposed system uses nothing more than a low resolution webcam that acts as a sensor and it is able to track the users hand bearing color caps in two dimensions and can recognize up to five different hand gestures, which are interpreted as mouse functions.

General Terms

Motion Detection, Adaptive Skin Color Model, Gesture Recognition.

Keywords

CC(Cursor Control) , HCI(Human Computer Interaction) , HRI(Human Robot Interaction) , HSV (Hue Saturation Value) , NUI (Natural User Interaction) , MHI (Motion History Image).

1. INTRODUCTION

As the computer technology continuously grows to develop, people are now interested in smaller and smaller electronic devices. Increasingly we are recognizing the importance of human computing interaction (HCI), and in particular vision-based gesture and object recognition. In our paper, we propose a novel approach that uses a video device to control the mouse system (Mouse functions). Gesture recognition enables humans to be able to communicate with the machine (HMI) directly and interact naturally without any mechanical devices. Using the concept of gesture recognition, it is possible to point a finger bearing color caps at the computer screen so that the cursor will move accordingly to the movement of the color caps. This paper proposes a novel vision based cursor control system, using hand gestures bearing color caps on the fingertip captured from a webcam[10].

Today we are using mouse or a touchpad to control the computer mouse which required physical contact with the devices. In this paper, we are using hand gestures which are required no physical contact other than color caps with any device and we can operate it from a large distance. This can be very comfortable method to control mouse. So mouse control using hand gesture is a unique and new concept to control the computer mouse.

The cursor control using hand gesture system can be implemented in MATLAB. The system was able to control the movement of a cursor by tracking the user's hand bearing color caps. Cursor functions were performed by using different hand gestures. This system has the potential of being a viable replacement for the computer mouse, however due to

the constraints encountered- it cannot be completely replace the computer mouse. The major constraint of the system is that it must be operated in a well lit room. This is the main reason why the system cannot completely replace the computer mouse, since it is very common for computers to be used in outdoor environments with poor lighting condition [4].

1.1 Problem Description & Overview

To design color caps acts as an object which the web camera senses. The camera is positioned in such a way so that it recognizes the moment of finger tips cover with color caps and performs the operations of mouse. The utilization of virtual mouse appears in space saving situations or in movement situation. Virtual mouse which detects hand gestures patterns instead of physical mouse. Basically we use colored tips for detection which are captured by webcam.

1.2 Significance Of Problem In Real World & Applications

As we know that most laptops today have a built-in webcam, which are mainly used for video conferencing. This proposed application will greatly extend the use of a webcam to cursor control, which can actually eliminate the need for a computer mouse. HCI using hand gestures is very interesting and effective technique for one to one interaction with computers and it provides a Natural User Interface (NUI). There has been extensive research towards novel devices and techniques for cursor control using hand gestures using color detection technique. Besides HCI, hand gesture recognition is also used in sign language recognition, which makes hand gesture recognition even more significant and popular.

1.3 Objective

The objective of this paper is to Develop and implement a computer application that utilizes alternate methods for cursor control. Thus, Proposes a novel vision based cursor control system, using hand gestures captured from a webcam by using color detection technique. The goal of this paper is to create a system that will recognize the hand gestures and control the computer/laptop according to those gestures using color detection technique.

2. BACK GROUND AND RELATED WORK

2.1 Description Of Related Theory

There are many other cursor control application using hand gesture, but they often require the user to wear a bulky data glove (Quam 1990). This hinders the ease of control and makes some gestures difficult to perform [1] and also increases the complexity of the system. There are generally two main approaches for hand gesture recognition for HCI, first is hardware based and second is vision based. One hardware based approach, proposed by Quam (1990), which

uses a data glove to achieve the gesture recognition. This method requires the user to

wear bulky data glove, hindering ease of use and NUI with the computer and even makes some gestures difficult to perform. Instead of this, Quam’s method gives high accuracy, it is not practical for users everyday life for CC. This means that the proposed design would have to be vision based.

Vision based hand gesture recognition can be classified into two categories, marker-based approach and marker-less approach. The marker-based approach requires the user to wear color markers or gloves, while the marker-less approach doesn’t required that [1].

The marker based approach generally has better accuracy and is easier to implement, but requires the user to wear a colored glove. Thus this approach is not very practical for a CC system to replace the computer mouse. The marker less approach would be the best choice for the system, since there is no constraint on the user to wear any colored or data gloves [2]

Gesture recognition can be seen as a way for computers to understand human body language, thus building a richer bridge between machines and humans than primitive text user interfaces or even GUIs (graphical user interfaces), which still limit the majority of input to mouse. Reference [6] used only the finger-tips to control the mouse cursor and click. His clicking method was based on image density, and required the user to hold the mouse cursor on the desired spot for a short period of time. A click of the mouse button was implemented by defining a screen such that a click occurred and mapping functions of computer mouse to the hand gestures bearing color caps [7][8] [9].

Table1: Comparison Of Related Work [1][2][3][4]

Year	Author	Title	Methodology	Limitations
2014	Abhik Banerjee, Abhirup Ghosh	Mouse Control using a Web Camera based on Colour Detection	Mainly focuses on the use of a WebCam to develop a virtual human computer interaction. Hand gestures were acquired using a camera based on colour detection technique.	The operating background be light and no bright colored objects be present. The system might run slower on certain computers with low computational capabilities
2013	Ashwini M. Patil, Sneha U. Dudhane, Monika B. Gandhi	Cursor Control System Using Hand Gesture Recognition	Focuses on the development of machine-user interface which implements hand gesture recognition using simple computer vision and multimedia techniques.	Before actual implementing gesture comparison algorithms, skin pixel detection and hand segmentation from stored frames need to be done.
2013	Angel, Neethu. P.S	Real-Time Static and Dynamic	design, develop and study a practical framework for real-time	unable to work at much complex background and not compatible

		Hand Gesture Recognition	gesture recognition that can be used in a variety of human-computer interaction applications.	at different light conditions.
2010	Chen-Chiung Hsieh and Dung-Hua Liou	A Real Time Hand Gesture Recognition System Using Motion History Image.	Focuses on a real time hand gesture recognition system based on adaptive skin color model and motion history image (MHI). A face based adaptive skin color model and a motion history image based hand moving direction detection method were proposed.	Cannot work for recognition of more complicated hand gestures .

2.2 Usefulness Of Proposed Work

This application would allow the user to control the cursor of computer using only their hand bearing color caps on the finger tip, without the need for any additional hardware. This is done using vision based hand gesture recognition with inputs from a webcam.

3. METHODOLOGY

The system can be grouped into four main components. Therefore in the Methodology, the method used in each component of the system will be explained separately. There are following subsections:

1. Color Detection
2. Hand Contour Extraction
3. Hand Tracking
4. Gesture Recognition
5. Cursor Control

1. COLOR DETECTION

Color detection involves detecting the color pixels of the tapes bearing on the finger tip in an image. It is a fundamental step. A wide range of image processing applications such as face detection, hand tracking and hand gesture recognition [8][2].. The result would be a grayscale image (back projected image), where the intensity indicates the likelihood that the pixel is a color tape pixel. This method is adaptive since the histogram model is obtained from the users color caps, under the preset lighting condition.

2. HAND CONTOUR EXTRACTION

The OpenCV [1] function cvFindContours() uses an order finding edge detection method to find the contours in the image. In the contour extraction process, we are interested in extracting the hand contour so that shape analysis can be done on it to determine the hand gesture.

The assumption was made that the hand contour is the largest contour therefore ignoring all the noise contours in the image. This assumption can be void, if the face contour is larger than the hand contour. To solve this problem, the face region must be eliminated from the frame. The assumption was made that the hand is the only moving object in the image and the face remains relatively stationary compared to the hand. This means that background subtraction can be applied to remove the stationary pixels in the image, including the face region. This is implemented in the OpenCV[1] function named “BackgroundSubtractorMOG2”.

3. HAND TRACKING

The movement of the cursor was controlled by the tip of the index finger. In order to identify the tip of the index finger, the centre of the palm must first be found.

4. GESTURE RECOGNITION

The gesture recognition method used in the proposed design is a combination of two methods, the method proposed by Yeo and method proposed by Balazs. The algorithm for the proposed gesture recognition method is described in the flow chart that can be shown below. It can be seen that the convexity defects for the hand contour must firstly be calculated. The convexity defects for the hand contour was calculated using the OpenCV inbuilt function “cv Convexity Defects”. The parameters of the convexity defects (start point, end point and depth point) are stored in a sequence of arrays. After the convexity defects are obtained, there are two main steps for gesture recognition:

1. Finger Tip Identification
2. Number Of Fingers

3. Cursor Control

It involves mapping different hand gestures to specific mouse functions

There is no inbuilt function in MATLAB which can directly access the mouse drivers of the computer. But MATLAB code supports integration with other languages like C, C++, and JAVA. Since java is a machine independent language so it is preferred over the others. A java object is created and it is linked with the mouse drivers.

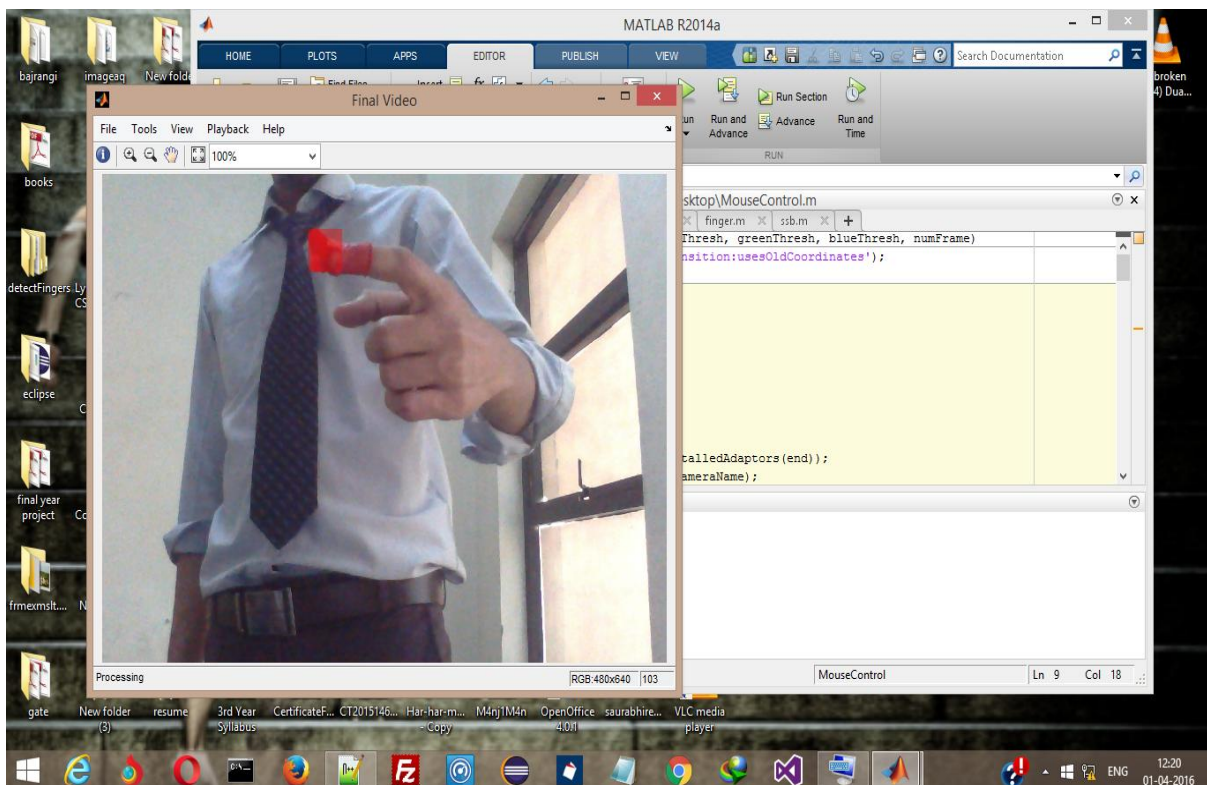
4. RESULTS ANALYSIS

INPUT	ACTIONS PERFORMED
One red color	To control the pointer position
One green color	For scroll up & down
One blue color	For left click
Two blue color	For right click
Three blue color	For double click

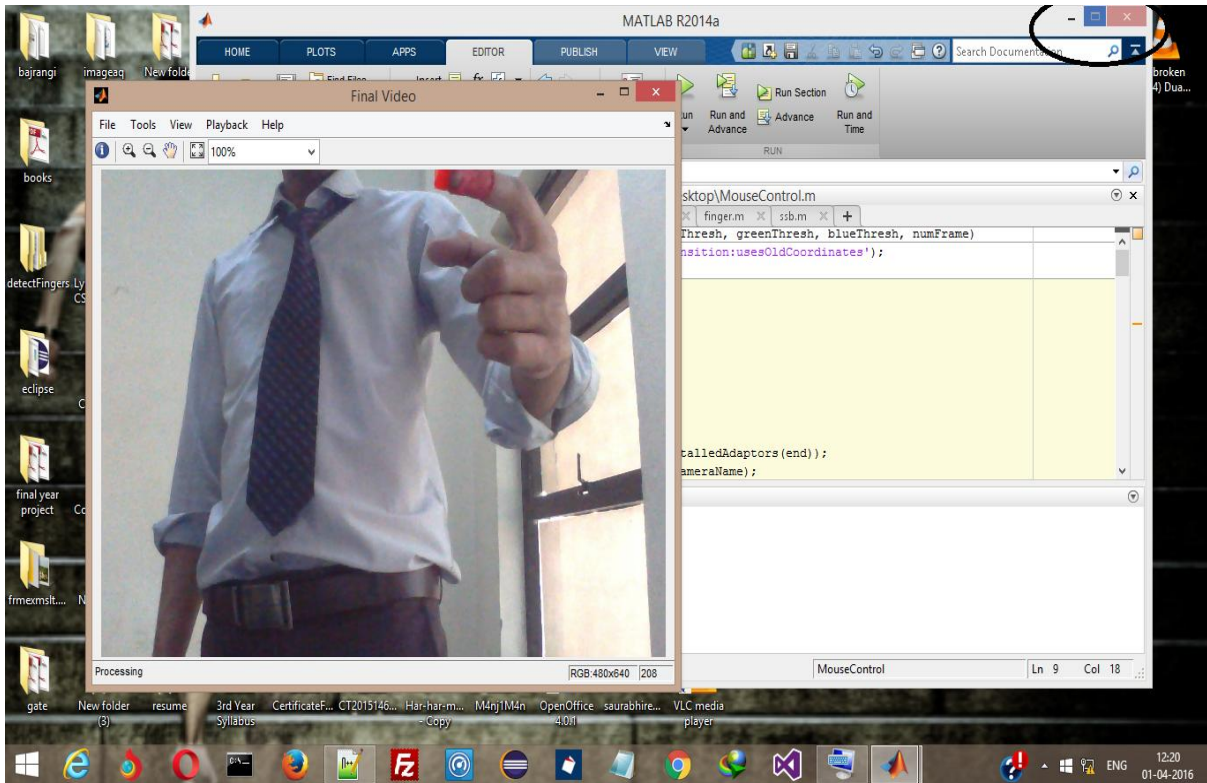
4.1 Analysis & Significance Of Results

The proposed system controls the functions of mouse pointer by detecting red, green and blue colored caps and perform five different mouse functions such as left click, right click, double click, cursor movement, scroll up and down. We can see it in following images:

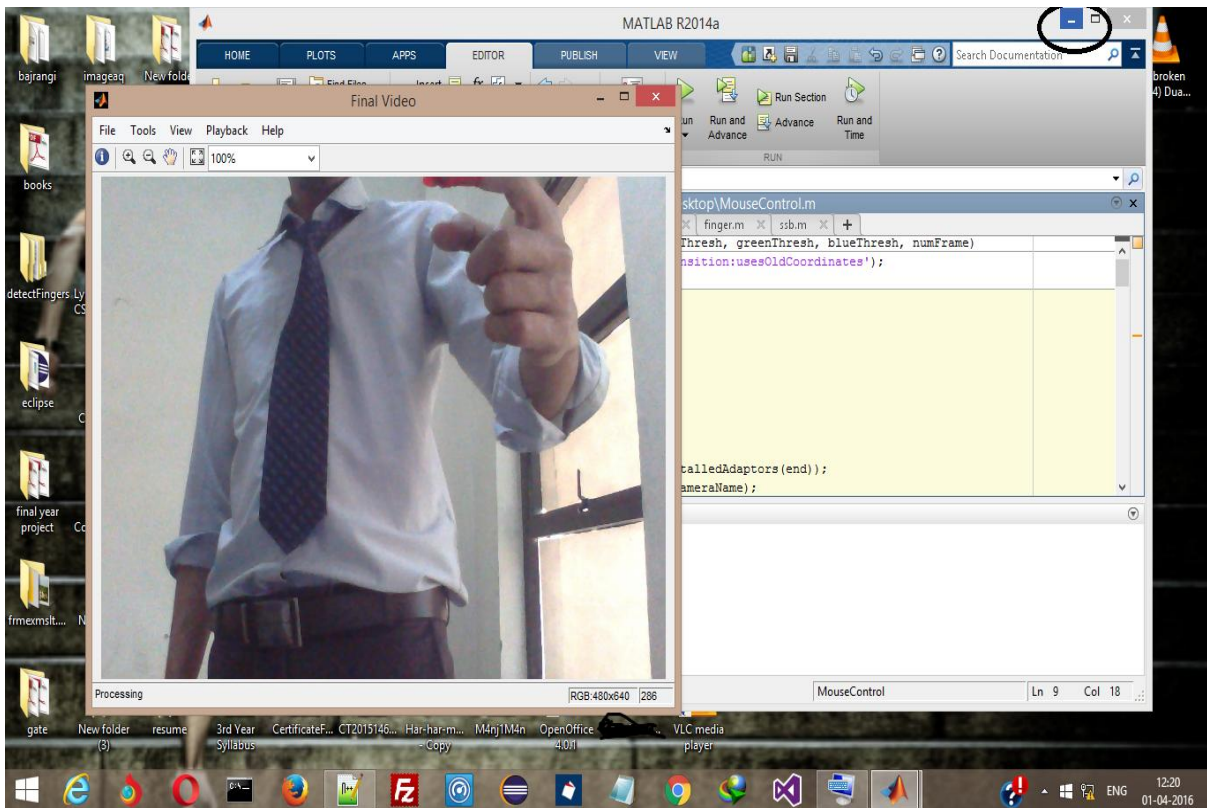
Detecting red color for tracking mouse pointer



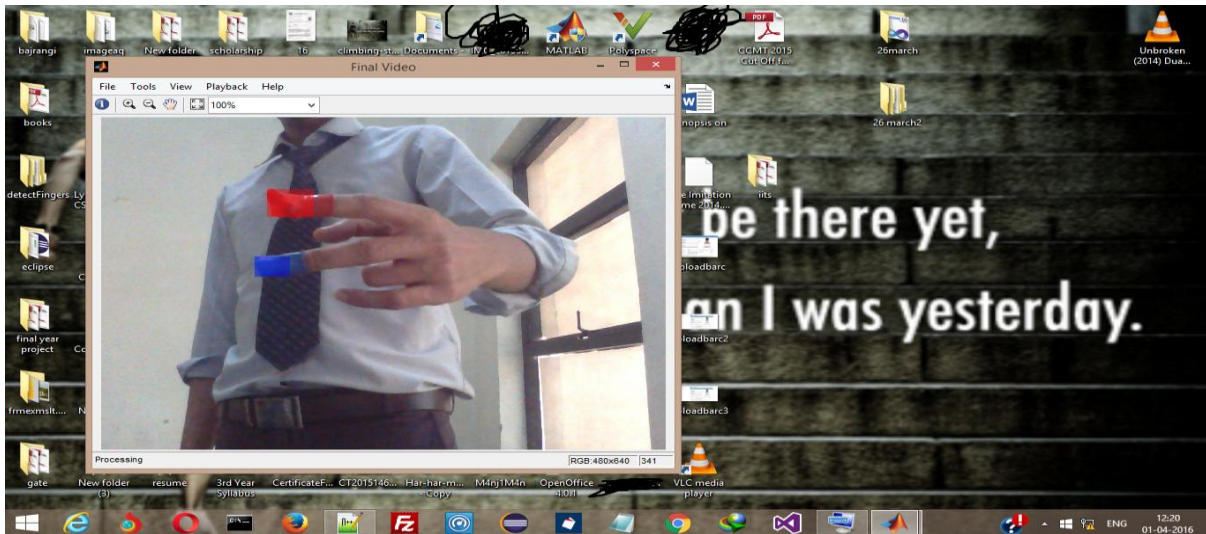
Moving cursor pointer



Moving cursor to minimization point



Minimizing the window using blue color



5. APPLICATIONS

This technology can also be used to help patients who don't have control of their limbs. In case of computer graphics and gaming, this application has been applied in modern gaming consoles to create interactive games where a person's motions are tracked and interpreted as commands.

6. CONCLUSION

A new technique has been proposed to increase the adaptability and response time of the system. We have developed a system to control the mouse cursor and implement its function using a real time camera. Implementation of all the mouse tasks such as left and right clicking, double clicking and scrolling up & down, starting the applications using the gestures like notepad, paint, command prompt etc.

This system is developed in such a way that the user, new to the system will just have to install the set up and not run the whole project. In this system, an object tracking based virtual mouse application has been developed and implemented using a webcam. The proposed system has been implemented in MATLAB environment using MATLAB Image Processing Toolbox, Open cv library.

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