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Virtual Mouse Using Hand Gesture Recognizer Via Convex Hull Algorithm

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Abstract -This paper presents a new approach for controlling mouse movement using a real time camera . Most existing approaches involve changing mouse part as adding more buttons or changing the position of the tracking ball. Instead we propose to change the hardware design . Our method is to use a camera and computer vision technology such as image segmentation and gesture recognition to control mouse tasks such as left and right clicking, double clicking and scrolling. The following paper is similar to the base research for Human Computer Interaction(HCI) which observes the way in which human interacts with computer and design technologies. The proposed paper makes use of image processing via Convex Hull Method and uses human hand gesture to replace mouse functions (i.e left click, right click, and cursor movement).

Key Words:Human Computer Interaction(HCI),image processing, Convex Hull Method , hand gesture.

1.INTRODUCTION

The computer mouse has remained largely unchanged over the last two decades, we have become increasingly proficient at operating the two button mouse. Mouse is the most ubiquitous part of any GUI. With a phrases of evolution mouse with multiple buttons, strollers and other sensing devices were discovered. More over with extrapolation of past trends the concept of mouse moreover remains in this area, this paper supports legacy application in both todays and future system, which requires mouse based input as a support .

Human Computer Interactions(HCI) serves as the area of research which observes the way in which human interact with computer and design new technologies. It's an important area where people try to improve the Computer Technology. Vision based gesture and object recognition is another area of research which do make of image processing techniques for its implementation.

There are simple interfaces like embedded keyboard and mouse available in markets. However these interfaces moving or may have restrained area of uses.

2. Related Work

We got inspiration of our project by a paper of Hojoon Park [5] where he used Computer Vision Technology and a web camera to control mouse movements. Earlier Erden et al [1] has used a camera and Computer Vision Technology such as gesture recognition and image segmentation to control mouse tasks. However Hojoon Park[5] used fingertip to control the mouse cursor and the angle between the thumb and the index finger was used to perform clicking action. Chu-Feng Lien[14] has usedan intuitive method to detect hand motion by its Motion History Images(MHI) in this method only fingertip was used to control both the cursor and the mouse click. In his approach the user need to hold the mouse cursor on the desired spots for a specific period of time for clicking operation. In paper [16] K N Shah et al have represented some of the innovative method of the finger tracking used to interact with a computer system using computer vision. They have divided the approaches used in Human Computer Interaction(HCI) in two categories: 1.HCI without using interface and 2. HCI using interface. Moreover, they have mentioned some useful application using finger tracking through computer vision.

Vision-based Human- computer interactions trough Real-Time Hand Tracking and Gesture Recognition Vision-based interaction is an appealing option for replacing primitive human computer interaction(HCI) using a mouse and a touchpad .We proposed a system for using a webcam to track a user's hand and recognise gesture to initiate specific interactions. The contribution of our work will be to implement a system for hand tracking and simple gesture recognition in Real-time.

Many researchers in the human computer interaction and Robotics field have tried to control mouse movements using video devices. However all of them used different method to make a clicking event. One approach, by Erden et al, used fingertip tracking to control the motion of the mouse. A click of the mouse button was implemented by defining a screen such that a click occurred when a users hand passed over the region[2,3]. Chu-Feng Lien has used only the fingertip to control the mouse cursor and the 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. Paul et al used the motion of the thumb (from a 'thumbs-up' position to fist) to mark a clicking event.

3. Proposed Work

This paper is a research paper for simulation of mouse and its functionalities via human gestures and image processing. The main method used to replace the actual mouse with human hand is by Convex Hull Algorithm. The following system architecture gives an overview of hand gesture recognition and mouse control system. First the input image is converted into binary image to separate hand from the background. Then the centre of hand is calculated and computed radius of the hand is found. Fingertip points are being calculated using Convex Hull Algorithm. All the mouse movements are controlled using the hand gesture.

Once we get an image from the camera, the image is converted into YCbCr from the colour space RGB as shown in figure 1. Then we define a range of colours as 'skin colour'

and convert these pixels to white; all other pixels are converted to black . Then, the centric of the dorsal region of the hand is computed. Once the hand is identified, we find the circle that best fits this region and multiply the radius of this circle by some value to obtain the maximum extent of 'a non-finger region'. From the binary image of the hand we get vertices of the convex hull of each finger. From the vertex and the canter distance, we obtain the position of the active fingers. Then by extending any one vertex, we control the mouse movement.

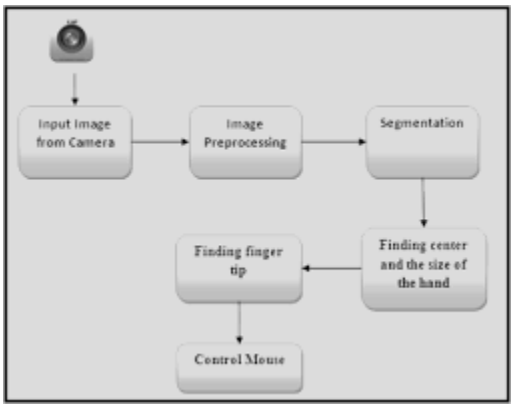


Fig -1: System Architecture

To recognize that the finger is inside the palm area or not, we will use a convex hull algorithm. The Convex Hull Algorithm is used to solve the problem of finding the biggest polygon including all vertices. Using this feature of this algorithm we can detect fingertips on the hand. We will use this algorithm to recognize if the finger is folded or not. To recognize those states we multiplied two times to the hand radius value and check the distance between the center and a pixel which is in a convex hull set. If the distance is longer than the radius of the hand, then a finger is spread. In addition if two or more interesting points existed in the result, then we regarded the longest vertex as the index finger and the hand gesture is clicked when the number of the result vertex is two or more. The result of convex hull algorithm has a set of vertices which include all vertices. Thus, sometimes a vertex is placed near other vertices. This case occurs on the corner of the fingertip. To solve this problem, we detected a vertex whose distance is less than 10 pixels when comparing with the next vertex. Finally, we can get one interesting point on each finger.

4. Implementation of Algorithm

A convex hull algorithm for Hand detection and gesture recognition can be used in many helpful applications, implementation of some efficient techniques and algorithms to detect hand gestures to be able to control the PC and other applications using the detected gestures. One of the techniques used, depends on the skin color features in the YCrCb color space. This color space is much preferable than RGB and HSV, as the skin color can be much efficiently differentiated in the YCrCb Color Model. For a more efficient detection, implementation of a background subtraction algorithm is used to differentiate between skin like objects and real skin colors. Initially, a frame is captured with only the background in the scene, after that, for every captured frame, each pixel in the new frame is compared to its corresponding one in the initial frame, if they pass a certain threshold according to specific algorithm computations, then this pixel is considered from the human body and it will be drawn in a new frame with its original color. If this pixel is below the threshold, then those two pixels are considered the same and they are considered as background so the corresponding pixel will take a zero color in the third frame. After repeating this for all frames' pixels, now we will have a new frame with only a human appearing in it, and all the background took a color of zero.

Fig 2: Hand Detection before Convex hull algorithm[4]

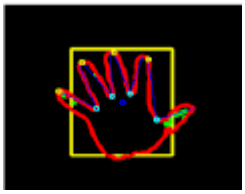


Fig 3: Hand Detection after Applying Convex Hull Algorithm[4]

Now we have detected hand as shown in figure 2 and 3, We applied on this hand object an efficient gesture recognition algorithm, that draws a convex hull over the hand object, and counts the number of defects in this hull, if no defects found, then it is a closed hand, if five defects found, then there are five fingers waving and so on.

5. Use-Case Diagram

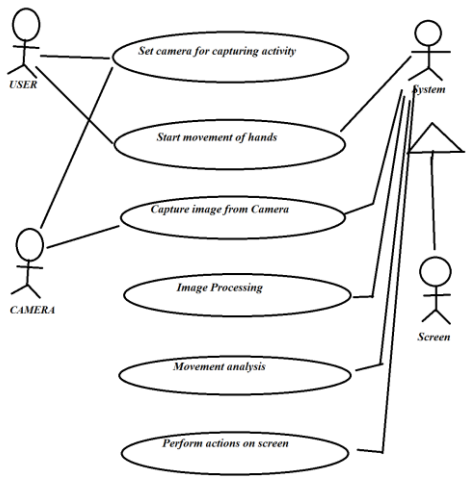
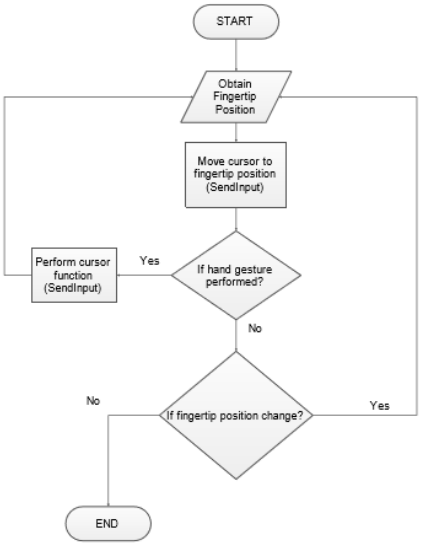


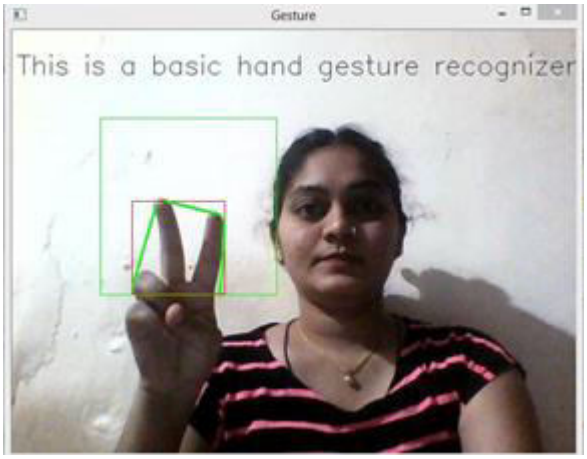
Fig 4. Use-Case Diagram

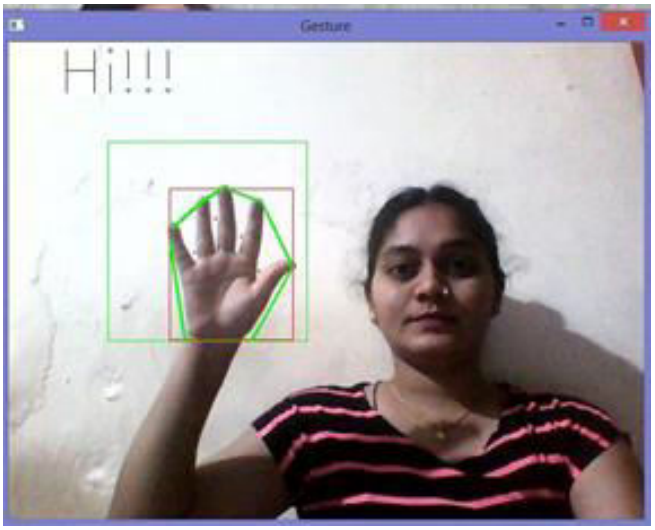
6. Algorithm Flowchart



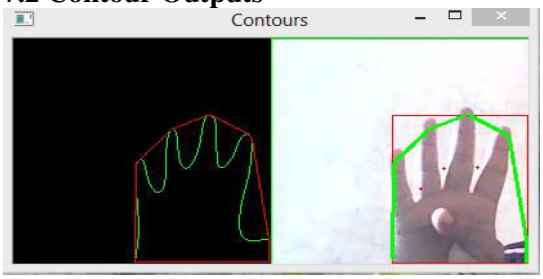
7. Results

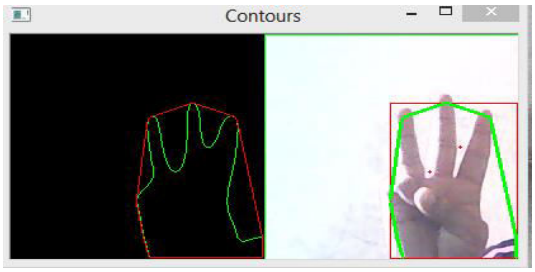
7.1 Input Images

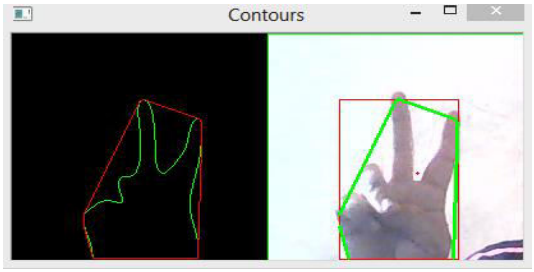


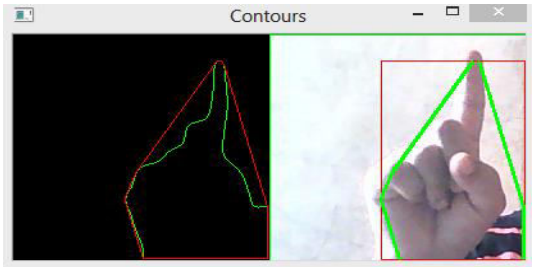


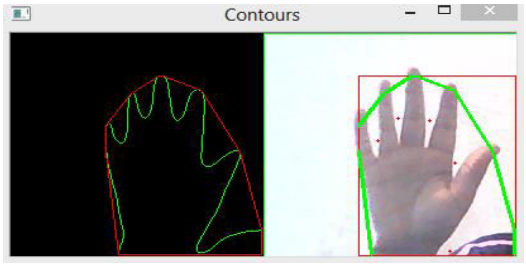
7.2 Contour Outputs



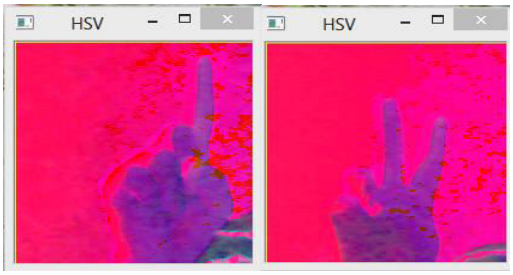


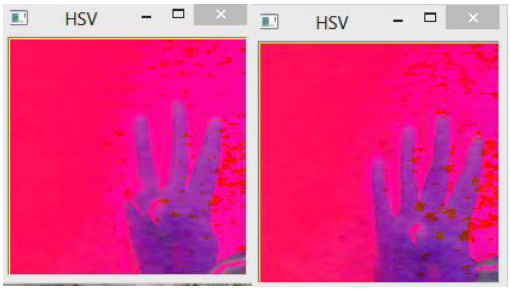


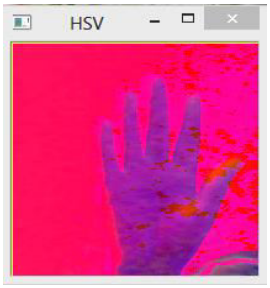




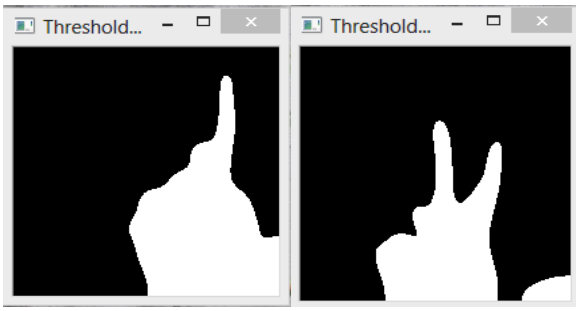
7.3 HSV Outputs

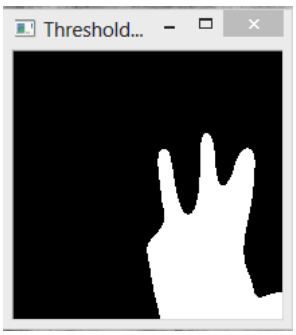






7.4 Threshold Output





8. CONCLUSIONS

Thus a new system has been proposed with enhanced dimensionality and usage of computing system. We have developed a system to control the mouse system with hand

gesture recognition with the help of real time camera i.e. web-cam. The goal of this project is to enhance the human computing methodology and increase the productivity of human, thus creating an impact on human computing trends. Advancement in the existing project can be done for the enhancement in the functionalities of traditional computing methodologies and replacing the traditional hardware by human gesture. The complete computer system could be then operated with the help of human gesture we can also integrate the human voice command for computing operations to be performed. This then would turn the phase of human computing.

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