RESEARCH PAPER ON DIGITAL IMAGE PROCESSING BASED TOUCHLESS MOUSE USING MATLAB

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Abstract - In this paper we present an approach for Human computer Interaction (HCI), where we have tried to control the mouse cursor movement and click events of the mouse using hand gestures. Gesture is one of the most vivid and dramatic way of communications between human and computer. Hence, there has been a growing interest to create easy-to-use interfaces by directly utilizing the natural communication and management skills of humans. This paper presents a hand gesture interface for controlling media player using neural network. The proposed algorithm recognizes a set of four specific hand gestures, namely: Play, Stop, Forward, and Reverse. Our algorithm is based on four phases, Image acquisition, Hand segmentation, Features extraction, and Classification. A frame from the webcam camera is captured, and then skin detection is used to segment skin regions from background pixels. A new image is created containing hand boundary. Hand shape features extraction, are used to describe the hand gesture. Hand gestures were acquired using a camera based on colour 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. This paper proposes a vision based system to control various mouse activities such as left and right clicking using hand gestures to make the interaction more efficient and reliable.

Keywords - *Hand gesture, Human Computer Interaction, Colour Detection, Web camera, Background Subtraction.*

I. INTRODUCTION

In this high tech world, it's almost impossible to imagine life without computers. The invention of computers is one of the greatest humankind's inventions. Computers have become an essential part of almost every day use for individuals of every age. In daily life, we interact many times with computers to make our work easier. Thus, Human Computer Interaction (HCI) has become a hot topic for research. In our daily life, vision and gestures are important approaches for communication among human beings and the same role is played by mouse in Graphical User Interface (GUI) based computers. So, a combined methodology can be used to make a better interactive system for HCI developing a technology in the field of digital signal processing, thus making it more attractive and efficient [1]. An image signal has a lot of information which can be utilized to control the different functions of computer. Hence, hand gesture can play a crucial role in this domain. In this paper, a vision based approach is presented for detecting hand gestures and executing varied functions such as left and right clicking which are usually performed by a computer mouse. Here, a web camera is employed to collect the images of hand gestures and then further used for tracking purpose. These images are processed in MATLAB software (version R2013a from Mathworks, USA) to find out centroid of each image. Hand movement also moves the centroid thus making it the principle of sensing for the alteration of cursor on computer screen. The hand image is treated here as the mother image. The left and right click functions of a mouse are implemented by folding the first and middle fingers of hand respectively and develop a baby image. So, by comparing the length of fingers in baby images with those in mother image gives an idea about the functionality performed by the hand gesture. When the length of finger crossovers the threshold length in baby image, it executes a clicking operation. Here, the efficiency of tracking the hand is improved by using red and blue colored caps on the fingers to make centroid looking more prominent. This paper takes off with a brief introduction and few insights into the HCI system.

In next section, video acquisition and region extraction are explained in detail with real time results. Finally, conclusion is highlighted. 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.

II.   RELATED WORKS

In reference [1], Erden et al have used a camera and computer vision technology, such as image segmentation and gesture recognition, to control mouse tasks. Our project was inspired by a paper of Hojoon Park [2] where he used Computer vision technology and Web camera to control mouse movements. However, he used finger-tips to control the mouse cursor and the angle between the thumb and index finger was used to perform clicking actions.

Chu-Feng Lien [3] had used an intuitive method to detect hand motion by its Motion History Images (MHI). In this approach only finger tip was used to control both the cursor and mouse click. In his approach the user need to hold the mouse cursor on the desired spot for a specific period of time for clicking operation.

Kamran Niyazi[4] et al used Web camera to detect color tapes for cursor movement. The clicking actions were performed by calculating the distance between two colored tapes in the fingers.

In their paper [5] K N Shah et al have represented some of the innovative methods 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 applications using finger tracking through computer vision.

III.   METHODOLOGY

Following are the steps in our approach:

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.   Colour detection and extraction of the different colours (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 colour pointers. The Basic Block Diagram of the System:
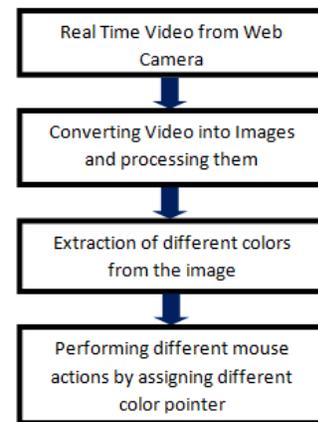

Fig 1: Proposed Methodology

The frame rate and resolution can be changed in the system if required.
1.   Computer Webcam is used to capture the Real Time Video
2.   Video is divided into Image frames based on the FPS (Frames per second) of the camera
3.   Processing of individual Frames

3.1 Flipping of Images:
When the camera captures an image, it is inverted. This means that if we move the colour 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 colour channels of the image are separated and then they are flipped individually. After flipping the red, blue and green coloured channels individually, they are concatenated and a flipped RGB image is obtained.

3.2   Conversion of Flipped Image into Gray
As compared to a coloured 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. [6]

3.3 Colour Detection:
This is the most important step in the whole process. The red, green and blue colour 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. [7]

3.4 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.

- Centroid of the image is detected
- Its co-ordinates are located and stored in a variable

3.5 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.

IV. RESULTS

Fig 2 : Red color detection for mouse cursor moving
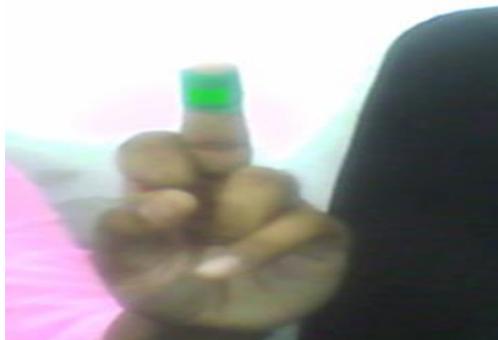
Fig 3: Green color detection for mouse scrolling
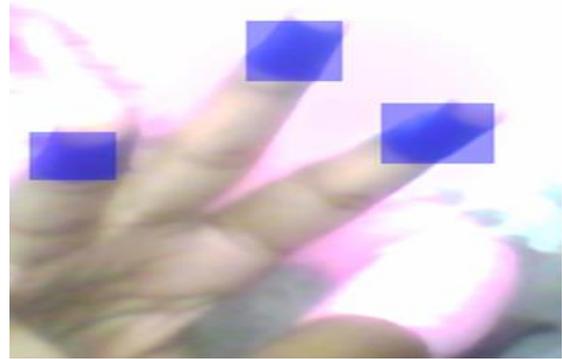
Fig 4: Blue color detection for mouse double click

V. CONCLUSION

In this paper, an object tracking based virtual mouse application has been developed and implemented using a webcam. The system has been implemented in MATLAB environment using MATLAB Image Processing Toolbox. This technology has wide applications in the fields of augmented reality, computer graphics, computer gaming, prosthetics, and biomedical instrumentation. Furthermore a similar technology can be applied to create applications like a digital canvas which is gaining popularity among artists. 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. Our 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.

VI. REFERENCES

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