Vision based Analysis using Sixth Sense Technology

Swarali Narvekar[1] and Manali Godse [2]

[1]M.E. Student, Dept. of Electronics and Telecommunication, DJSCOE, Vile – Parle (W), Mumbai– 400

[2]Professor and Head, Dept. of Biomedical, DJSCOE, Vile – Parle (W), Mumbai– 400 056

ABSTRACT
The recent trends in technology have revolutionized the means of interaction between the digital world and real time applications. The primary focus of human computer interaction is to improve the intercommunication between user and computer by making computer more receptive to the user's needs. Mouse too has undergone a significant revolution right from its invention starting with mechanical mouse with two buttons and scroll to an optical mouse and finally to a cordless mouse and is still used as a pre-dominant means to interact with a computer. In this paper our aim is to implement an invisible computer mouse that enables interaction with computer without attaching a hardware mouse. The methodology used is based on the SixthSense Technology where the user will be able to move the cursor by the movement of fingers. Our focus is to move the cursor on the screen as the user moves his/her fingers.

Keywords
Color Recognition, Motion detection, Image Processing, SixthSense Technology.

1. INTRODUCTION
'SixthSense' Technology augments the physical world around us with digital information and enables us to use natural hand gestures to interact with that information. A camera is used to capture live video or images. SixthSense Technology supports human computer interaction by allowing the user to interact with the captured information. It allows the information to be projected onto surfaces, walls, and physical objects around us, and enables us to connect with the projected information via natural human gestures such as hand movements, arm movements, head movements or blink of eye thereby relinquishing information from its confines by seamlessly integrating it with reality.This technology is gaining its popularity strength because of the usability, simplicity and ability to work independently in today's scenario.
At present, different techniques for hand gesture recognition are effectively combined to perform a robust hand detection and gesture recognition.In this project, we intend to implement an invisible computer mouse that enables interaction with computer without attaching a hardware mouse.The methodology used is based on the SixthSense Technology where the user will be able to move the cursor by the movement of hand fingers. Our aim is to move the cursor on the screen as the user moves his/her fingers using general-purpose hardware and low cost sensor, like asimplepersonal computer or an USB web cam, so that any usercould make use of it in his office or home. Further, the algorithm will be developed to recognize the color of the color caps present at the finger tips from images and to note down the position of the respective pixel indicating the presence of color. Change in the pixel position through series of frames will enable the cursor to move in the respective direction.

2. RELATED WORK
All Mouse and touchpad are primarily used for primitive human computer interaction (HCI). The use of Mouse and touchpad is eliminated by using the vision based Human Computer Interaction through Real Time Hand Tracking and Gesture Recognition. For this purpose a webcam is used to track a users hand and recognize gestures to initiate specific interactions [1]. The technology is based on the assumption that all hand movements are properly coordinated. The skin colour based ROI segmentation and Viola-Jones Haar-like feature based object detection are dovetailed to optimize hand gesture recognition for mouse operation. In this paper, colour is used as a robust feature to first define a Region of Interest (ROI). Then within this ROI, hand postures are detected by using Haar-like features and AdaBoost learning algorithm. Once gestures were recognized, then they were assigned to different mouse events, such as right click, left click, undo, etc [5].
A real time camera and computer vision technology, such as image segmentation and gesture recognition are used to control mouse tasks (left and right clicking, double-clicking, and scrolling) [3]. Air Touch technology which primarily uses computer vision techniques where the user interacts with a virtual plane that rests in between the user and the display can be used to enable mouse movements. On this plane, hands and fingers were tracked and recognized as gestures in a manner similar to a multi-touch surface [4]. The mouth-controlled mouse is implemented using face detection and tracking system. The images of the moving mouth were captured into computer by webcam, and the movement and click of the cursor was controlled by moving mouth. In this paper the method used for Mouse Simulation Method includes three stages. Firstly, a camera captures a real time video of moving hand in front of camera on a screen. The three stages are then performed on the captured frame. The first stage included implementing different models such as implementation of colour space model to extract the skin pixels, motion detection to extract the identified object. The second stage was calculating the probability of the hand identified by

convoluting the outputs of different models in stage I to obtain the finger tip. In the third stage, the finger coordinates detected were transferred on the mouse server with the help of sockets. These coordinates were then used to over ride the system mouse movements [7]. Another approach for enabling the cursor movement is by using face tracking technique based on tracking lens and pupils of the eye. The camera captured the images in the RGB format. The image was then converted into a grayscale image and the histogram of the image was equalized, so as to facilitate uniformity in processing the captured image. Further, the face was detected, then the eyes were detected and then the line of sight was calculated [8].transport the captured image to the program in the computer dealing with replacement processing. Then a comparison of the images from the identification system to that of the real person was made. The original RGB image was converted into HSV, and the default threshold of HSV was used to identify the mouth. Finally using their mouth the user finds a way to connect to and position the location of the cursor, a final analysis of the mouth-type determines when the 'click' function is applied. There are different types of mouth types which are associated with the cursor movement or the click [10].

3. SYSTEM COMPONENTS

The components of Sixth Sense used are Camera, Colored Markers/Colored Caps and C Sharp installed in Laptop.

3.1 Webcam

The webcam captures the real time video or images. It tracks the movements of the thumbs and index fingers of the user's hands and sends it to C-sharp programming language installed in the laptop where an algorithm is developed for colour recognition and motion detection.

3.2 Colored Caps/Colored Markers

The Coloured Markers or Coloured Caps are present at the finger tips of the user's hand. The color present at the finger tips of the user's hand are used to recognize different hand gestures. The movements and arrangements of these markers are interpreted into gestures.

Figure 1 Colored Caps

3.3 C Sharp

C Sharp is a simple, modern, general-purpose, object-oriented programming language wherein an algorithm is developed for color recognition and motion detection. It is full of features that make development faster and easier, usually at the cost of flexibility and/or runtime performance and is faster than C, C++, JAVA and MATLAB.

4. PROPOSED METHODOLOGY

Our aim is to enable mouse movement by detecting the position of user's hand fingers. Figure 2 shows the algorithm we used in our approach to move mouse cursor on screen using sixth sense technology.

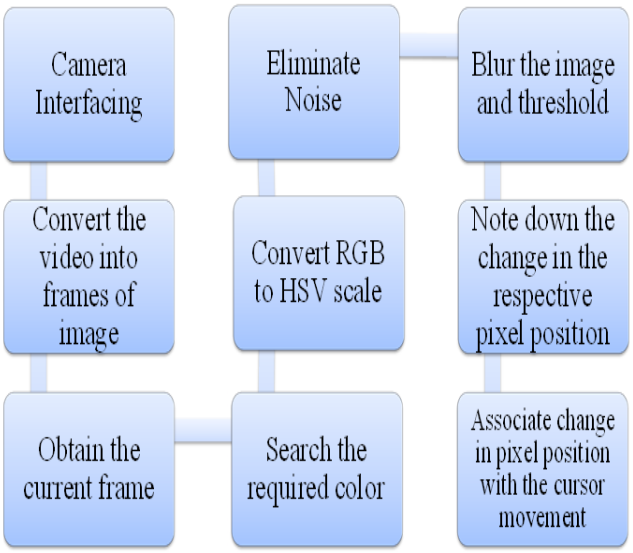

Figure 2 Algorithm

A Webcam captures the real time video and sends the captured information for further processing. The mechanism works in a continuous manner in which the captured real time information is converted into frames of images. The frames of images are obtained continuously one after the other and the latest frame is considered further for processing i.e. for the color recognition purpose. The camera captures the object in a polar fashion i.e. the right side of the real time image appears as left in the captured image and vice-versa. Therefore the captured image is first and foremost resized and flipped so that the captured image is found to be the same as the real time image.

In our proposed methodology we have chosen to detect the green color in particular. Hence the algorithm detects the required color which is the green color. The image captured by the webcam is in the RGB (Red Green Blue) color space. It is converted into the HSV (Hue, Saturation, and Value) color space, the reason being that HSV color space corresponds more naturally to human perception. Also, it is easier to understand and calculate. The parameters for hue, saturation and value or brightness are set prior for the conversion to HSV color space. The minimum and maximum values for Hue, Saturation and brightness or value are set at 50, 50, 125, 95, 255 and 255 for the detection of green color; the former representing the minimum values and the latter representing the maximum values.

The image obtained in the HSV Color space is then converted into gray scale where the color which is detected appears as white color whereas the other colors appear as black color. Then the two very common morphological operators i.e. Dilation and Erosion are applied in order to eliminate the noise. The objects other than those present in the desired color appear as black color in the gray scale image. The sharp contours or edges of the detected object are smoothened by blurring the image by using a Gaussian filter. Threshold being one of the simplest segmentation methods is used toseparate out those regions of an image corresponding to the objects

which we want to analyze. This separation is based on the variation of intensity between the object pixels and the background pixels.Once the important pixels are separated properly, we have set them with a determined value to identify them i.e. we have set the values in between 20 to 255. The cursor movement is associated with the change in the pixel value from one frame to another.

5. RESULTS

The color detection and motion detection process have been simulated by using the C Sharp programming language to process the image from the live video captured by the camera in order to obtain the final resultant image showing required colours only. The image processing and colour recognition process was performed using the machine having an Intel Core i5 processor. The algorithm returns the image showing the desired colour which is detected in the entire image. For this purpose we use a sample image.The sample image and its output image after colour recognition are shown in Figure 3.

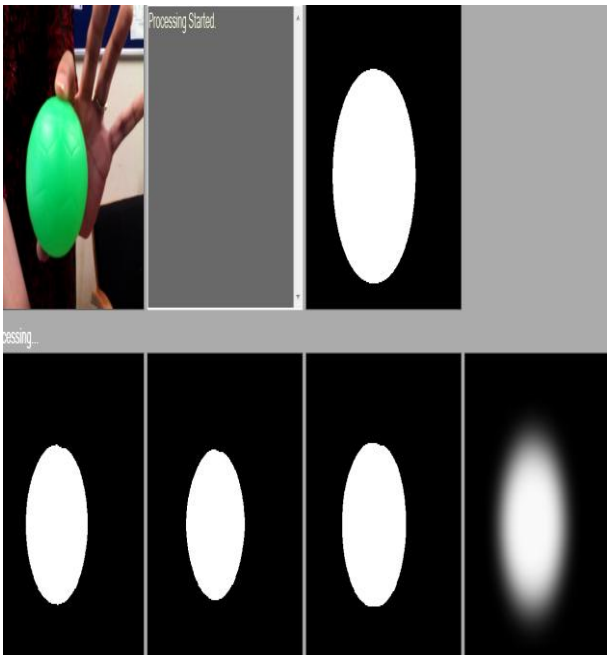

Figure 3 Output image obtained after color recognition process done for a single color i.e. green with the circular object i.e. ball kept at centre

Figure 3 shows the sample image taken to accomplish the colour recognition and motion detection process. A green coloured circular ball is taken as a sample to be recognized at first. It is placed at the centre. Out of all the colours present in the background, the green coloured ball is recognized which appears as white colour whereas all the other colours present in the background are turned black. Thus our desired object is detected along with its respective shape. Also it shows the result for dilution, erosion, smoothening and after setting up the binary threshold values. Figure 4 shows the changes in the image result when the ball position is changed. The ball is moved slightly in the upward direction.

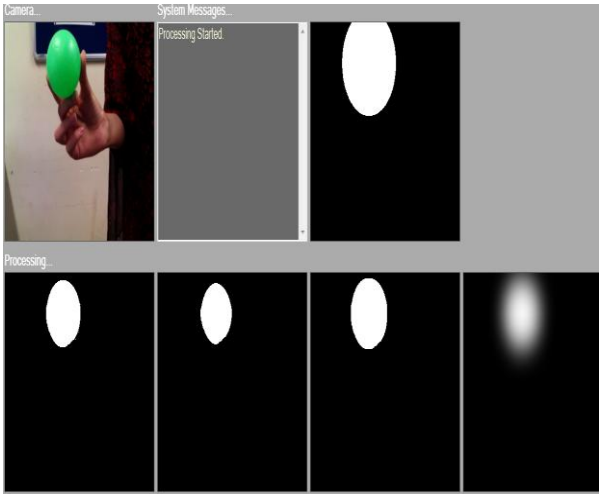

Figure 4 Output image obtained after color recognition process done only for one color i.e. green with the circular object i.e. ball moved slightly in the upward direction

The algorithm can be applied to detect variety of shapes and colors. Figure 5 shows results obtained for the detection of the green colored pen. Similar to the previous results, in this case the pen is detected and appears as white color in the resultant image whereas the background colors are turned black. Thus the desired object is detected and appears as white color whereas the other colors in the image are turned black.

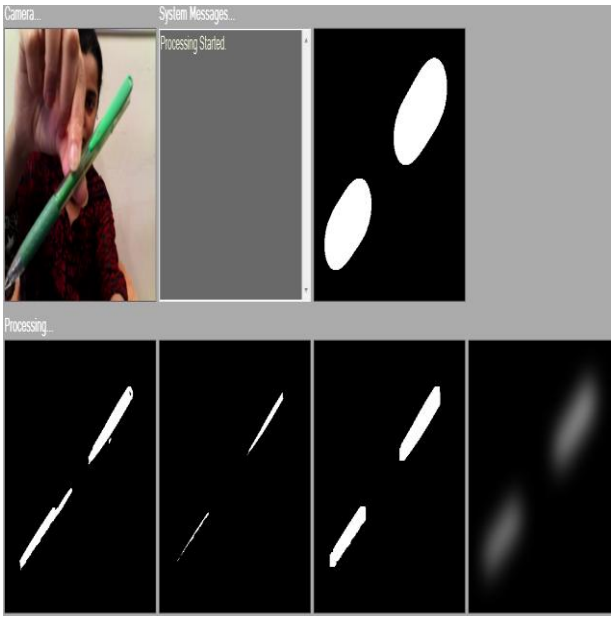

Figure 5Output image obtained after color recognition process done only for one color i.e. green with the object to be detected being a Pen

Figure 6 shows the image results for the detection of a cap attached to a pen. The user can wear this cap on his/her fingers in order to enable the movement of the cursor on the screen.

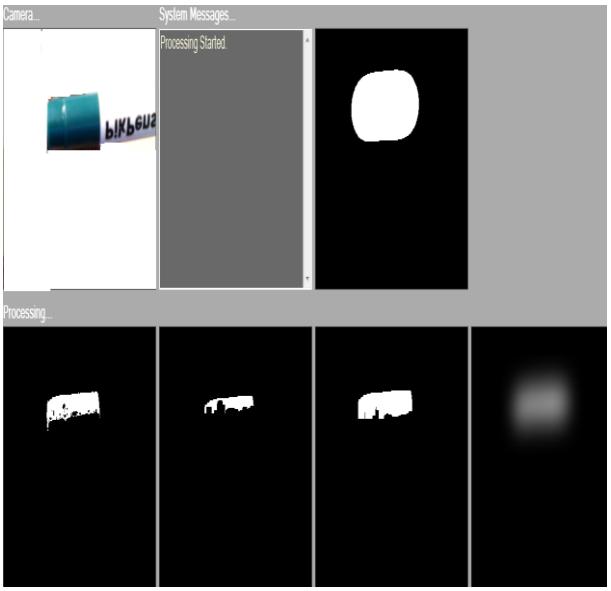

Figure 6Output image obtained after color recognition process done only for one color i.e. green with an even smaller object i.e. whiteboard marker with a green cap

6. CONCLUSION AND FUTURE WORK

The components of SixthSense technology have been extensively used for the colour recognition and motion detection process. The cursor movement is associated with the position of the colour pixel. However, it is very difficult to get stable results because of the variety of lighting and detection of the same colour in any other location in the background. The performance of the system can be improved by further by using a powerful camera.

A significant improvement can be obtained if the use of color markers would be eliminated. This is possible by directly detecting the fingers i.e. skin color and then associating the cursor movements to the hand fingers. The algorithm needs to be modified for this purpose so as to detect the skin color of people having different skin complexions. C Sharp programming language will be extensively used for this purpose.

7. REFERENCES

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