Analysis of Cursor Movement using SixthSense Technology

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ABSTRACT

Human Computer Interaction is one of the most exciting fields in modern user interface design. For many applications, it engenders an ease of use and intuitive tactile response that is unparalleled. It augments the digital world with real time applications allowing users to access the digital information by making computer more compliant to the user's needs. Despite the new iterations of technology the two button mouse has continued to remain a predominant means to interact with a computer. Our aim is to enable interaction with a computer without attaching a hardware mouse. The components of SixthSense Technology have been used for the implementation of an invisible mouse.

Keywords

SixthSense Technology, Image Segmentation, Skin Detection, Motion Detection.

1. INTRODUCTION

Human computing interaction (HCI) is one of the important areas of research where people try to improve the computer technology. Nowadays we find smaller and smaller devices being due to technological advances. Vision-based gesture and object recognition are another area of research. A simple interface like embedded keyboard, folder-keyboard and mini-keyboard already exists in today's market. However, these interfaces need some amount of space to use and cannot be used while moving. Touch screen are also globally used which are good control interface and are being used in many applications. However, touch screens can-not be applied to desktop systems because of cost and other hardware limitations.

As compared to the conventional HCI interface devices, the techniques using human body motions, speech, and eyeball movements provide more powerful and intuitive HCI interface. Human hands are frequently used for communication in our daily lives. Hand gestures are the most natural and easy way of communication. This powerful and instinctive property of human hand makes them adequate as HCI devices. At present, different techniques for hand gesture recognition are effectively combined to perform a robust hand detection and gesture recognition. By applying vision technology, coloured substance, image comparison technology and controlling the mouse by natural hand gestures, the count of wires required for interfacing a mouse with a computer will be reduced and it would eventually result in lesser amount of work space required.

2. RELATED WORK

A camera and computer vision technology, such as image segmentation and gesture recognition is used to control mouse tasks. The software is developed in JAVA language. Recognition and pose estimation in this system are user independent and robust as colour tapes are draped on human fingers to perform mouse control actions. The skin segmentation process outputs an image which is ready for detection of color tapes in the finger. For this an algorithm based on HSV color space is used which is very effective to select a certain color out of an image. The RGB pixels are converted into the HSV color plane, so that it is less affected to variations in shades of similar color. Then, a tolerance mask is used over the converted image in the saturation and hue plane. The resulting binary image is then run through a convolution phase to reduce the noise introduced. The click events for the mouse are mapped with different hand gestures. The idea focuses on processing the distance between the two coloured tapes on the fingers [9]. Keyboard and mouse are the most essential input devices to work with a computer. By the use of on-screen keyboard, a pointing input device such as mouse is sufficient to operate a computer with GUI software. The basic actions of a mouse are Mouse Movement and mouse button click. An assistive technology is used to replace the traditional hardware mouse by enabling mouse movement by head movements using OpenCV. In computing, a cursor is an indicator used to show the position on a computer monitor or other display device that will respond to input from a text input or pointing device. The cursor is moved on the screen by setting the coordinates for the desired position on the screen. Firstly a snapshot from the moving picture is taken and then the human face is detected using OpenCV Haar classifiers. The next step is to find the dimensions of the face. Then the two rectangular points are found i.e. the x-position and y-position is calculated and the cursor movement takes place in accordance with the changes in distance between the pixel position variation in the images The cursor is moved left, right, up and down by moving the head right, left, towards the camera and backwards the camera respectively [1].

Eye-guide is another assistive communication tool designed for the paralyzed or physically impaired people who were unable to move parts of their bodies especially people whose communications are limited only to eye movements. The prototype consists of a camera and a computer. A Camera is used to capture the images and send it to the computer, where the computer is the one to interpret the data. Eye-guide focuses on camera-based gaze tracking. The prototype is designed to perform simple tasks and provides graphical user interface in order the paralyzed or physically impaired person

can easily use it. One approach is through the use of video-based tracking. For this kind, using eye tracking tool, such as camera, the system was able to notice precisely where the user's eye is staring on the screen. The binocular eye-tracker has been configured to send x and y coordinates that is used to determine eye position with respect to the screen. Software on the PC uses this information and sends it to Windows as a mouse signal, and the x, y coordinates determine the cursor position to the screen. The selection (the emulation of pressing the button on a mouse) is achieved by the software detecting an unnatural event. This unnatural event refers to the time when the person winks (different from natural eye blink and the eye tracker won't treat blinking as a valid signal) or when the eye is held still for half a second. The use of a binocular system allows the closure of the right and left eyes to emulate pushing the right and left mouse buttons respectively [5].

A pointing device is developed with an objective to perform the same functions as a conventional mouse and to evaluate the performance of the proposed device when operated by quadriplegic users. It is controlled by head movements. Ten individuals with cervical spinal cord injury participated in functional evaluations of the developed pointing device. The device consisted of a video camera, computer software, and a target attached to the front part of a cap, which was placed on the user's head. The software captured images of the target coming from the video camera and processed them with the aim of determining the displacement from the center of the target and correlating this with the movement of the computer cursor. Evaluation of the interaction between each user and the proposed device was carried out using 24 multidirectional tests with two degrees of difficulty. According to the parameters of mean throughput and movement time, no statistically significant differences were observed between the repetitions of the tests for either of the studied levels of difficulty. The pointing device was composed of a video camera, computer software, and a marker or "target." The target is attached to the front part of a cap placed on the user's head. The target color could be selected as white, red, blue, green, or yellow. The standard for representing the colors of the images from the video camera was hue, saturation, and intensity (HSI). The software utilized the HSI parameters to identify the target with the desired color. White was used in the present study because the camera sensor represented the infrared light spectrum as this color. During the process of scanning for the target, the software first searched for possible objects with the same previously selected color. To achieve this, tracking was carried out vertically on a certain number of columns of the video image. Once the object with the specified color was found, an identification process began that used eight points located on the edge of the object, numbered 1 to 8, with 45° angles between them. The developed pointing device adequately emulates the movement functions of the computer cursor. It is easy to use and can be learned quickly when operated by quadriplegic individuals [4].

3. SIXTHSENSE TECHNOLOGY
SixthSense Technology was first developed by Pranav Mistry, a PhD student in the Fluid Interfaces Group at the MIT Media Lab and has since attracted a high degree of interest in the human computer interaction community. It augments physical world around us with the digital information. It projects information onto surfaces, walls, and physical objects around us, and enables us to connect with the projected information through natural hand gestures, arm movements, or our

interaction with the object itself. 'SixthSense' attempts to free information from its confines by seamlessly integrating it with reality, and thus making the entire world your computer. This technology is gaining its popularity strength because of the usability, simplicity and ability to work independently in today's scenario.

The different components of SixthSense used are Camera, Colored Markers/Colored Caps and C Sharp programming language installed in Laptop.

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.
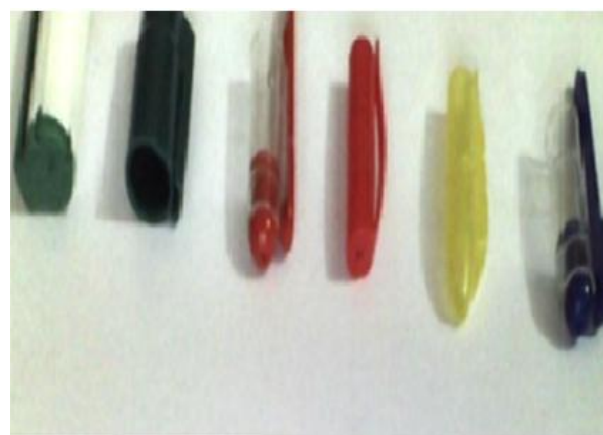
2) Colored Caps/Colored Markers

Fig 1: Colour Caps

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

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
In our work we have presented a system based on hand feature extraction. The hand gesture area is separated from the background by using skin detection and segmentation method of skin colour, then a contour of hand image can be used as a feature that describe the hand shape. Our aim is to enable cursor movement without attaching the hardware mouse. The components of SixthSense Technology will be used for this purpose. Figure 2 shows the algorithm we used in our approach to move mouse cursor on screen using SixthSense technology.
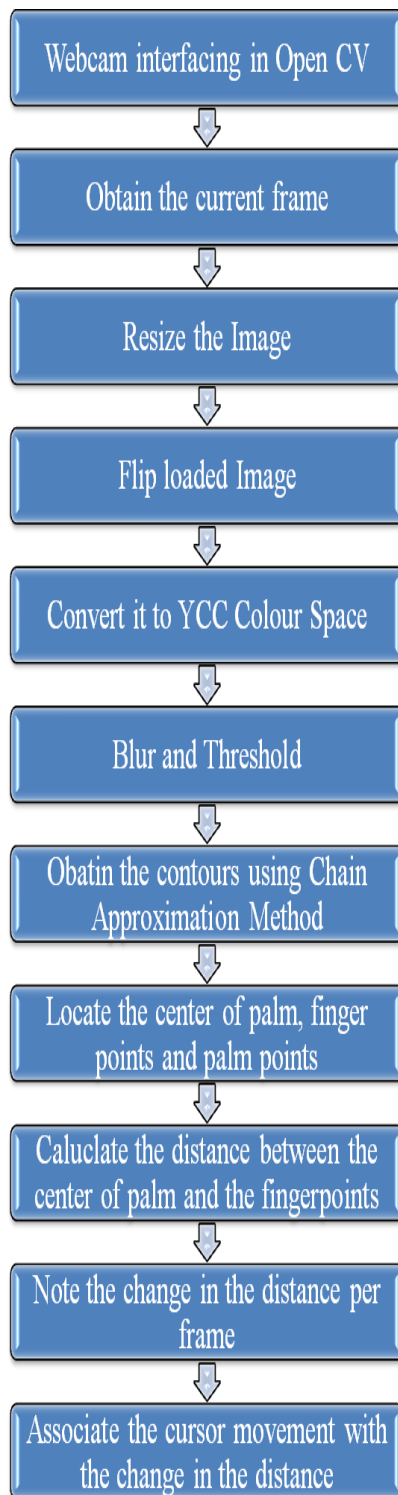
Fig 2: Steps for mouse movement

As such, the general process of the proposed method is Composed of the following main parts:-

1) Camera Interfacing

The Webcam acts as a digital eye and is used to capture RGB videos. The video is acquired under normal lighting conditions to simulate real-time environment. Natural lightning conditions are required to be present during the video acquisition process. A video acquisition process is subjected to many environmental conditions such as position of the camera, distance from the camera, illumination or lightening conditions available and presence of noise.

2) Obtain the current frame

The Webcam captures video and converts it into frames of images. The images are obtained one after the other in a continuous manner out of which the current frame is considered for further processing.

3) Resize and Flip the Image

The image captured from the webcam is first and foremost resized for processing. It is resized to an image 320×240. The image captured from webcam will be inversed from user's view. 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. Hence we need to flip the loaded image to make it appear like a mirror of the users on the screen. To flip an image, we need to know the width of the image, and then make a flipped image. Once the image is resized it is flipped.

4) Convert it to YCC Colour Space

First of all, we use the RGB pixel number to find the range of RGB pixel number for the skin. However, the RGB colour system is easily intermittent with a great influence of light source. As a result, two similar colours could have different RGB numbers, and the difference in lighting can greatly influence the colour of the skin. So we locate the hand on YCC colour space, which Y stands for luminance, former C stands for blue difference chrominance component and the latter C red difference chrominance component. The conversion is from RGB to YCC. The RGB value is between decimal 0 to 1, and conversion from 0 to 255. Information from the YCC colour map shows YCC colour is more continuous and less susceptible to the effects of brightness. It's easier to set a specified set of specific YCC, and the results have less noise. Here we have chosen to detect the human skin. Specifically for detecting the human skin we have chosen the range of YCC colour space to lie between 0,131, 80 and255, 185, 135; the former representing the minimum range and the latter the maximum.

5) Blur and Threshold

This step is creating a skin-segmented binary image by using a threshold value of probability, if the probability of a pixel in skin likelihood image is more or equal to estimated threshold value, it supposed that this pixel represents skin colour, if not it is supposed that this pixel does not represent skin colour. The skin colour pixels are white and the other ones are black in the skin –segmented image.

6) Obtain the Contour and palm area

The next step is to find the hand contour of the gesture image. The hand contour will act as the feature of the gesture. The feature extraction aspect of image analysis seeks to identify inherent characteristics, or features of objects found within an image. These characteristics are used to describe the object, or attribute of the object. Contour detection process consists of two steps: first find the edge response at all points in an image using gradient computation and in the second step modulate the edge response at a point by the response in its surround. Once the hand has been detected the next step is to find out the palm area. The palm area is calculated using convexity defect. The required set of points is created from the convexity defect depth points with the help of which the centre of the palm is detected using minimum enclosing

circle. We have then detected the finger points i.e. tip of all the fingers. The pixel position of these points is noted. The palm bounding circle is drawn joining all the finger points. Then the distance between the centre of the palm and the finger point is calculated.

7)   Obtain the change in distance

The distance between the centre of the palm and the finger point keeps on changing from one frame to another as the user moves his/her fingers.   The cursor movement is then associated with the change in the distance between the two pixel positions i.e. pixel representing centre of the palm and the pixel representing the finger point. Thus as the user moves his hands towards the left, the cursor moves towards the left and as the user moves finger to his right the mouse cursor gets shifted towards the right. Similarly different hand gestures are associated with single click, double click, left click and right click operations.

5. RESULTS

We took a couple of images as the sample image to accomplish the skin detection process. First we took figure 3 as our first sample image. As can been seen there is no human skin present in this image. A bottle of water and a wardrobe is present in the image. Therefore the algorithm does not detect any human skin in the image as seen in figure 4.

Fig 3: Sample image 1

The resultant image returned by the algorithm is as shown in the below figure 4.

Fig 4: Output image obtained after detection process

Next we took figure 5 as our sample image for skin detection purpose.

Fig 5: Sample image 2

The figure 6 shown below demonstrates the optimized skin detection output image. The human hand is associated with the cursor. The blue colour circle enclosed in yellow rectangle indicates the association of the skin with the cursor movement.
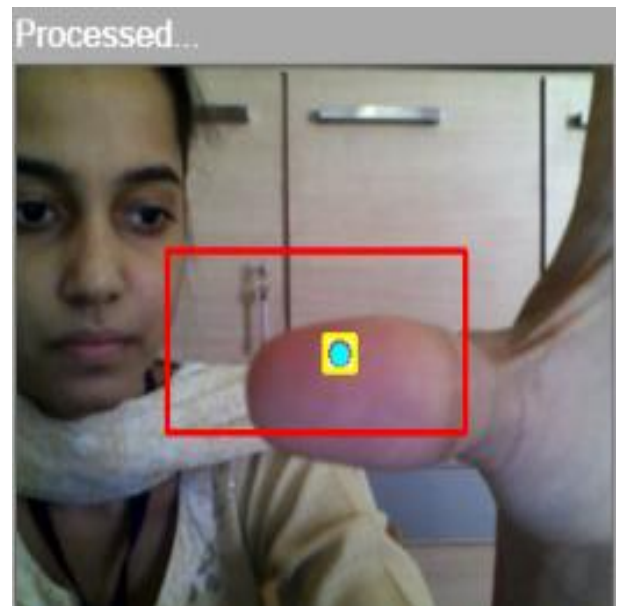

Fig 6: Output image after skin detection process

As the user moves hand over the screen the cursor movement takes place accordingly. As the user slides hand towards left the cursor moves in left direction and as the user moves hand towards right the cursor moves towards right. The above colour recognition was successfully done with better skin detection and visualization. The left double click operation is performed with the aid of simply two fingers as shown in figure 7.
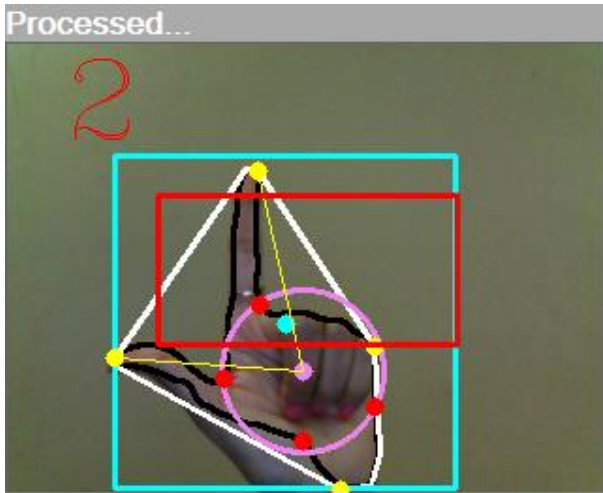
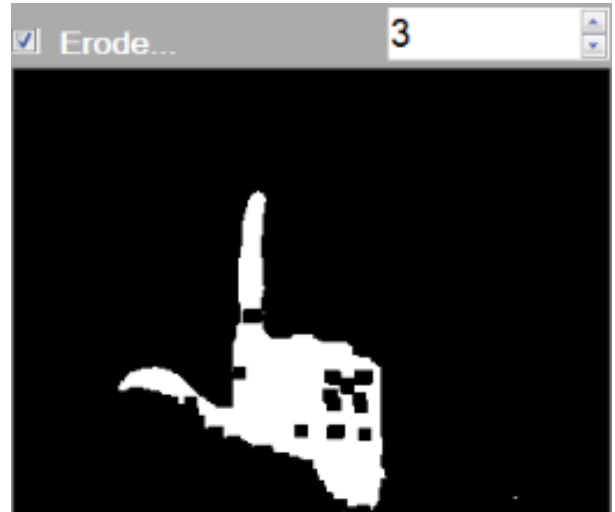**Fig 7: Hand Gesture for performing left single click**

Fig 10: Erode process
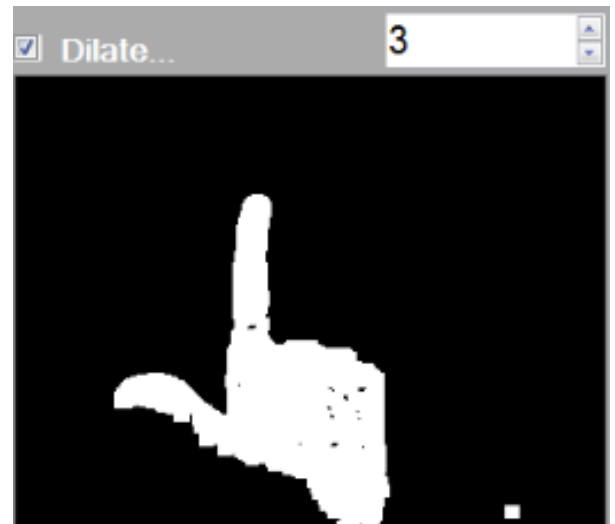

Fig 8: Processing started
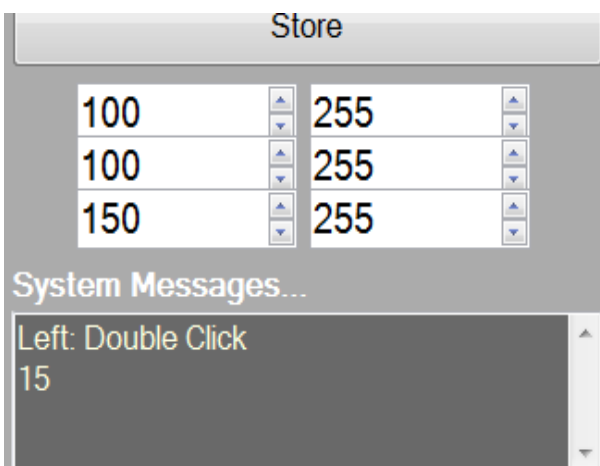

Fig 11: Dilation process

Fig 9: Left double click process
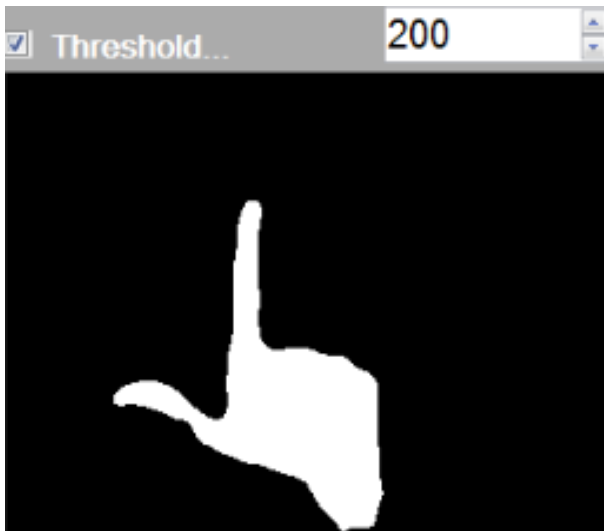

Fig 12: Smoothening the image

Fig 13: Threshold process

The start of the process is shown in figure 8. The left double click operation is performed with the movement of two hand fingers as indicated in figure 9. The resultant image after performing the erode and dilate processes is as shown in figure 10 and figure 11. The obtained image is further blurred and the required threshold points are selected for performing the click operation. The blur and threshold operations are shown in figure 12 and figure 13 respectively. Thus the Right single click, right double click, left single click as well as drag and drop operations can be performed using different hand gestures.

6. CONCLUSION AND FUTURE WORK

Motion detection and Skin detection are extensively used to enable cursor movement using hand gesture. The movement of mouse cursor is achieved with a good precision. However, it is very difficult to get stable results because of the variety of lighting in the background. The performance of the system can be improved by further by using a powerful camera.

7. REFERENCES

[1] A Simple Algorithm for using Face as a Pointing Device using OpenCV V. Pradeep International Journal of Advanced Research in Computer Science and Software Engineering Volume 2, Issue 2, February 2012 ISSN: 2277 128X.

[2] Camera as Mouse and Keyboard for Handicap Person with Troubleshooting Ability, Recovery, and Complete Mouse Events K.Arai & R. Mardiyanto International Journal of Human Computer Interaction (IJHCI), Volume 1 Issue 3.

[3] Design and Implementation of a Mouth-Controlled Mouse Chu-Hsing Lin, Shang-Sheng Yang, Jeng-Heng Chen

and Yi-Zhu Cao National Science Council under the grant NSC99-2221-E029-034-MY3.

[4] Development and Evaluation of a Head Controlled Human-Computer Interface with Mouse-Like Functions for Physically Disabled Users Development and Evaluation of a Head-Controlled Human-Computer Interface with Mouse-Like Functions for Physically Disabled Users César Augusto Martins Pereira, Raul Bolliger Neto, Ana Carolina Reynaldo, Maria Cândida de Miranda Luzo, and Reginaldo Perilo Oliveira Proceedings of IEEE TENCON Digital signal processing applications; 1996.

[5] EYE GUIDE (Eye-Gaze User Interface Design) Messaging for Physically-Impaired People Rommel Anacan, James Greggory Alcayde, Retchel Antegra and Leah Luna International Journal of Distributed and Parallel Systems (IJDPS) Vol.4, No.1, January 2013.

[6] GESTURE BASED OPERATING SYSTEM CONTROL Yuvraj V. ParkaleElectronics and Telecommunication Department College of Engineering, Malegaon (Bk), Maharashtra, India 2012 Second International Conference on Advanced Computing & Communication Technologies.

[7] Head Controlled Mouse Pointer Movement for the Physically Disabled Anbarasu V Dr.T.Ravi Proceedings of International Conference on Computing and Control Engineering (ICCCE 2012), 12 & 13 April, 2012. ISBN 978-1-4675-2248-9.

[8] i-Mouse Hands-free Cursor Control Yashaswita Bhoir Neha Malusare R. Mathangi Bhagyashree S Prachi Goel Department of Information Technology, Fr.C.R.I.T, Vashi, Navi Mumbai, Maharashtra, India Proceedings of the NCNTE-2012, Third Biennial National Conference on Nascent Technologies.

[9] Mouse Simulation Using Two Coloured Tapes Kamran Niyazi, Vikram Kumar, Swapnil Mahe and Swapnil Vyawahare International Journal of Information Sciences and Techniques (IJIST) Vol.2, No.2, March 2012.

[10] New Hand Gesture Recognition Method for Mouse Operations Ehsan ul haqI, Syed Jahanzeb HussainPirzadcl, Mirza Waqar Bailand Hyunchul Shin4 978-1-61284-857-0/11/$26.00 ©2011 IEEE.

[11] Robust Hand Gesture Recognition Algorithm for Simple Mouse Control Vivek Veeriah J. and Swaminathan P. L. International Journal of Computer and Communication Engineering, Vol. 2, No. 2, March 2013.

[12] The Camera Mouse: Visual Tracking of Body Features to Provide Computer Access for People With Severe Disabilities Margrit Betke, Member, IEEE, James Gips, Member, IEEE, and Peter Fleming IEEE TRANSACTIONS ON NEURAL SYSTEMS AND REHABILITATION ENGINEERING, VOL. 10, NO. 1, MARCH 2002.