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Facial Movements Based Mouse Cursor Control for Physically Disabled Individual

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Abstract - The system we have described in this which presents a hand-free interface between human and computer. Generally the mouse which used by people has been replaced in a new way which uses the human facial expressions and features. It uses various image processing methods such as face detection, eye extraction and interpretation of a sequence of eye blinks in real time for controlling a nonintrusive human computer interface. An interaction with the computer with the mouse is replaced with the human eye movements. It uses a typical webcam to capture an input image. Mouse cursor control can be done by facial movement by moving the face towards left, right, up and down and mouse events are controlled through eye blinks. To perform these operations different algorithms like Haar Cascade algorithm, Dlib are used. Our system is mainly aimed for physically challenged peoples to have an effective communication with computer.

Key Words: Human Computer Interaction (HCI), Conventional mouse, Nonintrusive, Eye movements , Haar Cascade, Dlib.

1. INTRODUCTION

Moving the finger or the computer mouse has become a common way to move the computer cursor along the computer screen in the present technology. To map it to the movements of the cursor the system detects any movement in the computer mouse or the human finger. This current technology will not be able to make use by some people like 'amputees' as they do not have their hands to operate[1][2]. Hence, the amputee and other physically challenged people can be able to operate, if their eyeball movement can be mapped to the cursor. If the direction of the eyeball movement is traced and direction towards which eye is looking at can be tracked, the cursor will be mapped and the physically challenged

able to move the cursor. An 'eye tracking mouse' will be of a lot of use to disabled and an amputee currently, this technology is not available at a large scale, only a few companies are trying to develop this technology and have made it available[3]. This paper intend to develop an eye tracking mouse where most of the functions which present in the computer mouse will be available, so that an amputee or disable people can operate mouse using their eye. Eye tracking technology has become one of the most popular techniques within the human and computer interaction (HCI) this is very important for the people who have difficulty with speech and movement disabilities, especially for the handicapped and amputees person[4]. The idea of computers with the eyes will remove the help required by other person to handle the computer.

1.1 RELATED WORK

The existing system which was proposed by Margrit Betke introduced the camera mouse for nonverbal and quadriplegic people. Here, by using a camera the user movements can be tracked where these can be plotted to the cursor points of the mouse which can seen on the computer screen[5]. Furthermore Robert Gabriel Lupu proposed another method for human computer interaction which has made use of head mounted device to trace eye movement and to convert it on screen. Another technique by Prof. Prashant salunke proposed a technique of eye tracking using Hough transform.

In this project, we develop a system which will use only Webcam, and to use human eyes as a pointing device for computer device and to provide user friendly human-computer interaction[6][7]. Designing a system for tracking face and eye using camera and also using facial landmark's

technique. This project is mainly developed to help physically disabled people. We can accurately detect the eye movement by detecting the exact location of iris present in our eyes and counters, here we use regression tree algorithm or Decision trees algorithm.

This paper introduced a system which is a human computer interface for performing the mouse operations using their eyes[8-12]. Our idea is to make mouse cursor hands free by using light-reflection based systems with non-imaging sensors, thus providing an alternative to computer mouse.

2. Methodology

The main contribution of our project is
building user friendly human and computer interaction. Since our project is about detecting the features of the eyes and facial movement and plotting them to the computer cursor[13-15]. Primarily the webcam wants to be accesses, which means the webcam is on and starts capturing images in video. Once webcam is started, the process begins and it extracts all frames from the captured video. The video captured by webcam has frame-rate around 30frames per second, at every 1/30th of a second a frame will be processed. Before the features of the frame are detected the frame goes through a set of processes and then plotted to the cursor. And this process interminably occurs as a part of a loop for every frame.

2.1 Modeling and Analysis

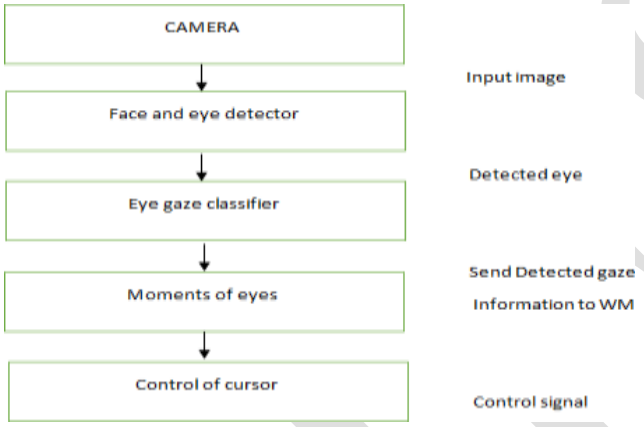

Fig -1: Model of the project

There are many image processing operations carried out in system, includes

1) BGR to Gray Conversion: To decrease the system delay time an original colored image is converted into gray colored image because for proper processing a frame size of the image should be minimum.
2) Feature Detection and Blurring Image: To detect the exact corners of specific area of resized image, the Gaussian blur filter performs blurring of the image.
3) Canny Edge Detection: It used a blurred image. It will be put in for soft edges of the image.
4) Hough Circle Transform: To draw a circle on eye pupil we use this Hough circle transformation method. Eye Tracking: We use coordinate system to detect the eye movement, which locates the center position of the eye.
5) Eye Tracking: We use coordinate system to detect the eye movement, which locates the center position of the eye.
6) Control Signal: Depending on eye movement cursor is moved in different directions.

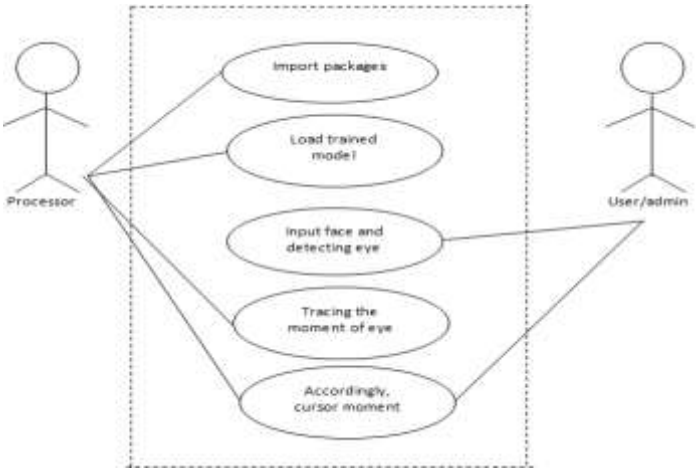

Fig -2: Use Case diagram of the project

Use case consists of user and processor where user is to provide the input to the system and processor is used to process the input data and provide output.

3. ALGORITHM

Step 1: Run the program, where the webcam will be ON. Step 2: Pinpoint the position of the face in the image.
Step 3: Recognize the key facial features on the face ROI. Step 4: Once the face is detected, MAR (Mouth Aspect Ratio) and EAR (Eye Aspect Ratio) will be calculate.
Step 5: Input will be read.
Step 6: The action of the eyeball can be plot to the cursor. Step 7: Managing of mouse cursor is acquired by facial movements as moving the face towards left, right, up and down and mouse events are managed through eye blinks.

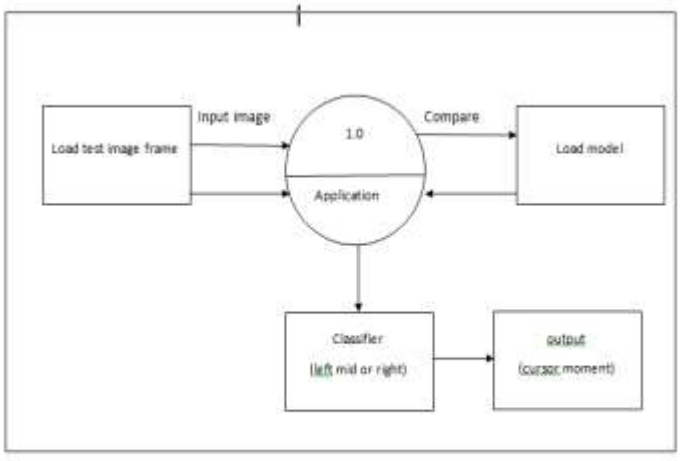

Fig -3: Work Flow of the application

4. PROPOSED WORK

In this paper, we have described a system that has facial tracking, detection of face, detection of eye and continuous eye blinks for controlling a nonintrusive human computer interface. Human eye movement has been used in the place of the conventional mouse. The main aim of this system is to help physically challenged and

amputee people especially person who do not have their arms.

4.1 Face Detection

The regions of the face has been detected by using facial landmarks such as eyebrows ends, eyes, mouth ends, nose, jaw line. It is successfully applied to alignment of face, estimation of head pose, face swapping, detection of blink and much more.

Fig -4: Detection of Facial landmarks

Shape prediction problems are subset of landmarks
detection of face. As an input the image is taken (and in generally an ROI which describes an interest in object), shape predictor make an effort of interest along the
shape of the face by localizing key points. Facial landmarks detection which is of two step process: Step 1: Pinpoint the position of the face in the image. Step
the face of ROI detecting key facial structures.
2:On the face of ROI detecting key facial structures.

4.2 Eye Region Detection

Begins with the left corner of the eye as you were looking at the person and it is working clockwise around the left out region. Each eye is represented with coordinates (x, y).

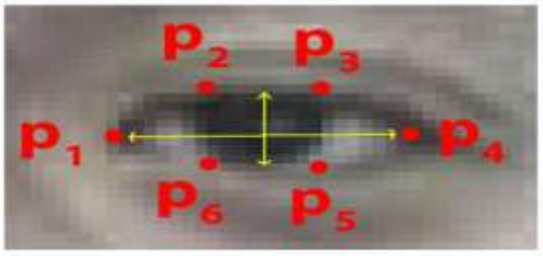

Fig -5: Eye Region Detection

On looking an image, we should consider the key points of an eye: As there is a relation between the height and width of the points (coordinates). Soukupova and Cech proposed a work in their paper, the detection of eye blink in Real-Time using facial landmarks, by this they derived an equation that reflects this relation called the eye aspect ratio (EAR).

$$\mathrm{EAR} = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

Fig -6: Eye Aspect Ratio

Where p1...p6 are 2D facial landmarks locations. The distance between the vertical eye landmarks is computed by the numerator of the eye aspect ratio while the distance between horizontal eye landmarks is computed by the denominator. There is only one set of horizontal points but two sets of vertical points.

4.3 Eye Movement Classification

The movement of eye can be classified using eye aspect ratio where if horizontal ratio is more than set threshold value then the user is looking left else user is looking right, if the values do not meet both threshold values then user is looking at the center, if EAR values is less than the set threshold then user is blinking. So using the values of EAR we can classify the eye movement as it moves towards left, right, up and down. Hence, if eyeball movement can be traced and in which direction, the eye is staring and looking at can be tracked, the eyeball movement can be plotted to cursor and disabled
and physically challenged people will be able to move the cursor at their will.

Fig -7: Movement Classification of Eye

4.4 Advantages

1) It will help in eliminating the other person who is required to control the cursor and to handle the system (computer).
2) This is also helpful for amputee and physically challenged people to operate the computer with the help of their facial expressions and eyeball movements.
3) This measure will be the most useful for paralyzed people who can operate cursor only by their eyeball movements.
4) There is no age limit to perform this technique.

5.CONCLUSIONS

By implementing this process we can conclude that the cursor movement control can be controlled by the facial expressions and eyeball movement i.e., without requirement of hands to operate the computer. This is useful for disabled and amputees to perform these cursor operations by using eyeballs, without requirement of the other person to operate the cursor. This technology in the future can be enhanced by inventing or modifying or improving more techniques like clicking events, human computer interface systems which uses eyeball movement, eye blinks to perform the cursor operation. Technology extended to this eye tracking technique to get the efficient and accurate movement.

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