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Assistive System for Physically Disabled People using Nose and Eye Movement

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ABSTRACT: This project presents a novel algorithm for controlling the movement of a computer screen cursor using the iris and nose movement. By accurately detecting the position of the iris in the eye and mapping that to a specific position on the computer screen, the algorithm enables physically disabled individuals to control the computer cursor movement to the left, right, up and down. The algorithm also enables the person to open and close folders or files or applications through a clicking mechanism. The growing population with disabilities in the world must be accompanied by the growing of research and development of tools that help these users on basic computer activities. Our project aims at developing a system that allows the use of personal computers using nose and eye movements. The system can be used by people with physical disabilities. For the development of this system, the most efficient techniques in previous works are collected and analysed, and new ones were developed in order to build a system with high performance and precision, ensuring the physically challenged people to have an effective communication with computer. The system described here presents a hand-free interface between human and computer. Generally, the mouse which used by people is replaced in a new way which uses the features like nose and eye movement. 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 human computer interface.

KEYWORDS: Kaggle's Dataset and Dlib libraries Algorithm, Face Detection Algorithm, Eye Movement, Nose Movement, click, scroll, move.

I. INTRODUCTION

Personal computers were initially used for solving mathematical problems and word processing. In recent years, however, computers have become necessary in every aspect of our daily activities. These activities range from professional applications to personal uses such as internet browsing, shopping, socializing and entertainment. Computers are designed to be readily accessible for normal individuals. However, for individuals with severe physical disabilities such as cerebral palsy or amyotrophic lateral sclerosis, usage of computers is a challenging task. There have been many research studies on Human Computer Interface (HCI) to improve the interaction between the user and the computer system. Most of these are applicable only to normal individuals. These interfacing methods include a touch sensitive screen, speech recognition methods and many others. Despite the success of these techniques, they were not suitable for the physically disabled individuals. Many researchers have tried to develop methods to help the disabled to interact with computers by using signals such as electroencephalography (EEG) from the brain, electromyography (EMG) and electro-oculogram (EOG). Other methods include limbus, pupil and eye/eyelid tracking, contact lens method, corneal, pupil reflection relationship and head movement measurement. These methods require the use of attachments and electrodes to the head, which makes them impractical. Other high-end techniques that are based on infrared tracking of the eye and nose movements to control computers were exceptionally expensive and were not affordable for those who need them. The only hardware that is required is a PC or laptop along with a webcam, which makes it feasible.

Eye tracking and nose movements detection have been used to allow the disabled people to use computer facilities. This is important since they are not marginalized in this new technology. An eye mouse has been investigated by many interested groups in related fields as a vital facility in eye tracking as a way of giving the disabled people a chance to use computers. A well-designed virtual mouse works by letting the eyes to perform computer operations. In designing this a computer and web camera providing tremendous results is used. An eye-control method based on electrooculography (EOG) can be used to develop a system for assisted mobility. An eye model based on electrooculographic signal is proposed and its validity is studied. Several Human Machine Interfaces



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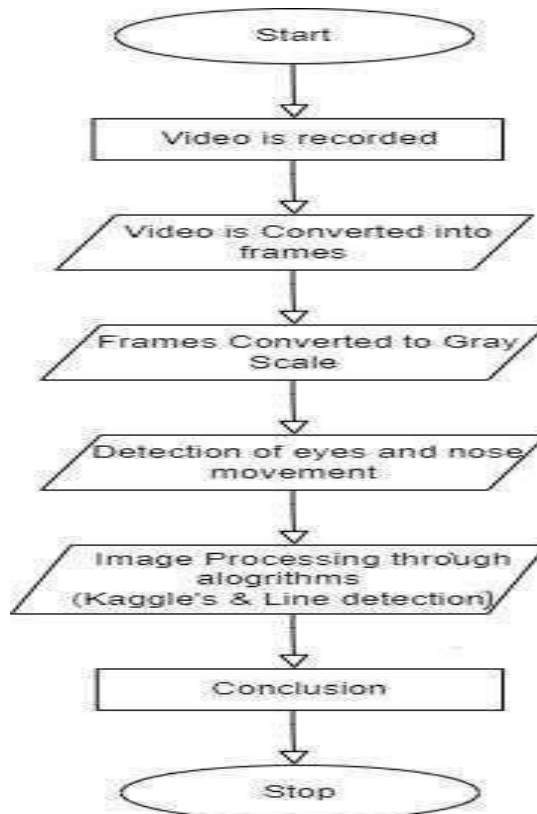
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(HMI) based on EOG are commented, focusing study on guiding and controlling a wheelchair for disabled people, where the control is actually affected by eye movements. Eye-control method can be applied to handle graphical interfaces.

II. RELATED WORK

In the last few years, there has been a significant increase in the development of assistive technology for people with disabilities and improving the traditional systems. Also, the growing use of the computer, both in work and leisure, has led to the development of PC associated handling applications, mainly using graphic interfaces. This way, the traditional methods of control or communication between humans and machines (joystick, mouse, or keyboard), that require a certain control motor on the part of the users, are supplemented with others that allow their use for people with severe disabilities. Among these new methods it is necessary to mention voice recognition or visual information. For example, voice recognition is used to control some instruments or applications by means of basic voice commands or write a text in “speech and spell” applications. Other options are based on video oculography or infrared oculography for detecting gesture or eye movements, on infrared head-operated joystick for detecting head movements or even on electrooculographic mouse for displacing a pointer on a screen. EOG is a method for sensing eye movement and is based on recording the standing corneal-retinal potential arising from hyper polarizations and depolarizations existing between the cornea and the retina; this is commonly known as an electrooculogram. EOG has various guidance strategies: direct access guidance, guidance by automatic or semiautomatic scanning techniques and guidance by eye commands. The systems were developed using concepts and techniques that proved to be efficient, and presents high processing performance, contributing to a better user experience.

III. METHODOLOGY



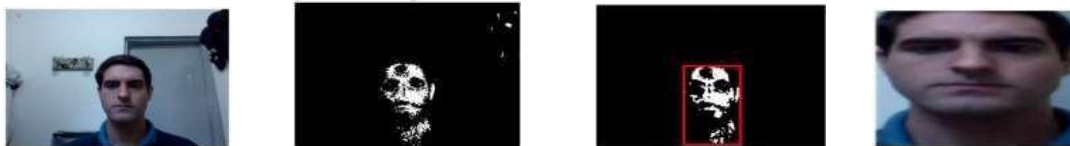
The image processing operations carried out in this system includes,

1. Firstly, using the webcam the video is recorded.
2. Then all the frames are extracted from the captured video.
3. From the collected frames, it is furthermore changed over into grayscale images and processes the values obtained from the Grayscale.
4. After processing, the edges of the face are detected with the help of Line detection algorithm.
5. From these edges, it detects eyes and nose in the frame and also the aspect ratio of the eye.
6. Finally, eye blink and nose movement are detected by Kaggle's Algorithm.

Line Detection Algorithm:

This Algorithm is used to collect the pixel values from an image to convert it into a grayscale image and also to detect the edges of face.

The face detection is the main element of the proposed system, and it is strongly related to system performance. The search for the user's face is performed with the help of the OpenCV library. Here an entire image is converted to grayscale image and based on different shadow values inside an image face is being detected. The process of finding face structure is shown in below figures.



Regular RGB image Conversion into grayscale image Detection of edges of face Detected face

Kaggle's Dataset and Dlib libraries Algorithm:

It accepts output (grayscale image with edge) produced by the line detection algorithm and detects the nose and eyes. And it is further used to perform the movements such as click, scroll, right, left, up, down movements. This dataset contains 7198 face images for image processing.

Face landmarks detection using Dlib Libraries algorithm:

Having the face location is not enough for the system to execute the control of the operating system. Hence it is necessary to look for more elements that allow the system to identify the face's position and other face elements such as eyes, mouth and nose. The proposed system uses face landmarks to estimate the face position. These points provide also information about the position of the eyes and mouth.

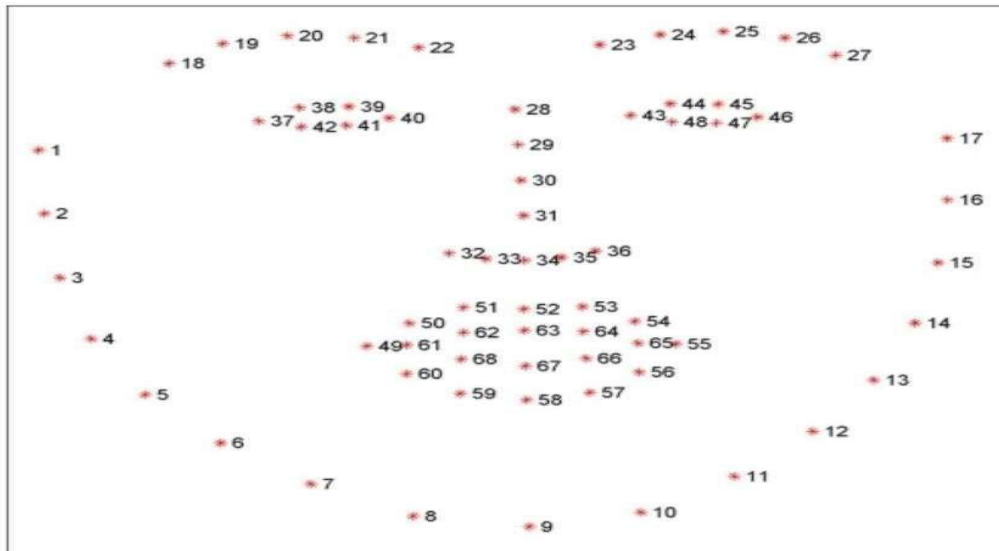
The implementation of this feature was performed with help of Dlib library, that provides an algorithm for face landmark detection based on the algorithm described by (Kazemi and Sullivan, 2014), that uses regression trees to estimate the position of face landmarks. This algorithm runs in the area of face detected and finds 68 face landmarks, proposed by (Saonas et al, 2013) as shown in below figure.



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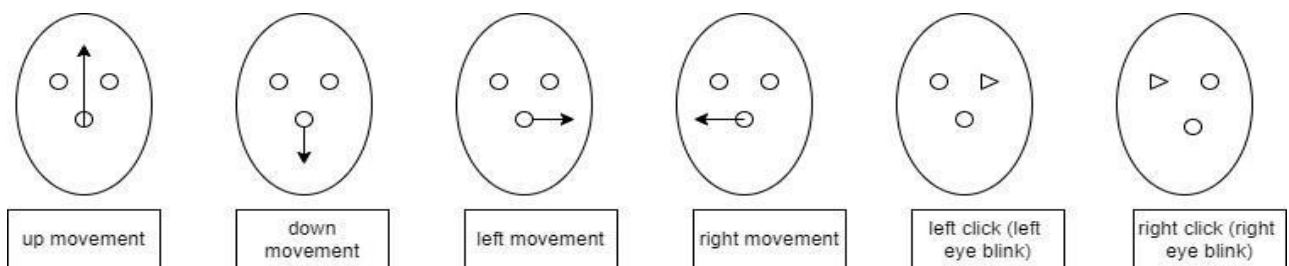
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IV. EXPERIMENTAL RESULTS

The main aim of our project is building user friendly human and computer interaction, since our project is about detecting the features of the eyes and nose movement and plotting them to the computer cursor. Primarily the webcam wants to be accessed, 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. Before the features of the frame are detected the frame goes through a set of processes such as converting each frame into a Grayscale images. After processing frame, the facial landmarks from image are detected and these facial landmarks are further used to detect the edge of a face.

Eye aspect ratio and nose movements features are then used to detect movement of nose and blink of an eye and then plotted to the cursor. And this process interminably occurs as a part of a loop for every single frame of a video.



V. CONCLUSION

The main goal of developing this project is to provide hand free cursor control which reduces the dependency on mouse. We mainly focus on physically disabled people who cannot use their hands to operate the system, do not perform well in poor lighting environment. The model proposed can be approximated to be a feasible solution for the physically disabled as well as normal people to use the computer without any difficulties. The project can be further developed into an OS where various threads can be used to run different applications simultaneously and efficiently. This system will be very helpful for physically challenged people for accessing the mouse and perform mouse actions. The experimental results will be showing that the proposed system is far better than the existing system and promises to perform better over time.

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