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COMMUNICATION FOR THE PHYSICALLY DISABLED USING EYE GAZE TECHNOLOGY

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Abstract: It's probable that two factors contribute in some measure to the yearly increase in the population of impaired individuals. Some people suffer terrible catastrophes, whereas some people are born with it. It's possible that these paralysed people can't speak since speech is so important to our survival. Although they cannot speak or use their hands to communicate, they may be able to control their eye movements and have good vision. Hence, we propose an affordable eye motion-based eye gazing communication system. The Eye Gaze project aims to use a human's eye gaze through a computer interface. The phrase "eye gaze communication" describes using a computer system that tracks a person's eye movement. The method is eye tracking.

***Index Terms* - Eye gaze, Oculography, Iris detection, GSM module**

I. INTRODUCTION

A living thing's ability to communicate is one of its most crucial abilities. Life gets more challenging without communication. It's possible that people with paralysis and motor neuron illness can't communicate like us. When paralyzed patients lack sensation, they are unable to move their limbs in any way. They consequently lose the ability to speak, which makes it difficult for them to explain their basic requirements and necessities and makes them dependent on others for all of their needs. The only voluntary motion a disabled person can control is eye movement. There are an estimated 150,000 people with severe disabilities who can easily control only their eye muscles. In this situation, an eye tracking device might offer a different choice for those with severe disabilities who are still only able to move their eyes. We can create a system that monitors a disabled person's eye movement for communication purposes.

So, in order to facilitate communication, we suggest a low-cost eye gaze communication system. Using a variety of image processing techniques, the position of the iris is used to track the movement of the eyeball. After eye tracking is established, numerous eye movements that are useful for communication can be integrated in a graphical user interface. Normally, eyes are utilized for observation rather than control. Moments in the eye happen naturally and quite quickly. By moving their eyes, users of eye gaze communication systems can control the system through eye gaze tacking.

II. LITERATURE SURVEY

The range of techniques for estimating and eye movement monitoring were explored by Kyung- Nam et al [1]. These methods include eye lid tracking, occluded circular edge matching, and longest line scanning. Computer vision and image processing techniques are utilized to measure eye gazing. There are two methods for estimating eye gaze: geometry-based estimation and adaptive-based estimation. Geometric estimate is superior to estimation based on an adaptive strategy. To gain eye gaze, determine the relationship between the face model and the camera picture point. The tracking method is non-intrusive. The 3x3, 4x5, and 8x10 screen resolution eye gaze tracking systems estimate gazing point using an adaptive base and geometry base estimation method. However at 8x10 screen resolution, eye gaze tracking techniques appear to be fairly effective. The non-intrusive tracking and measurement of eye movements based on vision was studied by the author. Kumar, Manu [2] the author covered a range of methods for using eye movement data in everyday tasks. The primary goal of this research is to provide flexible alternatives that users can utilize in accordance with their physical capabilities or preferences, rather than to replace the present methodologies. Also, this author defends the use of eye contact in interactions.

Linda Sibert and others described the effectiveness of eye gaze contact with a common, all- purpose device, such as a mouse, is compared. Computer input device illustrates advantages of human eye gaze. Two experiments that compare the eye gaze interaction technology with the commonly utilized mouse are described for this aim. In this experiment, the amount of time needed to complete simple computer tasks using the mouse and eye gaze is measured. In the first experiment, the respondent had to quickly choose a highlighted circle from a grid of circles measuring three by four.

III. METHODOLOGY

A customized video camera situated underneath the monitor watches one of the user's eyes as they are seated in front of the eye-gaze monitor. The eye-gaze System's computer uses sophisticated image-processing software to continuously examine the video image of the user'seye to pinpoint where they are looking on the screen.

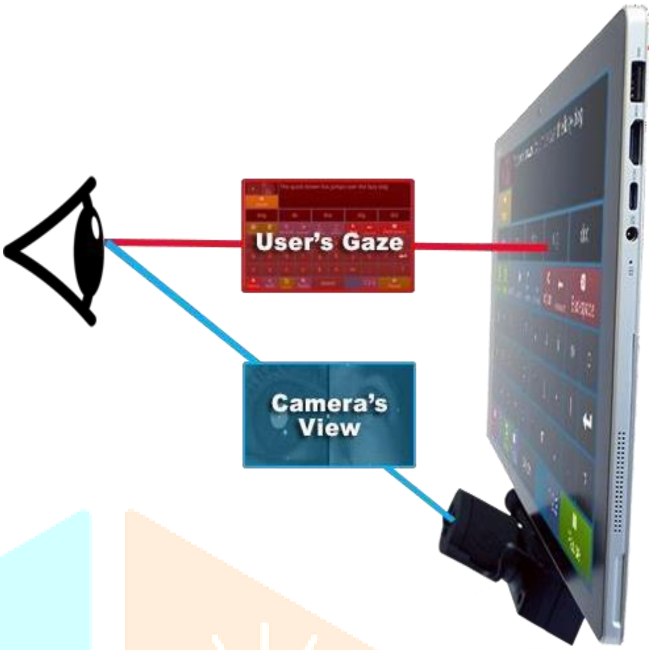


Fig-1: Basic Working Principle

The pupil-center/corneal reflection approach is used by the Eye-Gaze System to ascertain where the user is gazing at the screen. To capture images of the user's eye, 60 frames per second infrared-sensitive video camera is placed beneath the system's monitor. The eye is illuminated by a low-power infrared light-emitting diode (LED) positioned in the center of the camera's lens. A tiny amount of light is reflected off the cornea of the eye by the LED. Moreover, light enters the pupil, reflects off the retina, and the eye's back surface, and gives the pupil its white appearance.

The bright-pupil effect improves the camera's depiction of the pupil and facilitates the location of the pupil's center during image processing. Based on the relative positions of the pupil center and corneal reflection inside the video image of the eye, the computer determines the user's gaze point or the coordinates of where he is looking on the screen.

3.1 Electro-occulography

With this technique, sensors are affixed to the skin close to the eye to detect the presence of an electric field created as the eyes spin. The position of the eye can be determined by noting the minute variations in the skin potential around it. It is feasible to record horizontal and vertical movements by precisely positioning electrodes. Since it necessitates intimate contact between the electrodes, this approach is not suitable for everyday use. It's a quick, simple, and intrusive procedure.

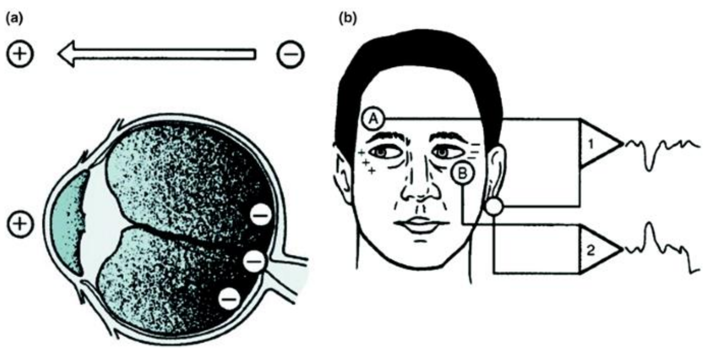


Fig-2: A pictorial representation of Electro- Oculography

Eye movements and the electrical activity of the eye are measured using the electrooculography (EOG) technique. To detect changes in the electric potential that happen as the eyes move or react to various stimuli, electrodes are placed around the eyes. The movement of charged particles within the retina and cornea, which results in an electrical potential difference between the front and the rear of the eye, is what creates the EOG signal. EOG can determine the direction, speed, and position of eye movements as well as the position of the eyes while they are at rest by measuring this electrical activity. The high temporal resolution of EOG, which enables accurate detection of eye movements and quick data collection, is one of its benefits. It can be used to research eye movements in a variety of populations, including infants, children, and people with specific disabilities, and is also non-invasive. However, EOG has certain drawbacks, including the requirement for meticulous electrode calibration and alignment and the possibility of data aberrations or errors caused by things like head motions or electrical noise from other sources.

3.2 Scleral search coils

In this technique, a customised contact lens is implanted with tiny coils of wire. A coil of wire generates a voltage when it moves in a magnetic field. A signal indicating the position of the eye will be generated if this coil is attached to the eye. The lens has an inbuilt mirror that enables the measurement of reflected light. The orientation of the lens' embedded coil can be determined using a magnetic field. After local anaesthetics have been used, these lenses can be applied. It is a very precise eye-tracking technique.

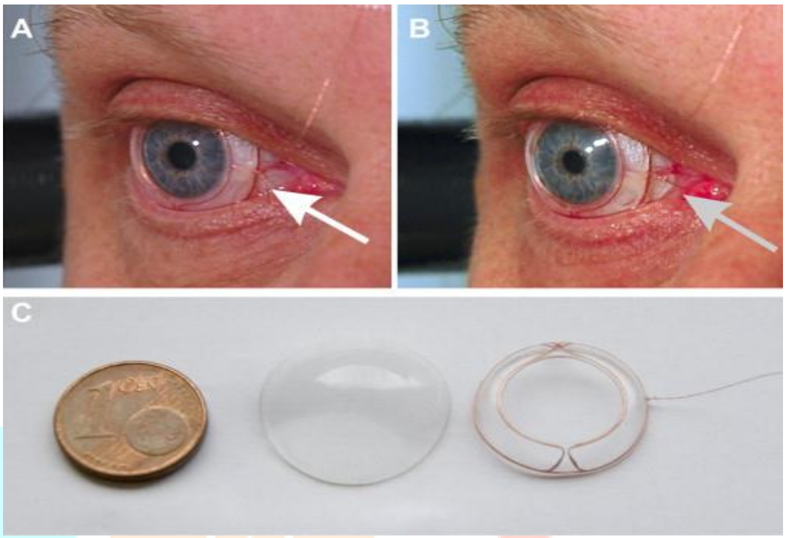


Fig-3: A pictorial representation of Scleral Oculography

Scleral search coils are a method for precisely and accurately measuring eye movements. The method entails affixing tiny coils to the eye's surface, usually near the sclera, the eyeball's white outer layer. A conductive material, like gold or platinum, is used to make the coils, and magnetic field sensors can pick it up. The magnetic field sensors can determine the position and speed of the eye by detecting a little electrical current that the coils produce when the eye moves. This makes it possible to monitor eye movements very precisely and accurately, especially during quick and complicated motions like saccades. The great spatial and temporal resolution of scleral search coils, which enables extremely accurate measurement of eye movements, is one of their benefits. They can deliver accurate measurements for extended periods and are also quite stable. However, the method's invasiveness and need for surgery to affix the coils to the surface of the eye may limit its applicability to particular populations or uses.

3.3 Infrared occulography

The intensity of reflected infrared light is measured by infrared Oculography. This technique uses reflected infrared light to light up the eye. The position of the eye is conveyed by the difference between incident infrared light and infrared light that is reflected from the surface of the eye. It can detect eye movement in the dark.

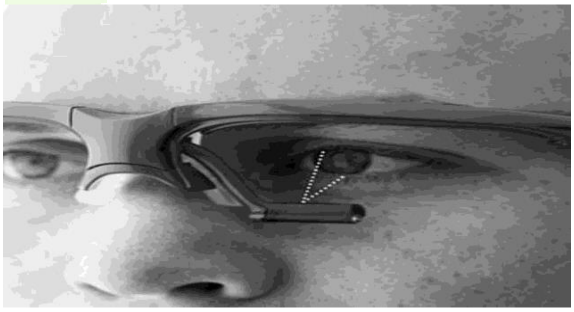


Fig-4: A pictorial representation of Infrared Oculography

An approach to measuring eye movements with infrared light is called infrared Oculography. It entails positioning tiny infrared cameras or sensors near the eyes to monitor how the eyes move as they respond to various stimuli or objects. As infrared light is invisible to the human eye, it has no negative effects on how the eyes move normally and doesn't hurt. The great spatial and temporal resolution of infrared Oculography is one of its benefits, enabling accurate detection of eye movements and quick data collection. It can be used to research eye movements in a variety of populations, including infants, children, and people with specific disabilities, and is also non-invasive.

Infrared Oculography has some limitations, though, including the need for exact calibration and alignment of the cameras or sensors and the possibility of artifacts or errors in the data brought on by things like head movements or ocular movements that take place outside the camera's or sensor's field of view.

3.4 Video occulography

The intensity of reflected infrared light is measured by infrared Oculography. This technique uses reflected infrared light to light up the eye. The position of the eye is conveyed by the difference between incident infrared light and infrared light that is reflected from the surface of the eye. It can detect eye movement in the dark

Fig-5: A pictorial representation of Video Oculography

A non-invasive method of measuring eye movements is called video Oculography, which makes use of video cameras and computer software. It entails filming the eyes as they move in response to various stimuli or while the person carries out particular tasks. Using specialized software that analyses eye movement and provides details on the direction, velocity, and amplitude of eye movements, video recordings are evaluated. A variety of eye movements, including saccades, smooth pursuit, and the vestibular ocular reflex, can be studied with video Oculography. Video Oculography has the benefit of being non-invasive, which makes it suitable for application in a range of clinical and research contexts. It can also offer accurate measurements of eye movements with the high spatial and temporal resolution, and it is quite simple to set up and use.

Video Occulography does have certain limitations, though, including the possibility of data mistakes or distortions brought on by things like head motions, lighting, or ocular movements that take place outside the cameras' fields of vision.

SPECIFICATIONS

This device is dependable and incredibly simple to calibrate. The system specifically takes into account some frequent reasons of gaze-point tracking inaccuracy. Remotely and discretely, the subject's eye is observed by a video camera hidden beneath the computer screen. The head doesn't need to be attached in any way. The camera lens's center houses a tiny light-emitting diode (LED) that illuminates the eye. The strong pupil image and corneal reflection caused by the LED improve the camera's ability to capture the pupil.

SKILLS NEEDED FOR THE USER INCLUDE:

- Accurate vision and good eye control
- The capacity to hold a posture in front of the eye gaze monitor.
- Cognitive skills

THE TYPE WRITER PROGRAM

The Typewriter application can be used for straightforward word processing. On visual keyboards, the user types by glancing at the keys. There are four different keyboard setups, from basic to complex. On the screen above the keyboard display, typed text can be seen. The user caneither publish what he has typed or "say" it. Also, he has the option of saving his material to afile for later retrieval. The text that was retrieved can be spoken, altered, or printed.

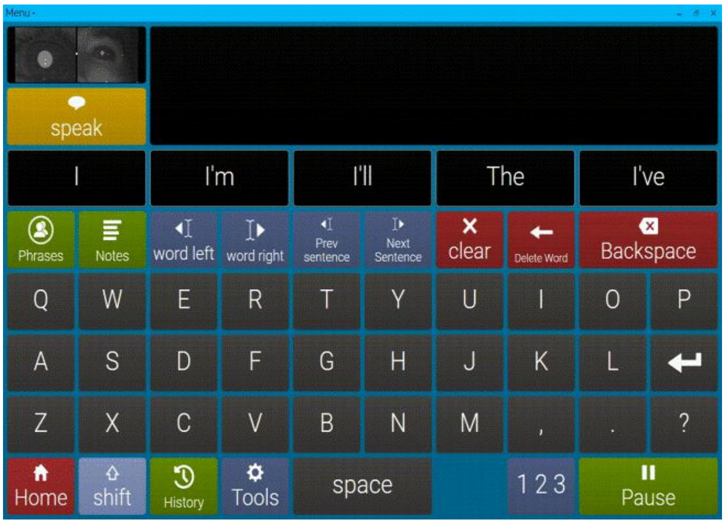


Fig-6: Illustration of Type Writer program

IV. IMPLEMENTATION

4.1 IR Sensor

It employs infrared light to identify people in its area of view, at which point the camera module is activated to take pictures.

4.2 Camera Module

The PIR sensor is used to activate the camera module, which aids in the video capture of the subject's face and the subsequent detection of the subject's face and iris using image processing algorithms

4.3 Monitor

The monitor is interfaced with the HDMI port of Raspberry Pi. It is used to display the Graphical User Interface designed. The monitor is set up in front of the subject which has soft keys that they can navigate through using iris movement which will aid assistance to the subject.

4.4 GSM Module

It offers a data connection to a distant network. The Raspberry Pi's GPIO pins are interfaced with the GSM module. In the event of an emergency or when assistance is needed, it is used to notify the family and the doctors.

4.5 SD Card

It is employed to store and load the operating system and software into the Raspberry Pi module, which enables the Raspberry Pi to be used as a little computer.

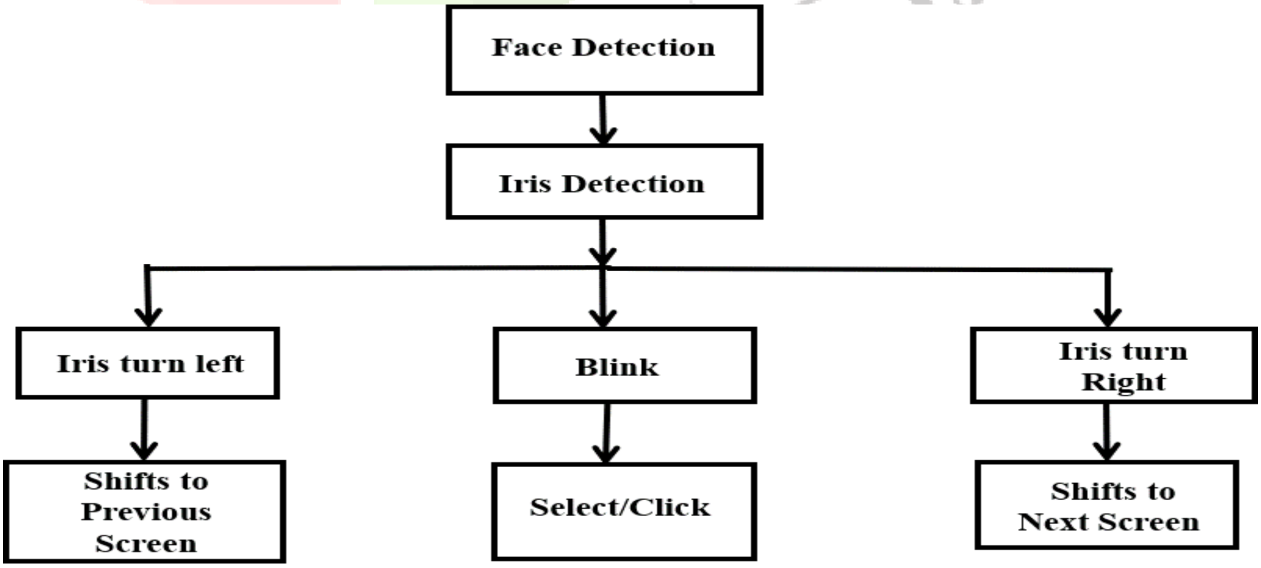
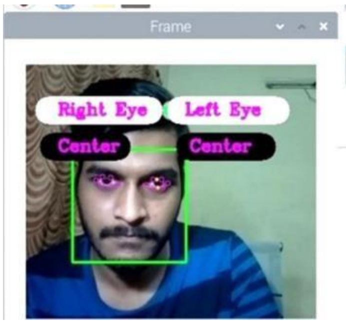
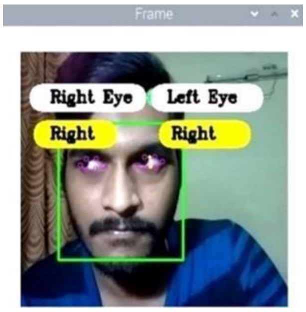


Fig-7: Block diagram for integration of Iris Detection with Graphical User Interface

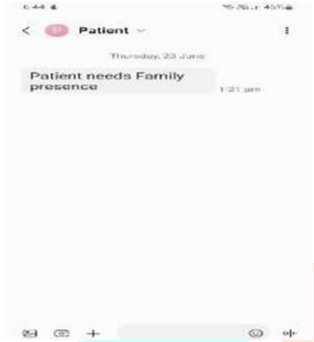


A patient using GUI



Side gaze detection

Blink Detection



Message screen for family

Family support

Fig-8: Implementation Process

V. SCOPE OF FUTURE RESEARCH

This has gained popularity as a promising assistive tool for people with physical limitations, including paralyzed people. For those who have little to no control over their limbs, this technology lets users to interact with computers, communication devices, and other assistive technologies using only their eyes. Future research on eye gazing technology for paralyzed people has a growing amount of potential as this field of study develops. Despite recent substantial advancements in eye-gaze systems, there is always potential for development. Researchers can experiment with new methods for precisely measuring eye movements. Researchers can investigate novel methods for enhancing the system's overall speed and accuracy, decreasing latency, and precisely detecting eye movements. For patients who are paralyzed, this might lead to more dependable and effective communication and control. The combination of eye-gaze technology with various assistive technologies is a further topic for future study. Researchers might, for instance, look at how eye gaze technology can be used to control robotic prostheses, exoskeletons, or other technologies that might allow patients who are paralyzed to move or carry out other physical duties. These people may be able to reclaim a level of independence and autonomy that was before unavailable, which would greatly improve their quality of life.

VI. CONCLUSION

The human eye-gaze can be recorded using standard methods thanks to modern technology. Eye- gaze-based user interfaces are primarily used because they offer a potential window into cognitive processes and communication with the eyes, which is faster than any other form of human communication. The user's attention will be drawn to the eye tracking system as its quality and accuracy increase and its price decreases. Eye movement should be used with caution because it involves both voluntary and involuntary cognitive processes in the human brain. In conclusion, the application's primary goal is to reduce the physical strains patients must endure when speaking, resulting in the creation of a practical and cutting-edge method of communication for patients with diverse abilities. In conclusion, a futuristic eye-gaze system for patients with paralysis is being presented. It incorporates cutting-edge technologies including BCIs, VR, AI, and wireless communication. These developments might considerably improve the eye gazing technology's usability and functionality, enabling paralyzed people to engage with their surroundings and communicate with others in a more organic and intuitive way. Eye gazing technology is projected to grow and become more widely used as technology develops, opening up new possibilities for people with impairments to lead more active, independent lives.

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