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Eye Gaze Controlled Communication

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Abstract: Eye gazing is the fundamental nonverbal interaction that is presently strengthening in emerging technology. This eye blink device facilitates communication among people with disabilities. The process is so simple that it can be done with the eyes blinking on the specific keys built into the virtual keyboard. This type of system may synthesize speech, regulate his environment, and provide a significant boost in self-belief in the individual. Our study emphasises the virtual keyboard, which not only includes integrated alphabetic keys but also contains emergency phrases that may seek help in a variety of scenarios. It can, however, provide voice notification and speech assistance to those who are speech-impaired. To get this, we employed our PC/computer digital Digi-Cam, which is integrated and recognises the face and its elements. As a result, the technique for detecting the face is far less complicated than everything else. The blink of an eye provides an opportunity for a mouse to click on the digital interface. Our goal is to provide nonverbal communication, and as a result, physically impaired people should be able to communicate with the use of a voice assistant. This type of innovation is a blessing for those who have lost their voice or are suffering from paralytic ailments.
Keywords: Eye blink, facial landmarks, Dlib, Open-CV

I. INTRODUCTION

Motor neuron disease(MND) is a medical condition in which the affected person's motor neurons are paralysed and incurable. It also results in muscle mass weakness in the hand, foot, or voice. As a result, the affected person is unable to perform voluntary motions, and it is extremely difficult for patients to express their needs. Tetraplegia is another condition in which people are unable to move components beneath their neck. In the current digital age, solutions for patients suffering from the aforementioned illnesses can be identified; one such invention is the proposed gadget described throughout. The proposed device could be used to manipulate and communicate with other human beings.

There was a huge demand when the brain-computer interaction became introduced in advance and was popularly used by the fantastic scientist Stephen Hawking, but our mission is an interaction between an eye fixed and the PC, it builds an interface that can construct a device of communication with eyes with the help of computers. The human eye blink detection is widely used for a variety of other purposes, such as tiredness testing for long-distance drivers, and it is also widely employed in data security, similar to how we use fingerprint biometrics. The advancement in this field has the potential to greatly benefit impaired people.

To use this technique, the most effective component that is desired is proper eye vision management. Because the user is in front of the screen, a webcam is connected to the screen and watches the user's gaze. This is accomplished by flashing the field-shaped square buttons, which may display alphabets and words. This device can be attached to a wheelchair in front of the consumer so that whenever the consumer wants to click on a favourite phrase or type a word, a blink is all that is required for the phrase or alphabet to be clicked automatically. When the button is pressed, the voice assistant provides the output.

II. LITERATURE SURVEY

There are various eye gaze tracking developments in past research that built in many tools with the human-computer interaction paradigm. Some of these employ additional hardware, such as infrared (IR) lights [4] or electrooculography (EOG) [6], which have cost or complexity limitations. Eye gaze tracking is also used in communication systems, although it requires the inclusion of infrared [2]. To choose any option in the interface, the system uses the user's eye as a cursor in the computer display. In the HCI concept, the implementation of an eye gaze system was constructed in a virtual keyboard environment [3]. To select a character from the keyboard, the user must move his or her gaze to the right or left side. The eye centre coordinate, which is utilised as a pointer reference in the keyboard interface, is derived by modifying integral projection. This system is run on an android mobile application and uses one eye as an input. The disadvantage of this approach is that it causes people's eyes to strain.

In this work, the construction of an eye gaze tracking system is used to control a PC communication system that includes a virtual keyboard with alphabet keys and emergency phrases. When the cursor is positioned on the specific keys, the keys are selected by blinking the eye. The statements are finally transformed into speech. Our approach aims to alleviate eye strain and aid patients.

III. PROPOSED METHODOLOGY

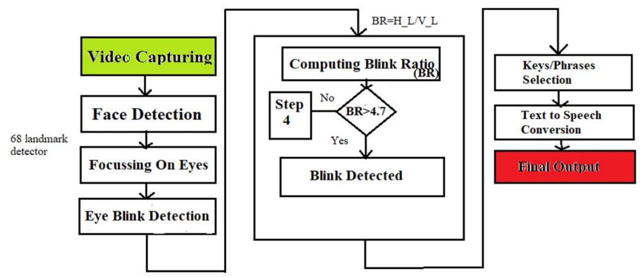

Fig 1. Flow chart

The system starts by recognising the user's face and detecting the eyes, which are followed by eye movements, and then detects eye blinks, allowing the user to select the desired word from the keyboard that displays on the screen. If the blink ratio is over 5.7, the blink rate is computed; otherwise, if the ratio is less than 5.7, the system deems it a non-blink and does not always compute it further. This is obviously dependent on the ratio at which the blink is made and whether it is a blink. Second, to the blink rate, if the blink rate is greater than four, the pointer clicks the preferred word set and alphabets, and as a result the audio help is also provided, but if the rate is less than four, it must be computed and checked once more to receive the output. The primary feature is the blink detection that occurs. The facial landmarks feature is used to discover the face with the help of the Dlib library.

IV. IMPLEMENTATION FLOW

We have designed a system which can be easily controlled by the paralysed people. This system provides the speaking power without using the mouth. Users are able to speak what they want through their eye blink. The user interface is very easy to use for all age groups from children to elderly people.

The constructed system takes live video taken using the webcam as input. The system architecture is as follows:

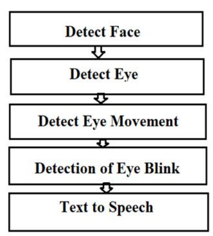

Fig 2. Implementation flow

A. Capturing Image and Face detection

Capturing a frame from a video with the system's camera starts the proposed system's execution.We transform the frames to gray-scale images and create a zero and one combination of white and black pixels.We perform the face detection using the get_frontal_face_detection() function and the shape_predictor_68_face_landmarks dat file aids in focusing on the eye region.We build a rectangle box to represent the identified face; it can detect many faces on the screen.

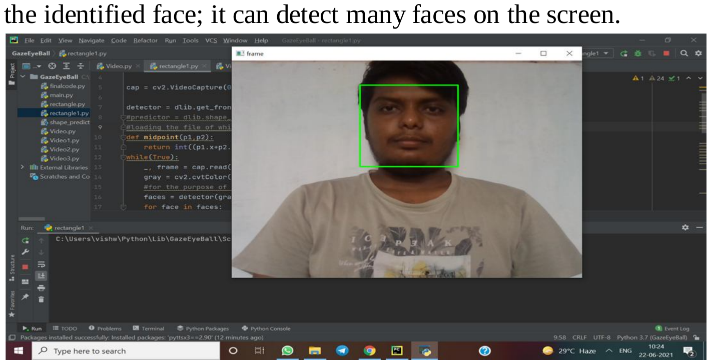

Fig 3: Face Detection

B. Eye Localization

The entire image processing proposed in this system is in grayscale mode. It is caused by the ease with which any data from an image may be calculated. The eye location is determined through face detection, on which the 68 landmarks are marked. This is why the camera should capture the entire user's face.As previously indicated about the face predictor 68 landmark dat file, facial landmarks are implemented within dlib to detect facial features such as eyes, ears, nose, and so on.We take 6 point pixels for the each eye.

Each landmark is assigned with an index. Using these indices, the desired region of the face is detected . Point index for two eyes:
left eye :- (37, 38, 39, 40, 41, 42)
right eye :- (43, 44, 45, 46, 47, 48)

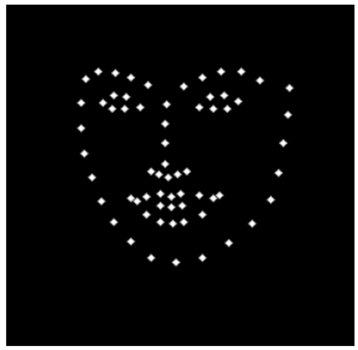

Fig 4. Facial landmarks for Eye detection.

Eye detected will be sent to check whether the eye is closed or open.

C. Eye Blink Detection

With the help of lines, we can identify blinks with the precise eye location. One is drawn horizontally, while the other is drawn vertically, dividing the eyes.Each vertical and horizontal line is almost the same for an open eye, however for a closed eye, a vertical line becomes smaller or virtually disappears. Using the vertical line ratio is calculated. We must specify a threshold number right here, and if the ratio is more than the reference, we can expect the attention to be closed; otherwise, it will be open.

We can Blinking ratio of each eye:
Ratio=Horizontal_length/Vertical_length
Blinking Ratio=(Left_eye_ratio+Right_eye_ratio)/2

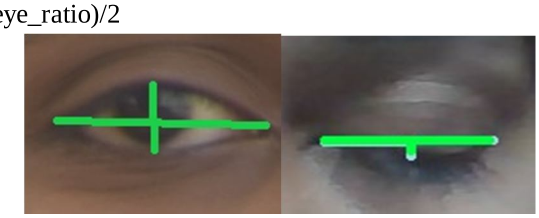

Fig 5.Opened eye and Closed Eye

D. Virtual Keyboard Design

The numpy package is used to construct a virtual keyboard in which rectangular boxes with alphabets are drawn and emergency phrases are also provided. Initially, the cursor advances to each key on the virtual keyboard, pausing for 30 seconds between each key. When the eye is closed and a blink is detected on a specific alphabet or phrase, it is selected and shown on the screen.

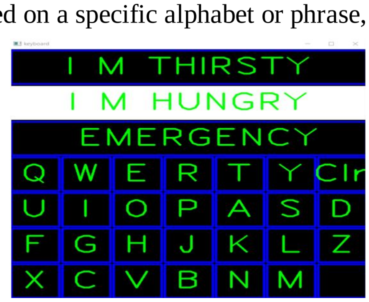

Fig 6. Virtual keyboard

E. Output Display and Speech Conversion

We proceed to the relevant keys and compose the phrase by blinking. It is visible in the text field. Using the pyttsx3 module, the output, which can be a word or a phrase, is then converted to audio.

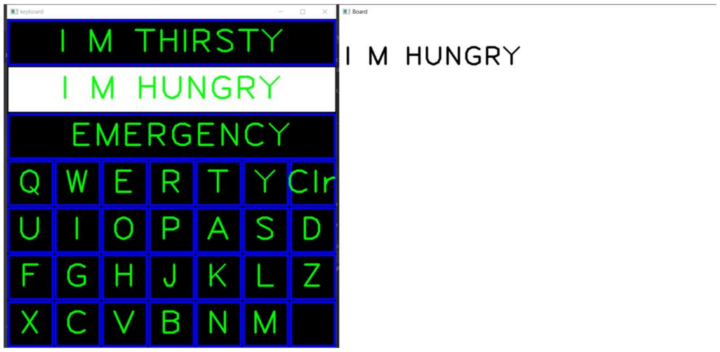

Fig 7: Phrase Selection

V. RESULTS

After testing by users, we discovered that moving on to each key takes 40 seconds, and the blinking ratio threshold varies depending on the person, but the blink is identified based on the blinking count rate, i.e. 4 counts. Speech conversion is quite useful in communication; depending on the application, we can attach speakers to increase sound. We demonstrate word formation utilising our eye blink technique in this video. While testing the system with different users, we can separately place a webcam apart from the built-in pc webcam to increase the distance between the user and the camera. The webcam can be set at a maximum distance of 50cm.

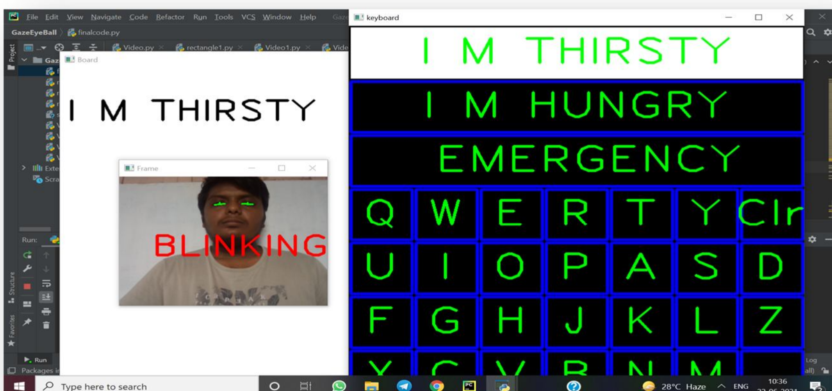

Fig 8. Phrase display using blink

VI. APPLICATIONS

1) Online remote proctoring is the act of supervising an online exam from any location in order to prevent inappropriate behaviour or instances of cheating and to maintain a cheat-free assessment environment. The use of AI (Artificial Intelligence) has enabled educators to closely watch test-takers' actions and easily give exams. Tracking the movement of an eye and displaying an alarm on screen whenever a person looks in other directions instead of the screen for more than 2-3 times is one method of online proctoring.
2) The Drowsiness Detection System advanced primarily based totally on eye closure of the motive force can differentiate ordinary eye blink and drowsiness and locate the drowsiness at the same time as driving. When the eyes are closed for too long, a caution sign is issued.
3) Eye tracking in advertising, the goal of advertising creative research is to determine what the client actually sees and what is completely overlooked. We can now optimise the advertising message and select the optimal design option as a result of this. An eye tracking study can reveal which elements were examined the most frequently and for the longest period of time.

VII. FUTURE SCOPE AND CONCLUSION

Eye tracking and detection is regarded as a safe and dependable method of human-computer interaction. In this research, we examined current tactics and presented the artwork from an eye monitoring and detection survey. The gadget is suitable for use in a range of settings, including hospitals, residences, and nursing homes. This gadget enables those who are paralysed to move their eyes, giving them a new lease on life.

Each body requires an average amount of time to execute, which might be quite green for real-time applications. An enhancement can be made by setting an alert that can be set while the caregiver is away waiting for the choice or seeing the message. This alarm will notify the caregiver, who will be able to respond instantly. Another improvised solution could be to place the IOT devices. An IOT device can be configured in such a way that the patient can execute light transfers and change the fan with the aid of blinks, reducing the caretaker's workload while also giving the patient a sense of independence.

VIII. ACKNOWLEDGMENT

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