MESSAGE CONVEYOR FOR LOCKED SYNDROME PATIENTS BY VIRTUAL KEYBOARD

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Abstract — the Message conveyor for locked syndrome patients is an assistive technology designed to help individuals with Locked-in syndrome. Locked-in syndrome is a rare disorder of the nervous system. People with locked-in syndrome are paralyzed except for the muscles that control eye movement. Conscious (aware) and can think and reason, but cannot move or speak; although they may be able to communicate with blinking eye movements. The system consists of a camera that detects the user's face and eyes and tracks the movement of the eyes to control a virtual keyboard on the screen. The system uses a Histogram of Oriented Gradients (HOG) descriptors to detect the user's face, and a Shape Predictor 68 Face Landmark algorithm to detect the user's eyes. Eye blinking is detected by drawing two lines in the eye and checking for the disappearance of the vertical line. Eye gaze detection is done by detecting eyeballs and applying a threshold on them. The system also counts the white part of the eye to determine the direction of the gaze. The virtual keyboard is displayed on the screen and is controlled by eye movements and blinking. The user can select letters and symbols by blinking, and additional controls are provided to adjust the settings such as language and speed of the speech output. The output of the system can be in the form of text or speech, and is displayed on a 16x2 LCD or pronounced using a speaker. The text or speech output is determined by the user's selections on the virtual keyboard. In summary, the Eye Gaze Controlled Typing System is an innovative technology that enables individuals with motor impairments or disabilities to communicate using eye movements and blinking. The system uses advanced computer vision algorithms to detect the user's face, eyes, and gaze direction and provides a simple and intuitive interface for controlling the virtual keyboard and adjusting the system settings

Keywords: Assistive technology, Eye gaze tracking, Computer vision, Virtual keyboard, Eye blink detection NodeMCU, LCD, Voice playback, Disabilities.

I. INTRODUCTION

The Message conveyor for locked syndrome patients is an innovative assistive technology designed to help individuals with motor impairments or disabilities to communicate using eye movements and blinking. This system uses advanced computer vision algorithms to detect the user's face, eyes, and gaze direction, and provides a simple and intuitive interface for controlling the virtual keyboard and adjusting the system settings. The system works by detecting the user's face using a Histogram of Oriented Gradients (HOG) descriptors and tracking the movement of the user's eyes using a Shape Predictor 68 Face Landmark algorithm. Eye blinking is detected by drawing two lines in the eye and checking for the disappearance of the vertical line. Eye gaze detection is done by detecting eyeballs and applying a threshold on them. The system also counts the white part of the eye to determine the direction of the gaze. The virtual keyboard is displayed on the screen and is controlled by eye movements and blinking. The user can select letters and symbols by blinking, and additional controls are provided to adjust the settings such as language and speed of the speech output. The output of the system can be in the form of text or speech, and is displayed on a 16x2 LCD or pronounced using a speaker. The text or speech output is determined by the user's selections on the virtual keyboard. Overall, the Eye Gaze Controlled Typing System is an innovative technology that provides a new way for individuals with motor impairments or disabilities to communicate and express themselves.
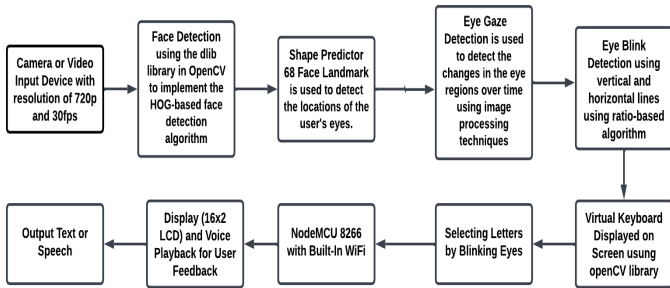
II. BLOCK DIAGRAM

Fig 2.1. Block Diagram

III. PROPOSED METHODOLOGY

The camera or video input device captures the user's face and eye movements. The face detection component uses the Histogram of Oriented Gradients (HOG) feature descriptor to identify the user's face in the image. The shape predictor 68 face landmarks uses 68 specific points to identify features such as the eyes, nose, lips, eyebrows, and face area. The eye detection component uses these landmarks to identify the user's eyes. The eye blink detection component tracks vertical and horizontal lines in the eyes to detect blinking. The eye gaze detection component tracks the user's eyeballs and applies a threshold to identify the white part of the eye. This allows the system to determine which part of the virtual keyboard the user is looking at. The virtual keyboard is displayed on the screen, and the user selects letters and other characters by blinking their eyes. The NodeMCU with built-in WIFI receives the user's text selection and sends it to the display (16x2 LCD) and voice playback components for user feedback. The user can interact with the system and control its functions.

IV. MODULE DESCRIPTION

A.Camera or Video Input Device

The camera used in the eye gaze-controlled typing system can vary depending on the specific implementation and requirements of the system. However, generally, a camera with high resolution and a good frame rate is preferred for accurate tracking of the user's eye movements. In general, a camera with a resolution of 720p or higher is suitable for eye tracking. The frame rate should be at least 30 frames per second (fps) to ensure smooth and accurate tracking. The camera should also have good low-light performance,

as the system may be used in different lighting conditions. In terms of the camera type, both webcam and Smartphone cameras can be used for eye tracking. However, webcams are typically preferred for their ease of use and better stability, while Smartphone cameras may be more portable and flexible in terms of placement. It's important to note that the camera used in the system should be compatible with the software used for face detection, eye detection, and eye tracking. The specific software may have recommended camera requirements, so it's important to check with the software documentation or manufacturer for any specific camera recommendations.

Fig.4.1. Web Camera

B. Face Detection (using HOG)

The face detection block in the eye gaze-controlled typing system uses the Histogram of Oriented Gradients (HOG) feature descriptor to detect faces in the captured image. HOG is a popular feature descriptor used in computer vision and image processing for object detection, including face detection. Here's a brief overview of how to face detection using HOG works: Image pre-processing: The input image is pre-processed to improve the performance of the face detection algorithm. This may include steps such as greyscale conversion, contrast normalization, and histogram equalization. Sliding window approach: The HOG descriptor works by dividing the input image into small, overlapping sub-windows or regions. Each sub-window is represented as a feature vector using the HOG descriptor. Gradient orientation calculation: The HOG descriptor counts the number of occurrences of gradient orientation within each sub-window. The gradient orientation is calculated by computing the gradient magnitude and direction of the pixels in the sub-window. Histogram of oriented gradients: The gradient orientation values are grouped into bins to form a histogram of oriented gradients for each sub-window. The HOG descriptor is a concatenation of these histograms. Support Vector Machine (SVM) classification: The HOG descriptor

is used as input to a binary SVM classifier, which is trained to distinguish between face and non-face sub-windows. The classifier is trained using a large number of positive (face) and negative (non-face) examples. On-maximum suppression: The output of the classifier is a set of bounding boxes around potential face regions in the input image. To reduce false positives, non-maximum suppression is applied to eliminate overlapping bounding boxes and keep only the most likely face region. The face detection block in the eye gaze-controlled typing system uses the dlib library in OpenCV to implement the HOG-based face detection algorithm. This algorithm has been shown to be more accurate than other methods for face detection, making it a popular choice for many computer vision applications.
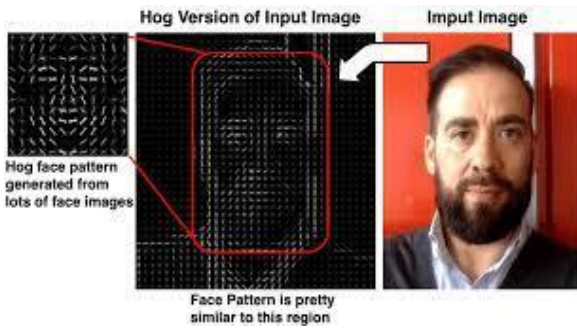

Fig.4.2. Face Detection using HOG

C. Shape Predictor 68 Face Landmark

The shape predictor 68 face is a machine learning-based algorithm used to locate 68 specific landmarks or key points on the face. It is commonly used in computer vision applications such as face tracking, face recognition, and facial expression analysis. Here's an overview of how the shape predictor 68 face works: Training data: The shape predictor 68 face algorithm is trained on a large dataset of face images, which are labeled with the locations of 68 specific facial landmarks. The training process involves using machine learning algorithms to learn the relationship between facial features and landmark locations. Feature extraction: The shape predictor 68 face algorithm uses feature extraction techniques to identify facial landmarks. Specifically, it extracts HOG features from the image, which are then used to train a regression model to predict the locations of the 68 landmarks. Regression model: The shape predictor 68 face algorithms use a regression model to predict the locations of the 68 facial landmarks. The regression model takes the extracted HOG features as input and outputs the landmark coordinates.

Facial landmark detection: Once the shape predictor 68 face algorithm is trained, it can be used to detect the 68 facial landmarks in new images. This involves applying the trained regression model to the input image to predict the locations of the landmarks. Landmark tracking: The landmark locations can be used to track the face as it moves, which can be useful for applications such as facial expression analysis or eye gaze tracking. In the eye gaze-controlled typing system, the shape predictor 68 faces are used to detect the locations of the user's eyes. The algorithm is used to locate the eye regions by identifying specific landmarks, such as the corners of the eyes and the iris. Once the eye regions are located, the system can use additional image processing techniques to detect eye blinks and track the user's eye gaze to select keys on the virtual keyboard
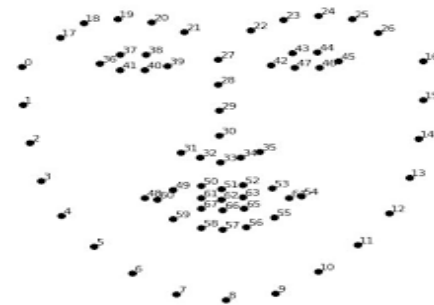

Fig.4.3. Shape Predictor 68 Face Landmark

D. Eye Gaze Detection (using eyeball tracking)

To detect eye gaze, the eye gaze-controlled typing system uses image processing techniques to analyze the video feed from the camera and monitor changes in the eye regions over time. The basic principle behind eye gaze detection is that the position of the iris in the eye can be used to infer the direction of the person's gaze. In the eye gaze-controlled typing system, the eye gaze detection algorithm first isolates the eye regions using the shape predictor 68 face algorithm. Once the eye regions are identified, the system applies a threshold to the grayscale image to convert it into a binary image. This binary image is then used to detect the iris and estimate the position of the pupil center. Once the position of the pupil center is estimated, the system uses various algorithms, such as Hough transforms and circular pattern matching, to estimate the position and direction of the gaze. This estimation is typically done by comparing the position of the pupil center with the position of the eye corners and

using this information to infer the direction of the gaze. By monitoring gaze direction, the system can allow users to select keys on the virtual keyboard simply by moving their eyes

E. Eye Blink Detection using vertical and horizontal lines

To detect eye blinks, the eye gaze-controlled typing system uses image processing techniques to analyze the video feed from the camera and monitor changes in the eye regions over time. The basic principle behind eye blink detection is that the eyelids close when a person blinks, causing a temporary occlusion of the eye regions. This change in the eye regions can be detected using image processing techniques, such as edge detection, thresholding, and blob analysis. In the eye gaze-controlled typing system, the eye blink detection algorithm first isolates the eye regions using the shape predictor 68 face algorithm. Once the eye regions are identified, the system applies a threshold to the grayscale image to convert it into a binary image. This binary image is then used to detect changes in the eye regions over time. To detect eye blinks, the system uses two lines that are drawn over the eye regions, one vertical and one horizontal. When the eye is open, both lines are visible. However, when the eye blinks, the vertical line disappears temporarily due to the occlusion of the eyelid. The system tracks the disappearance of the vertical line and uses it to detect eye blinks.

F. Virtual Keyboard Displayed on Screen

The virtual keyboard in the eye gaze-controlled typing system is a software-based user interface that allows users to input text using eye movements. It is displayed on the screen and consists of a grid of keys, similar to a standard physical keyboard. The keys can include letters, numbers, and symbols, depending on the language and preferences of the user. The virtual keyboard in this system is designed to be used with eye movements, specifically eye blinks and gaze direction. Each key on the virtual keyboard is selected by a combination of eye blinks and gaze direction. To select a key, the user first gazes at the key they want to select. Once the desired key is in focus, the user blinks their eyes to activate the selection. The system then registers the selected key and begins to build the text by adding the character to a buffer. The virtual keyboard output is received by the NodeMCU, which is a microcontroller with built-in Wi-Fi. The NodeMCU communicates with a voice playback and 16x2 LCD, which shows the text received by NodeMCU and pronounces it through a speaker if the text is stored. By combining the

virtual keyboard with these hardware components, the system can provide a complete solution for text input and output using only eye movements.

G. Selecting Letters by Blinking Eyes

In the eye gaze-controlled typing system, each letter on the virtual keyboard is selected by a combination of eye gaze and eye blink. Here's how it works: The user gazes at the letter they want to select on the virtual keyboard. Once the desired letter is in focus, the user blinks their eyes to select the letter. The system detects the eye blink and registers the selection. The selected letter is then added to a buffer, which holds the current text being input by the user. The process is repeated for each letter the user wants to select. The system uses a computer vision algorithm to detect eye blinks and distinguish them from other eye movements. The algorithm detects when the upper and lower eyelids come together and then separate, which signifies a blink. By setting a threshold for the duration of this action, the system can distinguish between a blink and other eye movements, such as saccades or fixations. The combination of eye gaze and eye blink allows the user to select letters on the virtual keyboard with a high degree of accuracy and precision. It can take some practice to get used to this method of text input, but it can be an effective way for individuals with motor disabilities to communicate using only their eyes.

H.NodeMCU with Built-In WIFI

NodeMCU is an open-source development board designed for the Internet of Things (IoT). It is based on the ESP8266 microcontroller and includes built-in Wi-Fi, making it easy to connect to the internet and communicate with other devices. The NodeMCU board is similar to other development boards like the Arduino, but it is specifically designed for IoT applications. It is programmed using the Lua scripting language, which is easy to learn and use. NodeMCU includes several features that make it a popular choice for IoT projects, including Wi-Fi connectivity: NodeMCU has built-in Wi-Fi, which allows it to connect to the internet and communicate with other devices.GPIO pins: NodeMCU includes several general-purpose input/output (GPIO) pins, which can be used to connect to sensors, actuators, and other devices. Analog input: NodeMCU also includes analog input pins, which can be used to read values from sensors that output analog signals.USB interface: NodeMCU can be connected to a computer via USB, which allows it to be programmed and powered. Low cost: NodeMCU is a relatively low-cost development board, making it accessible to hobbyists and

students. In the eye gaze-controlled typing system, NodeMCU is used to receive the text selected by the user on the virtual keyboard. This text is then displayed on a 16x2 LCD display and pronounced using a speaker connected to the NodeMCU board. NodeMCU communicates with the other components of the system using Wi-Fi, which allows for wireless communication and eliminates the need for additional wires or connections.

Fig.4.4. NodeMCU with Built-In WIFI

I. Display (16x2 LCD) and Voice Playback for User Feedback

In the eye gaze-controlled typing system, a 16x2 LCD display and a speaker are used to provide visual and audio feedback to the user. The 16x2 LCD display is a type of alphanumeric display that can show up to 32 characters at a time in two lines of 16 characters each. It is a commonly used display in embedded systems and is easy to interface with using digital input/output pins. In the eye gaze-controlled typing system, the LCD display is used to show the text selected by the user on the virtual keyboard. This allows the user to confirm that the correct text has been selected before it is pronounced by the speaker. The speaker is used to provide audio feedback to the user in the form of spoken words. In the eye gaze-controlled typing system, the speaker is connected to the NodeMCU board and is used to pronounce the text selected by the user on the virtual keyboard. The speaker can be any type of audio playback devices, such as a simple piezoelectric buzzer or a more advanced speaker with built-in amplification. Both the display and the speaker are connected to the NodeMCU board using digital input/output pins. The NodeMCU board communicates with these components using software libraries that allow for easy interfacing with the display and speaker. This allows the user to receive both visual and audio feedback from the system, making it more user-friendly.

Fig.4.4. Display (16x2 LCD)

J. Output Text or Speech

The output of the eye gaze-controlled typing system can be in the form of text or speech, depending on the user's preference. If the user selects text as the output, the system will display the selected text on the 16x2 LCD display. The user can then read the text and use it as needed. If the user selects speech as the output, the system will pronounce the selected text using the speaker. The speaker can be programmed to produce speech in a variety of languages and accents, allowing for greater flexibility and accessibility for users from different backgrounds. In either case, the output text or speech is determined by the user's selections on the virtual keyboard, which is controlled by eye movements and blinking. This allows users with motor impairments or disabilities to interact with the system and produce text or speech output in a way that is comfortable and natural for them.

V. RESULT AND DISCUSSION

After implementing all setup and successful run of our message conveyer several times to obtain results. This device is designed to help people who are physically disabled and are not able to Speak to convey their message to others. The system detects eye blinking and the letter in which The cursor is placed during the time of eye blinking will be shown on the screen, thus making a sentence. This system is designed at a very low cost so that it is affordable to everyone and is also accessible to small children as well. The proposed system will provide a robust and a sort of technique to write for physically disabled people, it is not a quick way of writing for normal people. The proposed system in this paper provides a new dimension in the life of disabled People who haven't any other physical abilities without eyes movement.

VI. CONCLUSION

The Message conveyor for locked syndrome patients is a significant advancement in assistive technology that provides an intuitive and efficient means for individuals with motor impairments or disabilities to communicate. The system uses advanced computer vision algorithms to detect the user's face, eyes, and gaze direction and provides a simple and easy-to-use interface for controlling the virtual keyboard. The system is designed to be customizable, with various settings that can be adjusted to suit the user's needs and preferences. The output can be in the form of text or speech, and is displayed on an LCD display or pronounced using a speaker. The Eye Gaze Controlled Typing System has the potential to greatly improve the quality of life for individuals with motor impairments or disabilities, enabling them to communicate more effectively and express themselves more freely. It represents a significant step forward in assistive technology and has the potential to become an essential tool for individuals with disabilities.

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