Effective Way to Communicate with Divyangjan Using Morse Code

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Abstract. In our day-to-day life, speech is one of the mostly used medium to communicate and express one's feelings. But this medium can't be used by the people who can't speak and hear. This hinders their communication with the outside world. Even, the similar problem is faced by the persons, who are working as a caretaker for such people. To overcome this problem of effective communication, in this project work, we have developed an interface using Morse code to communicate with people who are suffering from disabilities and can't express their feelings. The idea is to use the eye blinking of the person with disabilities and converting it into the Morse code in order to establish successful communication. Now, with the help of these eye blinks, dot will be recognized by a short eye blink and dash will be recognized by a long eye blink. These eye blinks are captured by using camera and hence, we can generate the Morse code. The captured code could be then converted into the respective language with the help of an algorithm. A simple algorithm has been developed by using Histogram of Oriented Gradients (HOG) and Support Vector Machine (SVM) with the help of libraries viz. (dlib, open cv). Eye Aspect Ratio (EAR) has been estimated using the feature points of the eyes. In this project we have generated the output in the form of dash and dots and convert the obtained output into respective speech.

Keywords: Histogram of Oriented Gradients (HOG) · Eye Aspect Ratio (EAR) · Morse code · Support Vector Machine (SVM)

1 Introduction

Conventional human communication primarily relies on verbal language and nonverbal cues such as facial expressions and body language. However, in specific contexts or situations, sign language, incorporating facial expressions and physical gestures, serves as a vital mode of communication. Not all situations support the victims or disabled people to convey help needed safely through hand signs or by speech. Communication methods for paralyzed patients typically involve mouth-operated joysticks, breath-controlled puffing straws, tongue movement assessments, and switch-mounted devices

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positioned near the user's head. However, these systems are costly to implement, can add stress to patients, and require skilled personnel for setup and maintenance. Few existing devices designed to address this issue are neither user-friendly nor cost-effective. This project aims to develop a simple and affordable computer program for patients experiencing communication difficulties, utilizing eye movements or blinks as alternative input methods.

Early in the 19th century, when individuals had no idea how to build circuits to transmit voice signals across distances, the Morse code was established. People used to refer to Morse code as the language of dots and dashes [1]. Originally developed primarily for radio communication, this concept has found several uses in the aviation and naval industries as well as in assistive technology, which facilitates communication for the disabled. In addition to helping those with speech impairments, this code can also be helpful in some military strategic scenarios [2].

2 Literature Survey

The video input is captured via the camera module, transferred to the Arduino UNO Board and displayed as text or voice signals on an LCD screen. It is developed with keen interest in helping the Locked-in Syndrome (LIS) paralysis patients and has a sustainable and effective solution. However, low lights affect the accuracy in prediction [1–3]. Open CV is used to open the webcam, dlib is used to detect the face and eye region, FLASK connects ML model and the front-end part and as a proxy server to store ML model, fetch the output and display. Decision Tree and Random Forest algorithms are used, which provide higher accuracy compared to the existing systems. Nevertheless, the execution time is considerable, the process proves laborious and intricate, and the presence of additional dots and dashes hampers the accuracy of predictions [4].

Utilizing gradient flow fields and color-based techniques, the system detects eye sclera, supported by horizontal gradient maps under infrared lighting [5]. It achieves a 98% blink detection rate and can classify blinks as either involuntary (short) or voluntary (long). However, prolonged squinting can render the open eye template outdated, potentially leading to erroneous outputs until the system loses track and re-initializes itself [6]. Haar Cascade algorithm (face detection in each image) and Local Binary Pattern (face recognizer) are used along with histograms to depict the implementation of face recognition. Featuring a precise face recognition algorithm, the system operates without the need for extra hardware, leaving no physical traces behind and delivering rapid processing. Nevertheless, in low-light conditions, the system may struggle to recognize registered users, and users might encounter difficulty in recalling complex Morse code compared to conventional alphabets and numbers [7].

In India, this system employs OpenCV, dlib, and imutils to detect eye blinks via facial pattern recognition. It has no adverse effects on users, is cost-effective, and boasts easy adaptability. However, while it facilitates mouse clicks, it lacks the capability to convey complete thoughts or provide alternative communication options. This stands in contrast to the numerous available AAC devices designed for comprehensive communication needs [8].

Eye blink detection with opencv, python, and dlib [9]. Image Morse code Text Input System. It uses OpenCV, web sockets and Flutter along with Viola Jones algorithm. It is made flexile; detection correctly decodes the Morse code and security is established while the Viola-Jones algorithm contributes to attaining high detection rates [10]. But voice capabilities are not included [11–12]. The system implements a three layered IOT architecture, the perception layer, communication layer, and application layer [13–14]. Face recognition arrangement remains route of finding expressive formal of a person [15]. Comprising a transmitter and receiver chip, a voice recording and playback chip, a VR module, and RF tags, this device offers straightforward operation. Users can control it effortlessly through voice commands instead of manual button presses [16]. Feature extraction is achieved through the utilization of Mel-frequency cepstral coefficients (MFCCs).

The system and methodology outlined above have inherent limitations that restrict their effectiveness to a select group, namely individuals with disabilities preventing hand or finger use, or impeding jaw movement due to fractures or other factors. These constraints pose challenges in extending the applicability of the proposed system to a wider spectrum of disabled individuals. Moreover, a notable drawback is the system's inability to generate speech, a critical aspect in light of contemporary technological advancements. This underscores the imperative to develop an audible system capable of verbal communication.

3 Problem Identification

Communication serves as a vital process through which individuals can articulate their emotions and ideas to others. How can people with disabilities and highly confidential matters be shared with others secretly? Throughout history, humans have utilized various modes of communication to interact with one another, including spoken language, sign language, and numerous other methods. Not all situations support the victim to convey help needed safely through hand signs or by speech. To enable discreet communication between two individuals, Morse code has been adapted, offering a highly efficient method of exchanging secrets solely through eye blinks. This method of communication is also useful for people with disabilities. Decoding and communication through Morse code can be difficult for people who are new to Morse code as well as for people who are familiar with Morse code.

4 Proposed Solution

This paper aims to create a platform for real-time assistance that utilizes Morse code through eye blinks. The system utilizes a webcam for data input and employs machine learning tree algorithms to enhance predictive capabilities. This platform also allows the end user to learn Morse code by encoding a message. In this project, Morse code is detected using image processing to detect the Text Message using the standard dictionary of Morse code using the dot and dashes. Here is a dictionary of code for respective letters with dash and dots and they are being used to estimate the respective Text Message. By using the dictionary of code for respective letters we can decode the transmitted message.

5 Methodology

In this research, we will use a typical dictionary of Morse code to detect text messages using dots and dashes. In order to estimate the appropriate text message, a dictionary of codes for the corresponding letters with dashes and dots is used in this instance [4]. The function dict.item () is used to get the respective text for the code [11].

Table 2 shows morse code alphabet [2] (Table 1).

Table 1. Previous work done for assisting disabled people

S.No	Author name	Title	Year	Techniques required\ Hardware	Remarks
1	Rickey Mathews	Morse code detection using eye blinks(for disabled people)	2021	Open cv, SVM, HOG	Couldn't genera te the text
2	Prof. Shalvi Tyagi	Morse code detection using Arduino(for normal people)	2021	Camera module, Arduino UNO.	Low light affect the accuracy in prediction.
3	Sumanth Deepak	Morse code Detection using FLASK module (for disabled people)	2020	Open cv, flask, Decision tree And random Forest algorithm.	Time complexity Is high and process is Complicated.

In the current work, the pattern of eye blinks during picture processing produced the Morse code. Either the recorded video or the real-time video will be used for this input. The recorded video is scaled, converted into frames, and then transformed into a greyscale image, preparing it for the face detection method to identify faces in each frame [12]. Then, after detecting the face it is going to detect eyes using the feature points (land marks) as shown in Fig. 1.

Then, according to the landmarks of the both the eyes the Eye Aspect Ratio [EAR] is being estimated [13].

$$EAR = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|} \tag{1}$$

Table 2. Morse Code Alphabet

A	•–	N	–•	0	–––––
B	–•••	O	–––	1	•––––
C	–•–•	P	•––•	2	••–––
D	–••	Q	––•–	3	•••––
E	•	R	•–•	4	••••–
F	••–•	S	•••	5	•••••
G	––•	T	–	6	–••••
H	••••	U	••–	7	––•••
I	••	V	•••–	8	–––••
J	•–––	W	•––	9	––––•
K	–•–	X	–••–	•	•–•–•–
L	•–••	Y	–•––	.	––••––
M	––	Z	––••	?	••––••

Fig. 1. Facial Landmarks

According to EAR value calculated using (1), we are able to find whether it is a blink or not. If the user closes the eye for closed 1 s then a dot (".") is generated and if the eye is closed for 2 s then an dash ("–") is generated as shown in Fig. 2a and b, respectively.

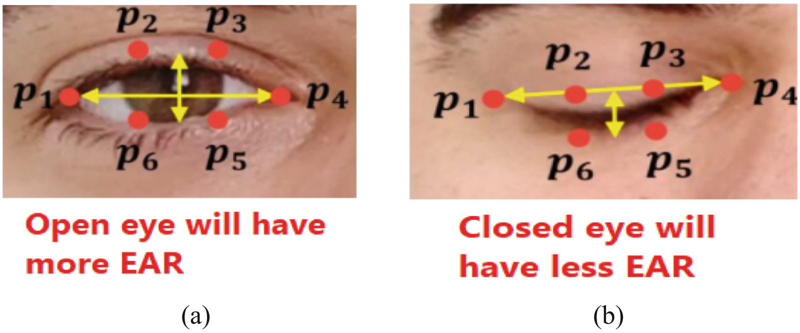

Fig. 2. Open and Closed Eyes

6 Overall Architecture and Flow Chart

The overall architecture and working procedure have been shown in Fig. 3. The model is quite simple to encode and decode the morse code sequence.

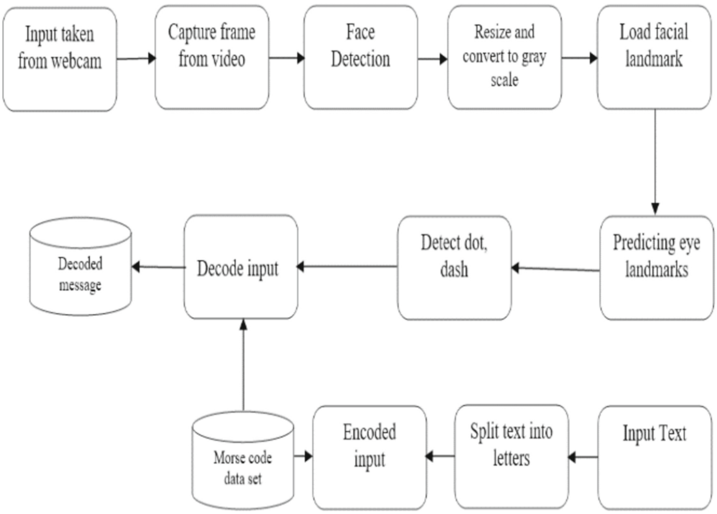

Fig. 3. Overall Architecture

Based on the data stored the message is appeared, the time module is used to know that how much time the eye is closed for, by knowing the duration it can be considered either the dot or a dash.dot is generated, if eye is closed for 1 s and the dash is generated if the eye is closed for 2 s. The flow plan for the efficient method of communicating with Divyangjan via Morse code is displayed in Fig. 4.

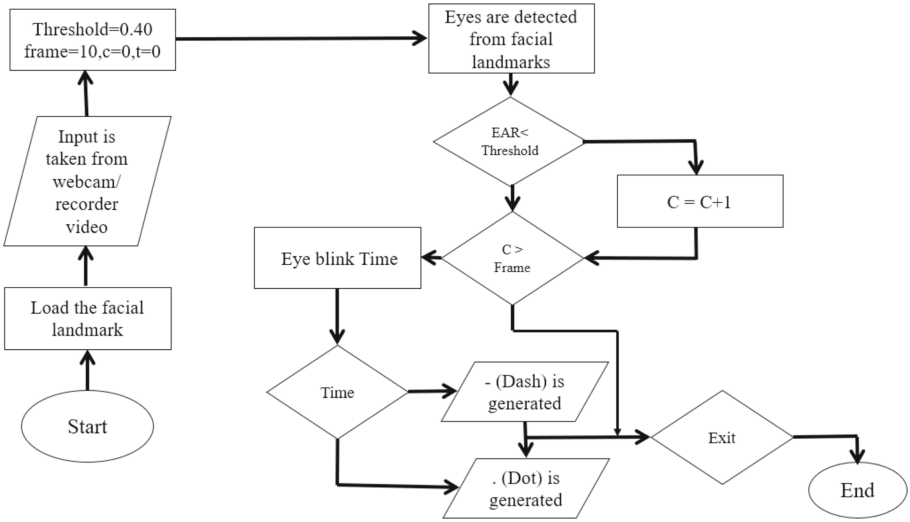

Fig. 4. Flow Chart

7 Results

The graphical user interface (GUI) is utilized in order to interact with the user as shown in Fig. 5. By giving the encoded data (text message) in it one can obtain the decoded message in the form of dot and dash (Morse code). By looking into the decoded dot and

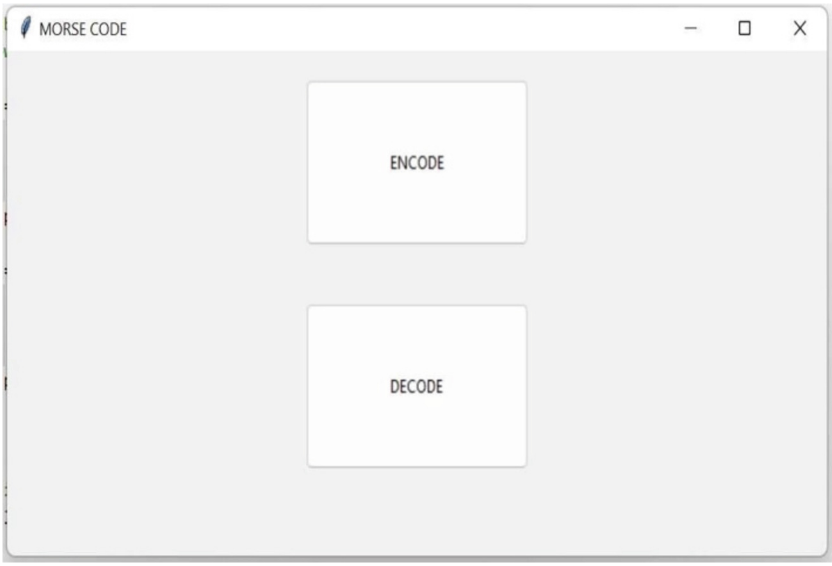

Fig. 5. Main menu

dash representation one can express the message more gracefully to the caretakers or to the outside people.

By giving the encoded data (text message) in it one can obtain the decoded message in the form of dot and dash (Morse code) by looking in to the decoded dot and dash representation one can express the message more gracefully to the caretakers or to the outside people.

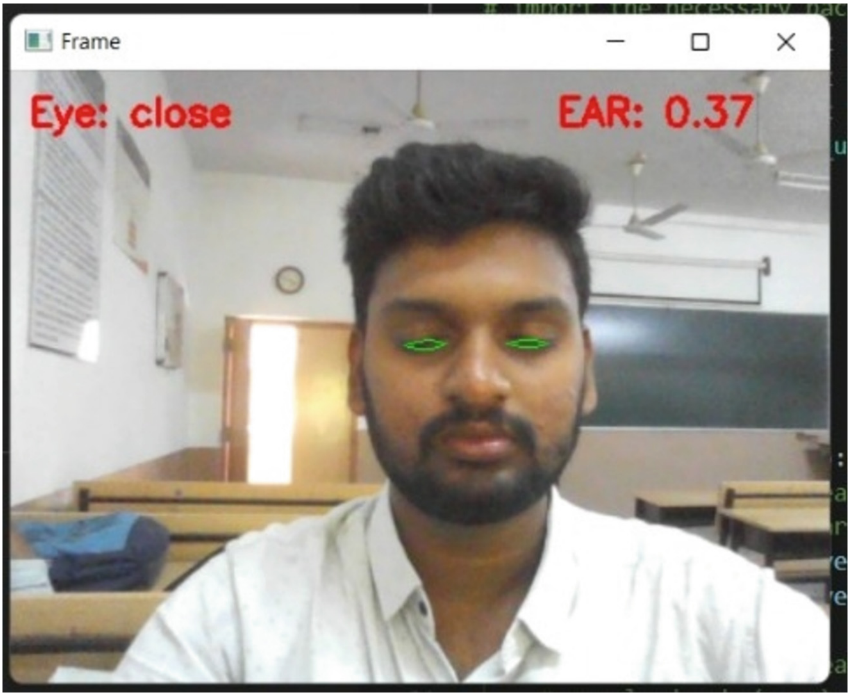

Fig. 6. EAR when eye is closed

The message is decoding by using the eye blinks of the user and the dot and dash are generated as shown in Fig. 6, 7 and 8 and Table 3. The dot and dash are converted into respective text message by using the standard dictionary of Morse code.

By using the graphical user interface, the text message is given in the sample box, so that one can see the Morse code for that text message as shown in Fig. 9. After generating the code, the respective Morse code is shown for the given text message. This work could find application in smart healthcare internet of things (IoT)-based system designed for future smart city application [16–18].

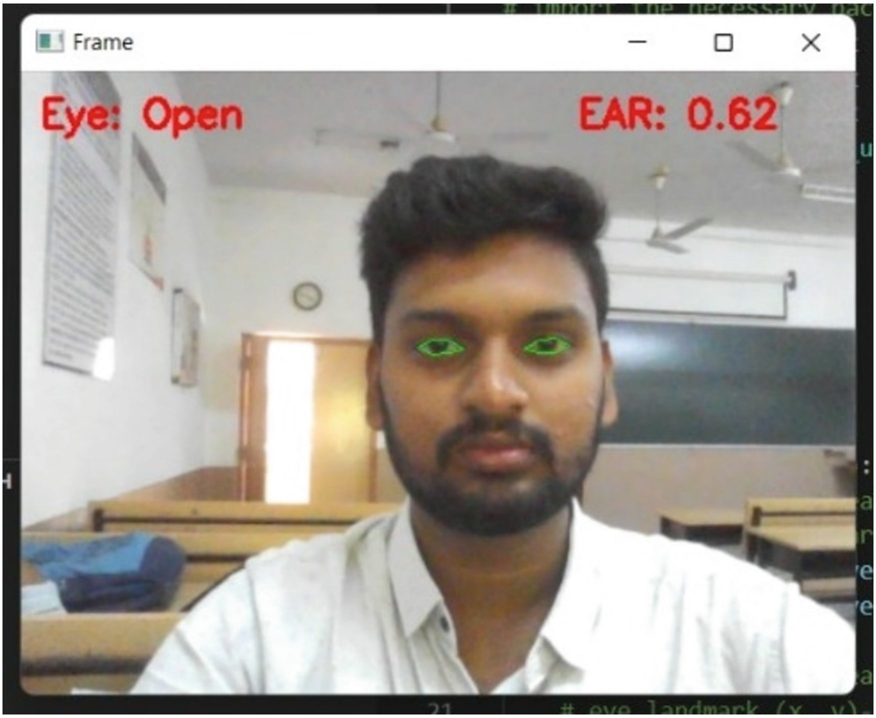

Fig. 7. EAR when eye is opened

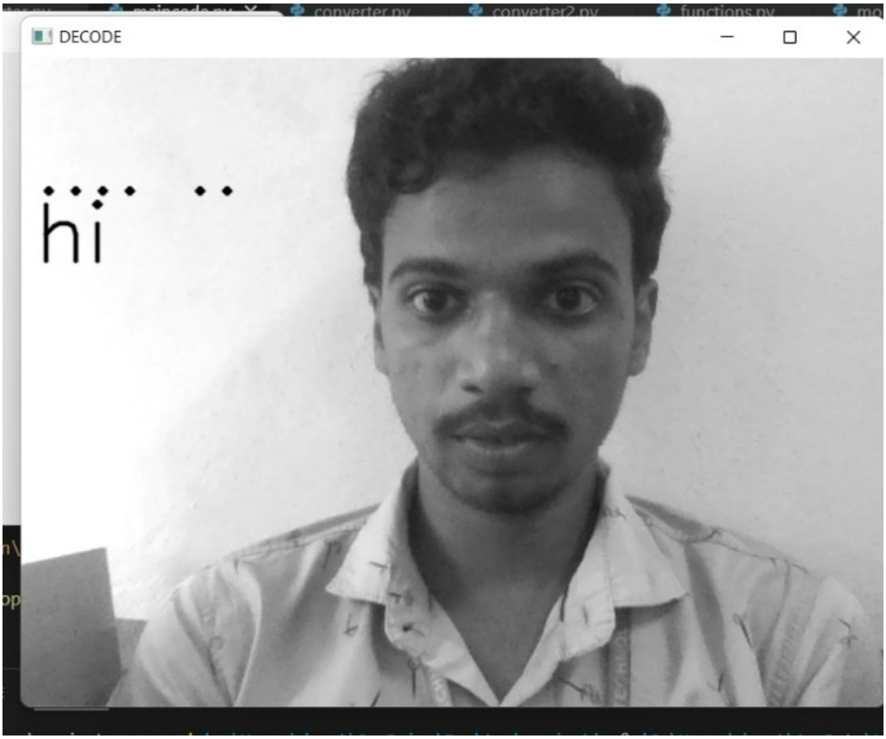

Fig. 8. Decoded Message

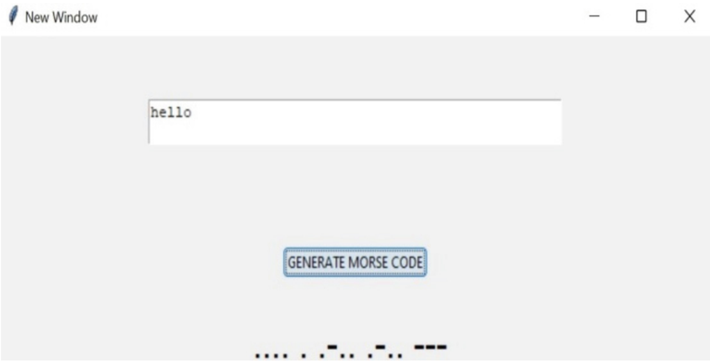

Fig. 9. Encoding Message

Table 3. Sample Conversion of Text to Morse Code

Text	Morse code
WELCOME	.-- . .-.. -.-. --- -- .
HELLO	.... . .-.. .-.. ---
HELP	.... . .-.. .--.
FOOD	..-. --- --- -..
ALERT	.- .-.. . .-. -

8 Conclusion

Real-time assistance now incorporates the detection of Morse code through eye blinks, facilitated by a webcam. This innovative approach enhances the system's predictive power in deciphering the conveyed messages. This platform also allows the end user to learn Morse code by encoding a message. Morse code is detected from a pattern of eye blinks using image processing. This would help any victim of assault to give emergency signals during emergency situations without alerting the assailant Patients with disabilities, who cannot convey their requirements properly through speech or sign, may use this technology to convey their needs through morse code, that is converted into text and voice signals.

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