



Morse code-based communication system focused on amyotrophic lateral sclerosis patients

Hussain Thanawala¹, Sanika Suthar², Simran Thakur³, Bhavika Thakur⁴

¹(Computer Engineering, Viva Institute of Technology/ Mumbai University, India)

Email : 18301060hussain@viva-technology.org

²(Computer Engineering, Viva Institute of Technology/ Mumbai University, India)

Email : 18301038sanika@viva-technology.org

³(Computer Engineering, Viva Institute of Technology/ Mumbai University, India)

Email : 18301068simran@viva-technology.org

⁴(Computer Engineering, Viva Institute of Technology/ Mumbai University, India)

Email : bhavikathakur@viva-technology.org

Abstract : This paper is based on the application of the Morse Code using facial feature techniques for the patients of amyotrophic sclerosis so they can communicate with each other and the staff. Amyotrophic lateral sclerosis also known as motor neuron disease happens making loss of motor neurons that helps to control voluntary muscle making a person highly dependent on other person for their daily activities. Various other techniques could be used but this system is created for its low-cost advantage for everyone can use it. In this software program, blinking of an eye is taken as input which is modified into words. Haar filters and cascade classifier is applied which are implemented in visual studio C. Many tests were made on five ALS patients who lost their speech ability were trained for using application software. The tests were done using two environments, one with low light intensity and the other with normal light intensity. This algorithm is consisting of five different parts: acquisition, processing, coding, interpretation and visualization.

Keywords – Acquisition, Augmentation, Amyotrophic lateral sclerosis, grayscale, histogram

I. INTRODUCTION

Every part of our body is made out of a reason with its great function, any fault in any part of the body leads a person feel unwanted, isolated and depressed. Through mouth they express their emotions, thoughts via speech and the problem is solved. Speech makes them feel connected to other human being. ALS is a disease in which there is loss of voluntary momentum which results in immobility of the patient. With new technologies, the life of patients is improved as they will be able to talk to the other people.

An example is the scientist Stephen Hawking who have been an ALS patient, wrote 10 and more books with his one figure with computer. Other alternative communication methods for ALS patients are: OnScreenKeys, Iriscom and Tobii C12 but since all these have a high cost which a normal person cannot afford it, so a low-cost system is proposed in this paper using Morse Code emphasizing on ALS patients named CodeBlink. CodeBlink have been developed in Visual Studio C # .net and intelligent agents. Intelligent agents helps communication of these patients as it contains face and default images. Since cells of the eyes is the one that is last to become worse, the face, eye and blinking is used for communication for the ALS patient at last or near stage.

With Morse code, blinking duration is determined in which short blinking is considered as dot and long blink is considered as dash. The dot and the dash are two symbols that are used in the entire Morse Code. For this code, these symbols are used to denoted letters and numbers in Spanish. GUI helps the process of communication as they have default words and keyboard of prediction.

II. Amyotrophic Lateral sclerosis (ALS)

Disease of ALS happens when the nervous system attacks the nerve cells leading the death of motor neurons. These nerve cells in the spinal cord and brain are carries signal to voluntary muscles. Early symptoms of ALS include stiff muscle, muscle twitches, and gradual increasing weakness and muscle wasting. People get badly affected having them dependent on another person for their daily activities requiring external help. As the research of ACELA, patients find the language difficult is because speech therapies only is not working so high level communication system is required which eventually is high cost because of which it is not possible to have in any institution. So, there comes urgency for low-cost solution of the problem for an effective conversation to happen between patient and the receiving person.

III. Augmentative and alternative communication aids for patients with ALS

Communication acts as the bridge of connection between the patient and the other person. Loss of speech means loss of connection making a person feel demotivated. Dr. Miguel A Sanz Bobi and engineer Maria Luisa Tavera Otero created a game mode where who do not have computer skills are able to create a digital album and it was designed to be used by people with disabilities. It was developed using C++ and Borland C++ compiler. Another system was developed from infrared lights connected to the computer and it incorporated a camera with the infrared lights that will make a focus on the user's eyes so that they can move the pointer wherever they want to. Another system was developed called OnScreenKeys in which a patient is able to use the computer by writing and speaking and mouse, its touch screen device by Tom Weber Software Company

IV. Morse Code

Morse Code, the language of dots and dashes giving output with dot and dash forming the alphabets when they are combined eventually forms the words. International Morse Code encodes the 26 basic Latin letters A through Z the Arabic numerals, and a small set of punctuation and procedural signals. Morse code is a method for transmitting telegraphic information, using standardized sequences of short and long elements to represent the letters, numerals, punctuation and special characters of a message. The short and long elements can be formed by sounds, marks, or pulses, in on off keying and are commonly known as "dots" and "dashes" or "dits" and "dahs." Morse code can be transmitted in a number of ways: originally as electrical pulses along a telegraph wire, but also as an audio tone, a radio signal with short and long tones, or as a mechanical or visual signal (for example, a flashing light) using devices like an Aldis lamp or a heliograph. Morse code is transmitted using just two states (on and off) so it was an early form of a digital code. However, it is technically not binary, as the pause lengths are required to decode the information,

V. Computational interpretation

As said before, the algorithm consists of acquisition, processing, coding, interpretation and visualization. While acquisition, the other person who is not ALS will select one camera after the system will start to click the images and then they are processed. In this processing phase, filters are applied so as to get grey scale images. Basically, it is done to fix the lighting to avoid the information loss. Along with this face and eye detection is done in this phase. Every blink is considered with the duration creating the Morse code word. Here dash means blinking for 600 to 1200 milliseconds and dot for less than 600 milliseconds. In visualization stage, patient's message is shown to receiver in their local language.

Talking about the use cases of each person while the communication. Patient writes a word, erases it if he/she wants to, select predetermined word and then finalize the word. Assistant/relative initially selects the camera, searches the intensity of the face, search intensity of the eyes as that's the most important, enable the detection and start the communication. The flow of the project goes with starting, camera detection, reading camera image, converting image to grey scale after image detection i.e normalize image, face detection, defining the region of interest (eye in this case), eye detection, blink detection, encode and interpret blinking and then visualization.



Fig 1. Internal Conversion Process Image

VI. Evaluations and results

The resulting tool is able to interpret all the tasks which are required for blinking purpose like capturing the images, display the words. Interface for system setting i.e assistant person and interaction with patient are the two interfaces of the program. It starts with capturing the image and then it verifies if the face is recognised and makes a box on the area to be used in the image. Conversion of image to grayscale is important and to the grayscale image histogram equalization is going to be applied to adjust the colour and brightness of the image. OpenCV is used after the eye detection to capture the eye which is performed by cascade classifier. For proper eye detection the value is taken from the region of interest which is face. Tests were done for 5 patients with 50% and 100% brightness and concluded that the results are so much better for 100% brightness resulting to answer more right answers.



Fig 2. Face recognition. Capture and processing.

VII. Conclusion

Amyotrophic Lateral Sclerosis being a disease of nervous system occurred by death of motor neurons resulting into paralysis and the patient facing problems in doing day to day work resulting to make them feel left out, depressed and unwanted. So, in order to take care of ALS patients and also keeping in mind the budget by making it low-cost, this tool is developed. Since, in any paralysis eyes are the last to get worst, they are used so that the patient with final stage can also communicate effectively. By using face and eye blinking technique as Morse code and the alphabet is encoded. One of the amazing feature of the algorithm is that it has writing prediction strategy is that it forms the complete word right from start which makes sentence completion easy.

VIII. References

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