SMART EYE BLINK SOLUTION FOR MND PATIENT USING PYTHON

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Abstract : Amyotrophic lateral sclerosis (Lou Gehrig's disease) Several people over the past few decades are unfortunately succumbing to the dreaded Motor Neuron Disease , the cause of which is still uncertain. Patients suffering from the same, exhibit a slow degeneration of their central nervous system which in turn affects several of their abilities such as locomotion and also speech. This paper describes a simplified setup and also elaborates a novel methodology to convert a sequence of eye winks or blinks into meaningful sentences with home automation function using also assist such patients to communicate. The algorithm discussed is not only accurate but is also 2 times faster than its predecessor algorithms. All experiments were conducted using python 2.7.13 and open cv and the setup for home automation system.

Index Terms - **blink recognition; open cv ; Motor neuron disease; Paralysis; wink recognition, Amyotrophic lateral sclerosis .**

I. INTRODUCTION

In a world full of modernization, there still exist some of the most chronicle and non-curable diseases. One of which is the motor neuron disease (MND). MND describes a group of diseases that affect the nerves (motor neurons) in the brain and spinal cord that tell your muscles what to do. The study conducted by different medical experts suggests that a lot of environmental and genetic factors affect the cause of MND and it does not have to be hereditary. The symptoms of MND range from muscle cramps, spasms to emotional liability, however they vary in speeds of development from person to person. Proposed system aims at the obstruction faced by the patients in terms of communication and the difficulty to express ones emotions due to their physical disability. The existing techniques in this field, is the speech generating device or the voice output communication aid used by Stephen Hawkings.

This device consisted of three major components. An infrared switch that traced his cheek was placed on his spectacles. Next an interface called the EZ keys facilitated him to operate a cursor on the screen by twitching his cheek. He could select a particular alphabet to form words and finally sentences. The last part is the speech synthesizer to output the speech loud in American Scottish or a Scan Davian accent . However, this will become difficult as his cheek muscles would detoriate. Thus another technology known as eye gaze that have lights and cameras that constantly send and receive information based on light reflections from eye pupils was developed . Still more techniques on this field, is the use of augmentative and alternative communication with the help of very little muscle control. The technology is based on residual EMG activity from the paralyzed patients to drive a binary click operation for the AAC device. Other techniques for locked in patients are the brain wave technique where the observed changes in the neural activity of the patient are read by the brain computer interface (BCI) .

The latter technique involves electrode piercing which as painful as it sounds is not a preferred option by many. first the blink dtection is done followed by eye extraction. The eye extraction is done as the area of interest here is the eye portion. To detect the blinks and count them, a simple metric known as the eye aspect ratio (EAR) is made use of. EAR can be calculated using the corresponding facial landmarks of different parts of the face depending on what the user wants. In terms of blink detection, we are only interested in two sets of facial structures namely the eyes.Thus further coding will convert that ratio into corresponding speech and home automation system like controlling o devices.

PROBLEM FORMULATION

A patient suffering from MND is unable to talk, walk, express feelings and communicate due to the weakening of muscles. The patient has control only upon his eye blinks. In order to abate the problem to communicate, an appropriate combination of hardware and software must be integrated to come up with a feasible solution,a portable solution to convert sequences of eye blinks to a speech output.

EXISTING SYSTEM

Methodology to convert a sequence of eye winks or blinks into meaningful sentences using Video Oculography and in turn assist such patients to communicate conducted using MATLAB 2011b and SIMULINK or python.

PROPOSED SYSYEM

The operating system used is Raspbian and python coding is done using 'Open CV' library to program Raspberry Pi . A camera captures the eye blinks and based on the EAR calculation, the code converts the sequence of the blinks to the corresponding speech output.

II. LITERATURE REVIEW

There are many literatures which reported relationship between nerves activity and neuropathy like Alzheimer's disease. Video oculography is non-invasive and video-based method for measuring the vertical, torsional and horizontal position components of both the eye blinks (eye tracking) using head-mounted mask which is furnished with small cameras to record. It performs thresholding for the detection of eye blink area. Therefore, measuring accurate transition of eye blink is difficult. This paper developed video Oculography system which has algorithm for eye blink movement. It evaluated for video oculography accuracy of 0.968. It showed more robust over eyelid overlap compared to other methods. It confirmed that the system can estimate light reflex parameters for eye blink approximately [6].

For the detection of eye movements, a technique called Video-oculography (VOG) is frequently used. In this paper, small video cameras are mounted on head and IR illuminations are used to image eye. Algorithms are developed for extracting vertical and horizontal movements of eye from video images. Developing a method for determining eye blinks is more complex. Using IR-wavelengths for illumination in a low image contrast is required. This paper presents design and implementation of algorithm detecting torsional robust movement of eye for VOG. The algorithm used here uses new approach for measuring torsional movement of eye and it is suitable for videos which are of low contrast. It is implemented in clinical device and the performance is compared with other techniques [7].

Video-Oculography (VOG) system is video-based method for measuring , torsional,the vertical and horizontal position components of both the eye blinks using which is furnished with small cameras to record. There are several techniques used for detecting closing and opening of eyes and eye movements. In this paper, the technique used is simple and less time consuming. Blinks are converted to sentence or words, which is not been used before. The camera which is focused to the face of the user records the blinks and is considered as video sequence. It is then considered as the input for detection of eye blinks and code counting. Calculating the number of eye blinks is done and the same corresponds to meaningful sentence according to the count. It works with less number of specifications. This also helps in cost reduction. For detection of eye blinks and eye blinks there are various methods involved. The method which is used in this paper reduces time for detection of blinks and also lessens the cost by large margin. The overview of the proposed system from camera for recording to the speech output [8].

Electro-oculography is a technique which defines interface of eye-gaze with the help of biological signal called as electro-oculogram (EOG). This interface helps the user to carry computer cursor on GUI i.e., graphical user interface which uses movement of eye. It is useful as it aids communication between individuals who are mobility handicaps. This EOG can be recorded easily. The roaming and blinking problems of these individuals should be solved for producing authentic interface of eye gaze. This is very painful because of the use of electrodes. These electrodes are attached to the upper layer of skin around eyes to measure potential difference and the blink of eye is recorded. The proposed system in this paper is known as video oculography [9].

The more useful organ in human is eye which helps in visualizing the outside world. With the analysis of eye movement, lot of knowledge about human is disclosed. Analysis of eye movement is used for applications like disease diagnosing, state of mind recognition, recognition of activity, identification of a person etc. This paper introduces an algorithm which helps in detecting movements of eyes such as blinks which can be used for communication. This technique which uses eye blink for communication is useful for people who have motor neuron disease where the patient feels hard in communicating with the world. The eye blinks can be converted to transmit messages to Morse code, in which eye blink is represented as dash or dot. For accomplishing this, an algorithm is presented which identifies first the facial region and then identifies eye blinks with the help of image processing. The algorithm designed and developed here for FPGA Spartan 3e and then it is tested using software MATLAB r2011b. The experiments conducted here consider different conditions for different set of individuals which have 92% accuracy for identifying different eye blinks were established[10].
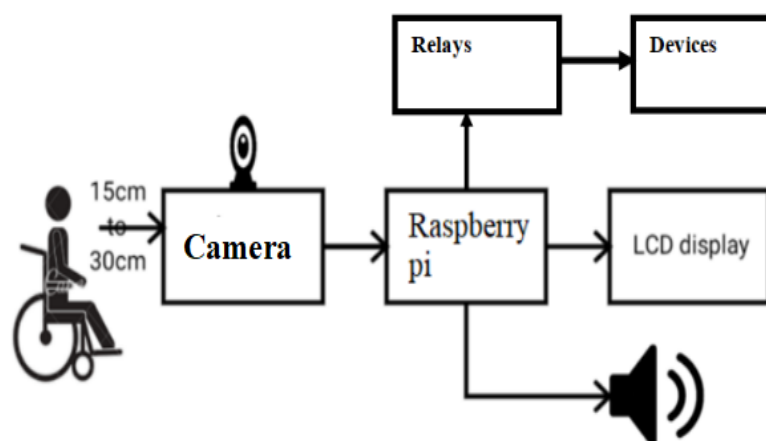
III. METHODOLOGY

Figure 1: Block diagram of proposed system

 The methodology used in our paper is simple and effective. Use of various library packages has been the main part. As the video from the camera starts, leading to the capturing of live images. The facial recognition starts with facial landmarking. This is basically done with the help of NumPy library and Dlib library. NumPy is a package in python used in faster complex mathematical computing and Dlib is a special kit containing machine learning algorithms. With the help of the these libraries we are able to localize and represent salient features of the face such as eyes, eyebrows, nose, mouth and jawline. These are basically marked with 68 x-y points and then finally region of interest is taken.Then we focus on the spatial filtering of the live image. This is basically done with the help of 'scipy.spatial' library. The trapezoidal type of green lines near the eye is done with help of this library. Thus, further leading to the calculation of Eye Aspect Ratio (EAR).

      The aspect ratio is very important for knowing whether the eye is open or closed. Thus, after the RoI (Region of Interest) is got that is the eye part, it further pictures and marked to a point scale that is p1-p6. The figure 6 below shows the marking of the 6points.
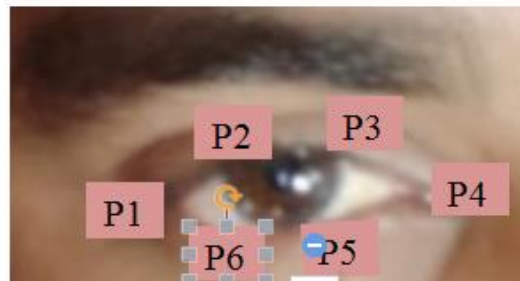

$$EAR = [(p2-p6) + (p3-p5)] / [2*(p1-p4)]$$

      The Raspberry Pi processor is nothing but a series of small single-board computers developed in UK. The processor has a speed ranging from 700MHz to 1.2GHz with an on-board memory range from 256MB to 1GB. Secure SD slot is given and comes with built-in WiFi.

      The speaker for the Raspberry Pi gives a voice and sound. The speaker is connected to jack on the Raspberry Pi. It has its own power supply that can be charged with the USB port. The volume can be controlled with a button on the speaker or from Raspberry Pi.

      The display screen is used in order to display the eye blinking and tracking motion. The screen is mostly important for the caretaker. It can guide him along the proper setup of the product. For the proper display, we have chosen to use 7'inch HDMI LCD display screen.

      The iBall Face2Face HD night vision camera is used for video and picture capturing. This camera comes with the 5G wide angle lens which helps in providing the smooth video and lets to make the quality of video capturing high.
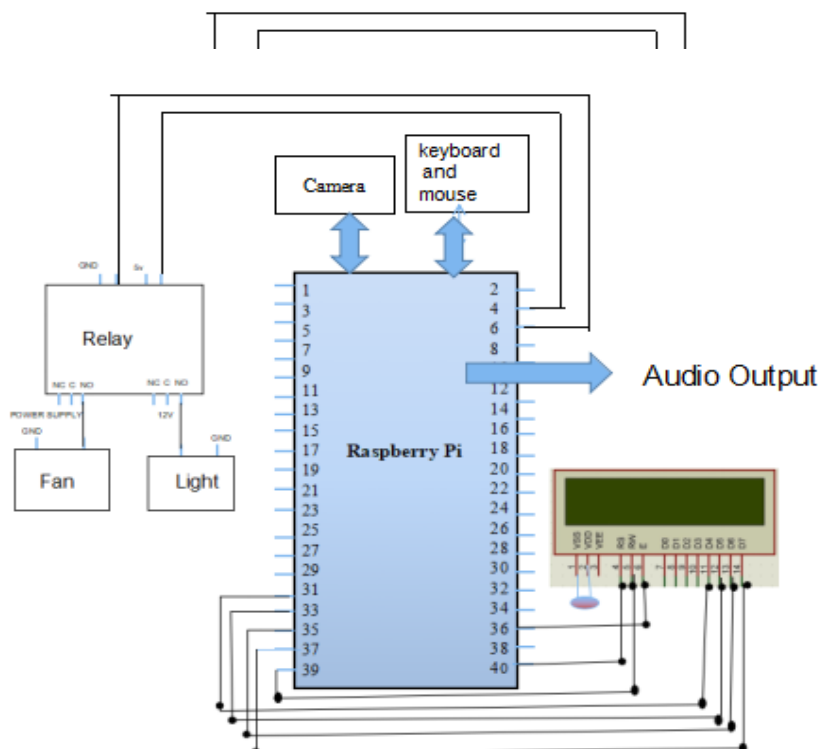
IV RESULTS ANALYSIS AND DISCUSSION

Figure 3:Project Setup

The parameters considered here are, Home automation system which have controlling of fan and light. Depending ration of eye blink the corresponding relay will turn on in turn fan or light .The main part o the proposed system is programming in python with open cv.

The proposed project aims to bring out a solution for the paralyzed people without any harm to their body externally or internally. It over weighs the previously developed prototypes in this field because none of the components are in direct contact with the patient's body hence it definitely will prove to be safer. Use of Raspberry pi is simple and also developing tremendously in the market today. The tool had advantages over the older conventional tools.

To make cost effective: The main objective of developing algorithm of a real time video Oculography system is that to provide cost effective for those people who cannot afford. The existing technique for such patients to communicate is too costly.

Thus, it is necessary to design a system which is affordable to common people which includes cost effective components for designing.

Electrode less system: To develop a system in which the patient can communicate without any application of electrodes. Because this electrodes need to be pierced to the skin of human body which is very painful. The use of electrodes is the technique available as of now which is cost effective but it is painful and makes the patient conscious every time and this technique is uncomfortable too.

Fast: There are few algorithms which are developed for video Oculography system for communication. The main objective of this project is to develop an algorithm which is extremely fast compared to the existing ones.

Accuracy: The main objective of this project is to develop an algorithm which is more accurate compared to the existing ones.

V. CONCLUSION

The proposed system aims to bring out a solution for the paralyzed people without any harm to their body externally or internally. It over weighs the previously developed prototypes in this field because none of the components are in direct contact with the patient's body hence it definitely will prove to be safer. Use of Raspberry pi is simple and also developing tremendously in the market today. The tool had advantages over the older conventional tools. Depending on the eye bink the voice generation with home automation is obtained successfully, If any emergency the message also will get with beep sound using python coding with open cv.

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