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Video Oculographic System enabling Communication for Patients suffering from Motor Neuron Disease

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Abstract: In the current scenario, there are numerous diseases which are caused due to the damage of parts in human body. One of main disease is with respect to the human brain. Such disease is named as Motor Neuron Disease (MND). This disease mainly affects speech i.e., the patient cannot be able to communicate with others. It also affects the locomotory organs so that the patient cannot move his hands and legs. In order to develop communication gap between the patients and others, this paper presents a system which includes developing an algorithm based on the eye blinks so that the patient finds no more difficulties in communication.

Keywords: Motor Neuron Disease; Video oculographic system; Swift key technique; Brain wave technology; Electro-oculographic system

I. INTRODUCTION

Motor Neuron Disease (MND) is one of the forms of paralysis. It occurs to 2 of 10 paralysis patients. MND is a condition in which the motor neurons are paralyzed. Due to this, motor neurons stop working by getting damaged eventually. This type of disease is incurable. So there are several systems in order to communicate. This paper presents a technique known as Video oculographic system. This system is based on the video of the patient which is recorded using a camera which focuses the eye portion so that the eye blinks are captured. There are several techniques for eye blink detection. This paper uses the technique which is simple, less time consuming and cost effective. With the help of blinks, a sentence is structured and read out using speaker, which is not so used previously.

II. LITERATURE SURVEY

Joshua et al in [1] propose that concussion is an unconsciousness which occurs temporarily but mainly due to the head blow. This leads to serious problem. Hence, there is a need of sensitive tests for finding changes in brain function. This paper provides a complete study for developing low cost device for eye tracking which inturn detects concussion. This device evaluates eye motion function and can be used on sidelines that give fast indication of severity of head trauma. It can also be used for curing injuries and controlling injuries in brain. Results give better accuracy.

According to Sudhir Rao Rupanagudi et al in [2], the patients who have motor neuron disease find difficulties in communication. Experimentation work is going on for finding communication systems. Various methods are designed that involves algorithms which are complex enough and also fail in terms of area, power and speed. This paper develops algorithm which can be used for communication. These are based on blinks which are transferred into sentences using MATLAB software. Accuracy level is 92%.

in [3], many thesis have been introduced which reports relationship between neuropathy and activity of nerves like Alzheimer's disease. This paper is based on video oculography. This technique measures position of eyes in the entire ways using mask which is mounted on head for tracking of eyes which also includes cameras for recording. It detects the pupil. Accurate pupil transition is difficult. This paper develops algorithm which has accuracy of 96.8%.

For eye movement recognition, Video-oculography is used frequently [4]. This paper makes use of camera which is mounted on head and also includes IR illuminations for imaging eye. This paper designs an algorithm for drawing eye movements from the video. Algorithm developing for eye is difficult. IR wavelengths are required for low image contrast. This paper implements algorithm for robust eye movement using video oculography. It is applicable for videos which are of lower in contrast. They are useful in clinics and have better performance.

Video oculographic system is a means of providing information about diagnosis that deals with disease advances which has problems with eye's vergence movement i.e., Parkinson's disease [5]. There are different systems which describes the use of IR devices. This paper shows that this system uses camera which will provide accurate values which are compared to that of IR based VOG system. This paper proves that the program for iris locating crosses methods present on BiolD database. System proposed contains algorithm sets for steps in image processing, iris localization. Tests are performed on Parkinson's disease patient with the method

proposed and using IR device. By tests, this paper achieved 84.1% correlation and also shows that the accuracy with respect to visual system is almost same as that of head mounted device. Later, this paper suggests having camera with more frame rate due to which large diagnostic values are obtained.

III. EXISTING TECHNIQUES

The scientist Dr. Stephen Hawking had this kind of disease. As we know that all the speeches of his are recorded earlier and later telecasted. For communication purpose, He preferred technique called Swift key technique.

The swift key technique used in order to communicate by Scientist is shown in figure 1. According to this, the wheel chair is attached with a screen which displays A to Z alphabets one after the other in order. Letters will pop out in alphabetical order. When the appropriate letter comes on screen he used to freeze that letter by tweaking his cheek. Once the starting letter is freezed, using word prediction software the words starting from the freezed letter appears. So again by doing the above procedure words are freezed to form a sentence. This system costs too much i.e., around 2 million USD. Hence, it is unaffordable to common people.

Fig 1. Swift key technique used by Scientist Dr. Stephen Hawking (Courtesy: christiantoday.com)

There are other techniques introduced relating to enable communication, which are of less cost. Such techniques include Electro-oculography and Brain wave detection technique.

The image which depicts the patient who has undergone this type of technique is shown in figure 2. Both of these involve using of electrodes. These are attached to human body by piercing them into the epidermis layer of skin. The potential is measured between the electrodes pierced around eyes, which investigates the eye movements. As we can imagine, these two techniques are painful and even the user must be very conscious and he will be too uncomfortable.

Fig 2. Technique involving piercing of electrodes [Courtesy: Introduction to biometric instrumentation]

IV. DISCUSSIONS

Joshua D. Fischer, Dawie J. van den Heever [1], this paper develops a low cost portable video occulographic device. But the main problem with this is that it uses a head mounted device because of this the patient need to be conscious and feels uncomfortable.

Sudhir Rao Rupanagudi, Vikas N S, Vivek C Bharadwaj, Manju; Dhruva N; Sowmya K. S [2], this paper develops an algorithm which uses old technique and even the accuracy rate is 92% and relatively less speed.

Masaru Kiyama, Hitoshi Iyatomi and Koichi Ogawa [3], this paper also develops a mask object which is mounted on to the patient's head. The patient feels uncomfortable and is conscious always. It also develops algorithm which is of 96.8% accuracy.

S. M. H. Jansen, H. Kingma, R. L. M. Peeters and R. L. Westra [4], this paper develops algorithm which are based on IR. IR wavelengths are of low in contrast. Hence, developing this type of algorithm is pretty difficult.

Jacek Naruniec, Michał Wieczorek and Marek Kowalski [5], this paper makes use of camera which has low frame rate which is mounted onto the head and the accuracy obtained by the algorithm developed is 84.1%.

V. PROPOSED SYTEM

By considering all these disadvantages, the aim of this paper is to develop an algorithm which uses camera with high frame rate, comfortable, electrodeless and cost effective. The motivation of this paper is to design an algorithm such that it is easy to use, affordable by common people and has high accuracy level and speed factor compared with other previously developed algorithms.

This is mainly based on the image processing. The main idea is to develop an algorithm for the incoming video which facilitates communication for the motor neuron disease patients. The algorithm basically works by considering the eye blinks and eye movements of the patients. It is done by using a camera which records video

of the patient and further processing of this video is done in MATLAB R2011b software.

The block diagram for the video oculographic system with the help of which the patients communicate is shown in figure 3. This system involves several steps starting from video frame capturing to converting blinks into sentences.

Video is recorded and sent to MATLAB R2011b for processing. In MATLAB, color processing is done and selected color model. The face is separated from background and the eye position is recognized. Then the eye blinks are recognized and the same is converted into speech.

In MATLAB R2011b, suitable color models are selected and the eye portion is recorded in order to obtain eye blinks. The eye blinks are recorded and processed into basic sentences, which the patient thinks of conveying. Once the eye blinks are recognized, they are converted into speech using the designed algorithm and output with the help of a speaker. This system relatively makes easy for the person who looks after the patient and he need not always be with patient and can do his, not worrying much about the patient. The entire system is implemented on Basys 2 FPGA kit.

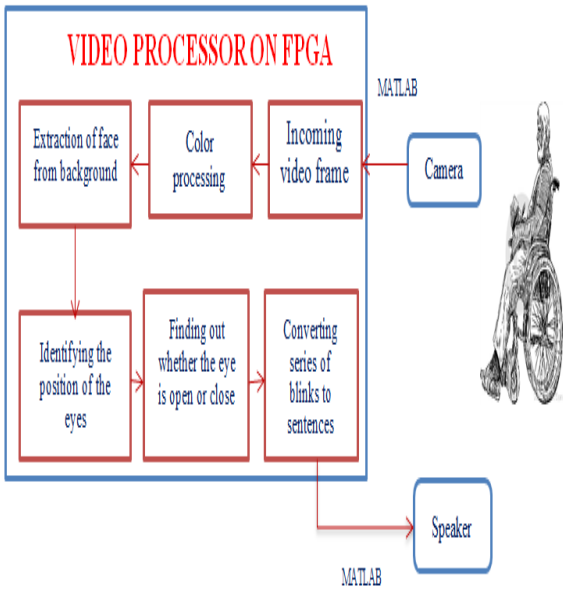

Fig 3. Block diagram for the video oculographic system

This proposed system is compared with the Viola Jones algorithm and by calculating time shows that this system takes less time compared to existing one.

VI. CONCLUSION

This proposed system aims at progressing the system which is less costlier when compared to others. The proposed algorithm is compared with the existing algorithm i.e., Viola Jones algorithm. The time obtained from the proposed system is 3.1095 seconds whereas the time obtained from Viola Jones algorithm is 19.620 seconds. Thus the proposed system is time efficient.

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