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An Efficient Eye Blink Identification Technique for Handicapped: Assisting System for Paralyzed and MND Patients

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Abstract

This paper aims to give an incredibly low evaluated gadget that peruses and changes over eye-squints from the patient to an all around acknowledged correspondence code-The Morse code. There are a couple of clinical issues that can provoke an individual getting debilitated or Locked-in-syndrome that restrains discourse or voice creation. Conditions, for instance, LIS, ALS and Cerebral Palsy are among the normal contaminations that impact talk. In all or most such cases, patient loses the capacity to speak with the outside world in a viable way despite the fact that his insight is generally unaffected. Some redid AAC contraptions have been developed that utilizes gesticulations from the patient and changes over them into an information that can be conveyed however such gadgets are extravagant and are for all intents and purposes far off for a great many people influenced.

Keywords: *Eye Blink, Arduino Uno, Morse Code, Motor neuron disease, IR Sensor Module, Embedded C, String Mapping, Video Oculography, Electro Oculography*

1. Introduction

In lately electronic devices are improving day by day and there demand is additionally improving. Smart phones, tablets are example of this. The system detects the attention blink and differentiates between an intentional long blink and a traditional eye blink. Tetraplegia may be a condition where people cannot move parts below neck. The proposed framework can be utilized to control and Communicate with individuals. Inside the ongoing years on account of the quick headway inside the innovation there has been an astounding interest of human PC or portable communication. Blink might be a fast activity of opening and shutting of the eyes. Detecting an eye blink is a crucial enabling component in various domains like human computer interaction, portable communication, human services, and driving security. For instance, squint has been utilized as an info methodology for individuals with incapacities to associate with PCs and cell phones.[1]

Speech disorders can be the consequence of an immense number of therapeutic infirmities due to brain hemorrhage, paralysis, stroke and a couple of various ailments. It can result from harm to brain or spine during casualty and leave an individual totally incapable to impart. Data from several research suggests around one million people in several nations have fragmented or complete incapacity of language explanation realized by cerebrum hurt, normally from stroke. Since speech can be the aftereffect of countless ailments, the specific number of individuals experiencing discourse hindrance isn't all around recorded and is hard to gauge effectively. However, there is little uncertainty that the number is extremely huge and can reach out past any estimation.

The system detects the eye blink and differentiates between an intentional long blink and a standard eye blink. Tetraplegia could be a condition where people cannot move parts below neck. The proposed system can be used to control and

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Communicate with people. An open and shut eye template for blink pattern decisions supported correlation measurement is employed.[3] The practice was explicitly helpful for individuals who were seriously incapacitated. A continuous eye flickering recognition was propounded and bolstered with SIFT highlight following GPU based usage. [2] Barely any gadgets have been built up that can address this issue in a general and profitable way.[1] The advancement of a straightforward and savvy framework to help patients experiencing discourse issue has been the main goal of the paper.[1] The example and length of eye flickers are recorded, investigated and changed over to normal English letter sets utilizing the Morse code.[1]

A productive eye tracing framework is introduced in [1, 2] retaining an element of squint identification for controlling an annexation that gives an elective method for Communication for the individuals that are stuck by some sensibly serious physical inabilities the suggested framework utilizes eye ball for tracing the gesticulation of eyes.[3]

2. Related work

As per an overview, about 1 in each 7000 individuals suffer from paralysis. Completely incapacitated patients needs all day assistance. In any case, in these days, it is beyond the realm to supervise the patients all day. So they need an individual who takes care of impaired or patients suffering from paralysis.

"Augmentative and Alternative Communication Device Based on Eye-Blink Detection and Conversion to Morse-Code to Aid Paralyzed Individuals" - Kingshuk Mukherjee, Debdatta Chatterjee:-

This paper exclusively speaks about several medical disorders Which can raise in an individual where he or she gets paralyzed and can not communicate with the world in a viable way and have difficulties in producing voice or speech. The situations such as LIS or motor neuron disease. Since discourse debilitation isn't straightforwardly inconvenient to the prompt strength of the patient, it's frequently a somewhat ignored player in clinical gadget improvement. Barely any gadgets are built up that may address this issue during an all inclusive and cost successful way. There are a few Infrared sensor kits which can give great execution with this technique if properly adjusted.

Are the likely diseases that arises in an individual and causes a condition where they cannot express their basic requirements or thoughts to others through speech or expression. Therefore, this does causes distress to the individual and also to his care-takers. There are many devices based on augmentative. AAC that has been designed pointing on the situation mentioned above. But these devises but these devises nor affordable by the public who is effected as the are highly expensive. That is why we planned a model which can fulfil the requirements of the user of the device and it is comparatively very cheap as compared to other available devices.[1]

Many reasons like brain haemorrhage , stroke that causes paralysis that results in speech disorders. Data from research tells that one in one million people suffer from paralysis and this data is not accurate and there may be many more such people who cannot communicate with others and it is difficult to calculate the exact number. As speech disorder does not directly effect the health of the patient, so development of medical devices pointing this issue is ignored. Very less devices exists on this problem and they are not affordable ass well. Hence, designing an affordable system to the individual suffering from speech disability is the main aim of this paper. Technically depends upon Infrared technology where these Infrared Sensor is used to determine the status of the eye blink, weather the eyelids are closed or opened and a pattern from several blinks are observed to form a word or sentence that the user is trying to convey.[1]

"Review On Smart Eye Blink Solution For Mnd Patient" - Tambe Samreen Mohammed, Rajeshwari P :-
This paper illustrates the growth of technology in medicine field diminish the difficulties of patients to a immense extent. The patient has control only upon his eye blinks, the issues faced by MND patient is obtaining an answer day by day. It is that the evolution of technology in medical field can reduce the hardship faces by person receiving treatment. Motor neuron disease (MND) is one of such disease encountered by individuals which is the rare type of physical disability. The patients affected by MND are incapable to function unlike a normal human, for example they cannot walk, talk or communicate with generally with other in a viable way. Despite they need to be in a complete surveillance and to be handled with care which can not be achieved all the time. The is a wide view of various solutions or MND patients acquiring variety of enigma everyday. In this paper we have explained technically what has been used to resolve the difficulties faced by the patients. System to help the incapacitated to talk is by following eye movement.

EOG and VOG are two types of oculography that can be carried out to determine eye flickering EOG is referred to as Electrode Oculography and VOG- Video oculography. These methods are highly complex and real time implementation of this technique may be a difficult job and requires plenty of your time and this method isn't cost effective. an alternate to the current can be EOG. According to the recent survey the stimuli produced by the parts body which are likely not affected by the disease from patients can be used as an input so that we can draw a pattern of what they are trying to communicate. These signals can be obtained by ocular movement or brain stimuli which are generally not affected by the infection.

On the process of producing signals based on brain stimuli it is demanded to use of electrodes kept at different position of the head and obtain the performance of brain, which in-turn is converted in electronic pulses

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format and observed as Electro Encephalo Gram (EEG). This paper gives a literature review about smart blink solution for MND patient, which by researched are overcome with proposed method with greater accuracy and quick response compare to older techniques. [2]

"Development of Communication Support Application With Blinks" - Ippei Torii, Shunki Takami, Kaoruko Ohtani, Naohiro Ishii:-
This paper tells about the development of devices that can support the communication with eye blinks. Authors build a support framework for genuinely impeded youngsters to talk with others by a wink. due to limited capability to use their bodies and a ton of mental stress a lot of them cant speak with their parents and guardians. The indicated framework will help these incapacitated people to communicate exactly what they really want to convey to their steward. Debilitated youngsters with extreme mental handicaps tend not to have capacity of verbal correspondence, so they need some help devices to communicate their musings or requirements. There are many correspondence collaborator apparatuses called VOCA. Few frameworks for PDA like voice4u, TapToTalk have already been introduced which can be accessed by cell phones. genuinely impeded kids are characterized as kids with changeless disablements of their torso and appendages due encephalopathy, paralysis, genetic disease etc. These patients are often on their bed and have a very bounded torso activity, this causes difficulty in communication and to convey anything they are intended to. The best way to communicate with such incapacitated people is by using "Yes=○" or "No=×" templates. In this method steward of those patients should be able to prognosticate what patient is exactly trying to convey by considering previous circumstances and should be capable of understanding that and help the patient in every way possible in correspondence to the requirements.

The main moto of this study was to make use of modern technology of envision of data into lifestyle. A framework was generated for analysis and fact finding and for addressing the issues and put in an app to follow further steps. The goal is to increase the accuracy and speed of the framework for better and faster communication between a patient and his guardian. When a guardian successfully understand what his patient is trying to communicate with him using this framework, it will help us in knowing one another better. The incapacitated will also gain confidence to convey their thinking with one another regardless of their in-capabilities will hold up each other and steer the society.

3. Methodology

The flow diagram portrays the working of our framework. The Infrared sensor unit is centered around the eye with the assistance of a goggles or a VR or a comparable item fixed concerning the eye. The Light Emitting Diode concentrates the light on the eye which is thrown back and is identified by the sensor. The measure of reflected light fluctuates when the eyelid is shut and when eyelids are open and provides two distinct degrees of signs obtained which will be used to distinguish between an open and a shut eye. The normal time required for natural eye flickering is around one third of a second. Remembering that, Readings are taken ceaselessly at the pace of twenty every second and flown into an Arduino Uno microcontroller. Arduino Uno microcontroller was employed as it amazingly easy to understand, adaptable and in particular, budget affable.

The Infrared sensor transmits the analogue input to controller and controller contrasts it with a formerly set worth and decides whether the eye is shut or open dependent on the information esteem being lower or higher than the set worth. Embedded C program enfolds the blueprint of the commands that must be taken care of into the microcontroller. The principle part of the program manages the investigation of the deciphers got from the infrared sensor. A short flicker relating to a '.' and a more drawn out flicker to a '_' as per the regular Morse code. Aside from the standard letter sets and numeric, two additional order arrangements have been added for clear screen and compose a space. In the event that a match is discovered, it is shown onto a LCD. On the off chance that no match is discovered, at that point the LCD report as unrecognized flicker sequence. The flow diagram of the framework is disclosed below.

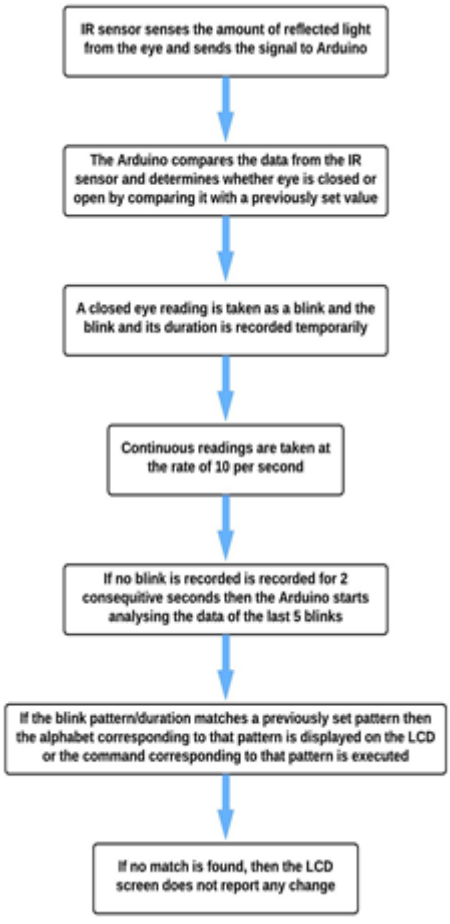

Image 1: System Flow Diagram

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In this framework we have followed an universally accepted Morse codes that represents the eye blink durations, which can be used for mapping those eyeblinks with strings which indeed are helpful in communication. The Morse code table is shown below.

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

Image 2: Morse-Code table

Figure mentioned below represents the hardware implementation of the system which includes Arduino Uno microcontroller connected with IR Sensor module which detects and synthesize the eye blinks and sends it to microcontroller for processing. Microcontroller is also interfaced with LCD monitor to display the mapped string and connected with speaker to obtain audio output which is an easier way for communication.

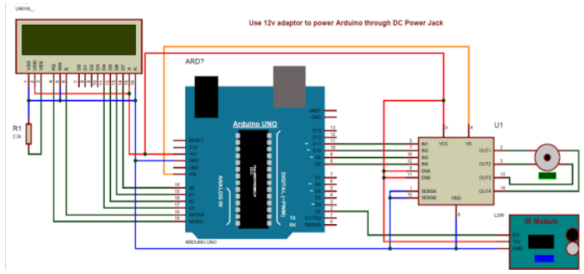

Image 3: Hardware Implementation(Circuit Diagram)

The algorithm or outline of source code for this framework is represented below.

I. READ output from IR sensor
II. COMPARE sensor output with threshold
  a. IF (output>threshold)
    i. SET status=0
  b. ELSE
    i. SET status=1
III. IF (status=0)
  a. TRACK number of progressive shut eye readings
IV. IF (status=1)
  a. TRACK number of progressive open eye readings
  b. IF (number>20)
    i. ANALYZE last 5 eye blinks (durations)
V. IF last 5 blinks fall into a pattern
  a. DISPLAY alphabet/numeric on LCD
  ELSE
  b. Take no action
VI. LOOP to 1

4. Results and Discussions

In the course of our trails, we noticed at first it needed some investment to become accustomed to the gadget and wrong passages were throughput in that period. The framework was broadly tried by us and furthermore on not many patients and it demonstrated incredible execution. We have connected exhibitions of how our framework functions. Patient required a training for a span of fifteen days to get the eye wink in a state of harmony with the pre stacked examples. Later we observed after a period of tutelage, the correspondence was amazingly smooth and speedy like our normal communication. Patient required different span time to grasp various strings and words. Time span varied from word to word because some had more specks shorter eye wink and few had more runs Longer eye wink. During the training time span the program can be dawdled to let patients get comfortable to the framework. After a degree of commonality has been accomplished, the code may be accelerated. Patient griped on a mean ten seconds to impart a string.

The pinnacle consistently stayed over 310 and the rift stayed underneath 275. A limit worth can be set at a point halfway between a pinnacle and a rift. A limit estimation of 290 was utilized for our tests and it gave fantastic execution.

A shut eye addresses a vertex in the graph and rift address an open eye. the efficacy on Y axis of the graph address analogue gesticulation obtained from infrared sensor. Harvest range for the shut eye rests between 325-395 and interval for a open eye is 220-275. IMG 4 speaks the same as described above.

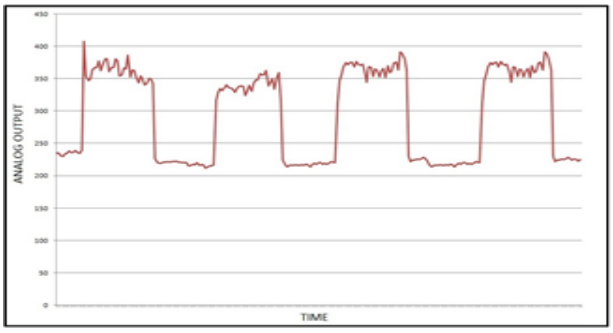

Image 4: Waveform for four equally space eyeblink

The following waveform represents the alphabet ‘A’ which is mapped according to Morse-Code table.

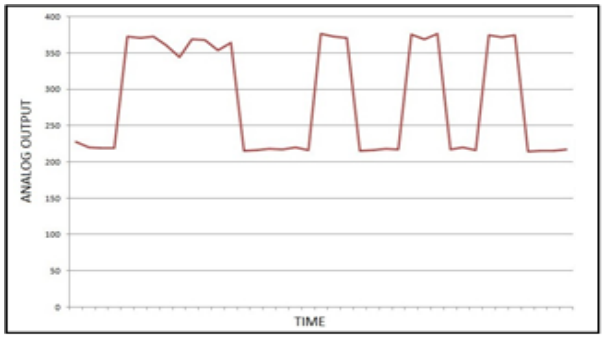

Image 5: Waveform for alphabet ‘A’

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The below mentioned waveform is for the string "NEED FOOD"

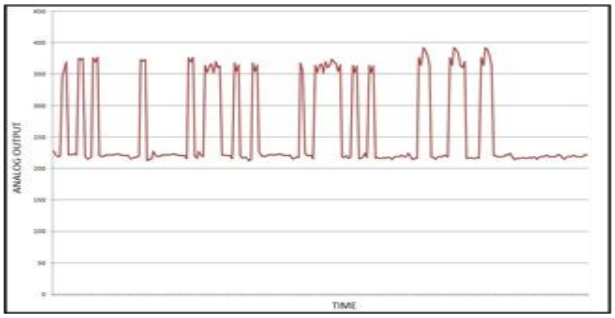

Image 6: Waveform for String "NEED FOOD" Snapshots

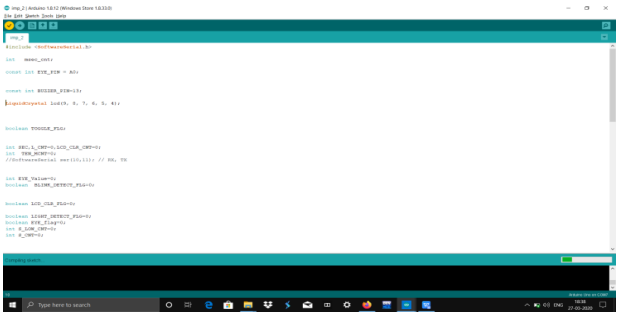

Image 7: Embedded C code for eyeblink detection

An Embedded C code is written to detects the eye blinks and determines whether the eye is closed or opened and also determines the long eyeblink duration and standard eyeblink duration and an unintentional eyeblink.

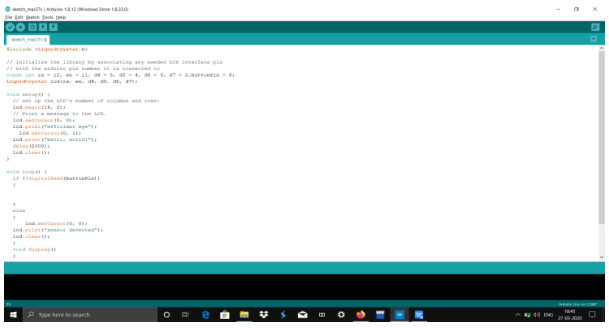

Image 8: Embedded C code for mapping strings

This picture shows a C code which processes the eyeblinks and maps the eyeblinks with the respective characters and the strings.

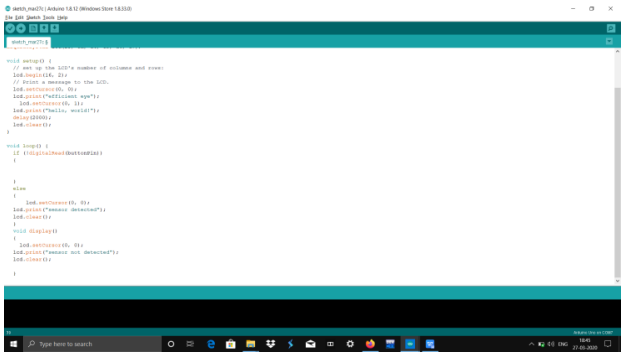

Image 9: Embedded C code for the string "Need Food"

The above snapshot represents a code that is mapped with an eyeblink sequence which represents "NEED FOOD" string. The graphical waveform of this is mentioned above in IMG. 6.

The outputs that are obtained after testing the system and experimenting in different situations are shown below in the form of snapshots. The LCD showcases the outputs that are obtained successfully after carrying out several tests.

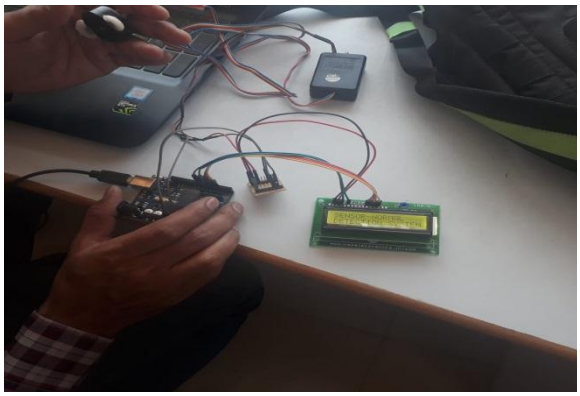

Image 10: Circuit connections of the system

IMG. 10 represents the interfacing and connections of the Arduino Uno microcontroller with LCD display, IR Sensor module and speaker.

Image 11: Sensing Eye Blink

IMG. 11 shows that the eyeblink has been detected by the sensor and is been sensed and processed by the Arduino Uno microcontroller and the mapping of the sensed eyeblinks with the respective string is under process and hence the LCD is displaying as sensing the eyeblinks.

Image 12: Output of the string "NEED FOOD"

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Image 13: Output of the Mapped string "TURN ON TV"

IMG. 12 and IMG.13 represents the output of the mapped strings along with their respective eyeblink sequences and durations. These outputs are obtained only when accurate sequence of eyeblinks are detected as per the predefined notations as per Morse-Code table mentioned in IMG. 2.

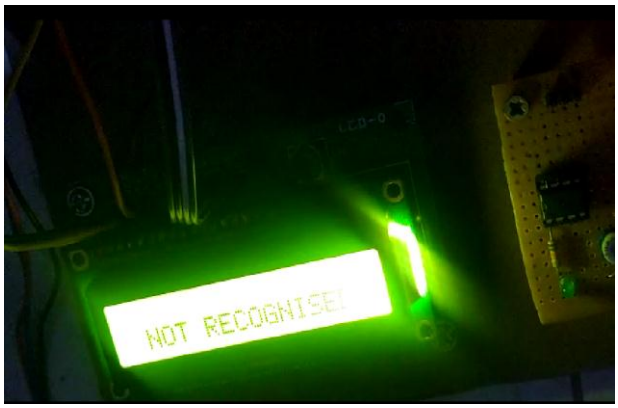

Image 14: Eyeblink not recognized

Above figure represents the output on the LCD screen that is obtained when IR sensor module doesn't recognize any eyeblink sequence or when a the eyeblink sequence detected doesn't match the predefined sequences.

5. Conclusion and Future Scope

The proposed system aims to bring out an answer for the paralyzed people with none harm to their body externally or internally. Use of Arduino UNO is simple and also developing tremendously within the market today. The tool had advantages over the older conventional tools.

- To form cost effective: the foremost objective of developing algorithm of a true time video Oculography system is that to produce cost effective for those who cannot afford. this system for such patients to speak is simply too costly. Thus, it's necessary to style a system which is affordable to folk which incorporates cost effective components for designing.
- Electrode less system: To develop a system during which the patient can communicate with none application of electrodes. Because this electrodes must be pierced to the skin of chassis which is extremely painful. Utilization of inert anode is the only strategy accessible as of now which is financially savvy however it's difficult and makes the patient reactive and this competence is excruciating as well.
- Speed: There are barely any method which are produced for video Oculography framework for correspondence. the chief focal point of our task is to build up a algorithm which is incredibly quick contrasted with the present ones.
- Precision: The premier focal point of our undertaking is to build up a method which is progressively exact contrasted with the present ones.

This proposed framework design utilises the basic Arduino Uno microcontroller and an IR sensor module for eyeblink detection and processing. Further this system can me enhanced and modernized using Raspberry microcontroller and VR for eyeblink detection which is a enhanced and more secured way for eyeblink detection. This system can also be upgraded using different methods of Image and video Oculography for better results and to increase the accuracy of the working system and several other enhancements can be initiated in the architecture design of this system for better results.

6. Acknowledgement

The completion and ultimate result of this project required a lot of direction and help from numerous individuals and we are incredibly privileged to have this up and down the fulfilment of our project.

We respect and genuinely express gratitude toward Professor Ananda Shankar for his help and direction which made us complete the project obligation.

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