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Electronic Assistance for Paralysed Using Eye Blink Detection

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ABSTRACT
The constant demand to improve daily living standards for paralysis patients serves as a motivation to develop newer technology. The task once performed by big traditional computers is now solved with smaller smart devices. Paralysis is defined as the complete loss of muscle function in any part of the body. It occurs when there is a problem with the passage of messages between the muscles and the brain. The main objective is to design a real time interactive system that can assist the paralysis patients to control appliances such as lights, fans etc. In addition, It can also play pre-recorded audio messages through predefined number of eye blinks and it also helps to alert the doctor or concerned person by sending SMS in case of emergency by using eye blink Sensor. The eye blink sensor is able to detect an intentional blink from a normal blink, which is useful for the paralysis patients especially Tetraplegic patients to regulate their home devices easily without any help.
Keywords - Eye blink sensor, Raspberry Pi, Twilio Module

I. INTRODUCTION

In the era of modern technology, automation is taking place everywhere. From Home to Industries, the blessing of automated system has improved the efficiency by a large magnitude. One of the great examples of the Automation System is the Home Automation. Some of the largest tech giants like, Google, Amazon etc. already have flooded the market with the smartest home automation systems. Though, the automation is meant for simplifying our daily life however, a very targeted group of people have always been overlooked by all of these companies. Therefore, we mainly focused on this group of people who are physically challenged or paralyzed. As, this group of people are physically challenged, they mostly rely on other people's assistance. Even, they have to rely on someone else for day to day tasks. Therefore, any innovative and effective home automation technologies can be a great help for the senior citizen, disabled people and paralysis patients. As mostly these patients have limitations on physical movement, they even cannot move their hands or even talk. Furthermore, there has not been any significant medical improvement to remedy this type of disability. Though, in many cases, physical exercises and proper medication can benefit the patient, but again thesis a very lengthy process and the success rate is very negligible. Consequences are lifelong physical disability. However, the only controls they have are their eyes. Therefore, we

decided to work on an automation technology, which they can control easily using their eyes.

The existing home automation systems are mostly designed and developed for general a person who has the access to any device by physical movement. This is not useful for a paralysis patient. Hence, to develop a home automation system for patients which could be used with least or minimal effort to control the home appliances such as light, fan, air conditioner and other communication devices for emergency sms and call. In this paper we have worked on a Home Automation Project mainly aimed for paralyzed people to develop an IR based eye blink sensor which will be used to control electronic devices as mentioned earlier. The solo purpose of our work is to make a sustainable and effective solution for people with physical disability.

Paralysis is the loss of muscle function in part of your body. It happens when something goes wrong with the way messages pass between your brain and muscles. It happens when something goes wrong with the way messages pass between your brain and muscles. Paralysis can be complete or partial. It can occur on one or both sides of your body. It can also occur in just one area, or it can be widespread. Paralysis of the lower half of your body, including both legs, is called paraplegia. Paralysis of the arms and legs is quadriplegia. A treatment plan and outlook for the condition will depend on the underlying cause of paralysis, as well as symptoms experienced. Technological

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innovations and therapeutic interventions may help you maintain your independence and quality of life. The symptoms of paralysis are usually easy to identify. If you experience paralysis, you'll lose function in a specific or widespread area of your body. Sometimes a tingling or numbing sensation can occur before total paralysis sets in. Paralysis will also make it difficult or impossible to control muscles in the affected body parts.

If you have partial paralysis, you'll have some control over the muscles in the affected body parts. If you have complete paralysis, you'll have no control over the muscles in the affected areas. Your paralysis may be temporary.

For example, Bell's palsy is a condition that can cause temporary paralysis of your face. Strokes can also temporarily paralyze one side of your body. With time and treatment, you may regain some or all of your feeling and coordination. Some people are born paralyzed. Others develop paralysis due to an accident or a medical condition. According to the Christopher and Dana Reeve Foundation, stroke is the leading cause of paralysis in the United States. It's responsible for nearly 30 percent of cases. Spinal cord injury accounts for an estimated 23 percent of cases. Multiple sclerosis causes an estimated 17 percent of cases.

The advancement of the technologies has always fascinated us. On the other hand, we also found that, there are not significant researches on automation devices for physically challenged or disabled people. Therefore, we started to look into the published papers and innovations around us. Now-a-days medical science improving day by day. On this developing procedure human beings innovating greater strengthen scientific accessories such as smart belt which locate patient respiration as well as electro dermal activity (EDA) sensors to sequentially display for physiology symptoms of seizures at night time. Medical operations are now getting easier. Newly developed high-tech gadgets implemented in patient's body to restore normal activities. Especially paralysis patients, such as Tetraplegic Patients who suffering a lot for their physical disabilities. It's now highly important to develop a system which may help paralysis patients like Tetraplegic Patients. Moreover, people are highly interested to digitize their daily life with less physical movement. To fulfill both requirements it's high time to develop a system which may help Tetraplegic Patients as well as people who are interested to use for efficient and comfortable life

After researching a lot in lab and over the internet, we found an Idea to develop such a system which may help a person to control any

appliance which we use in our daily life by less physical effort. We found a concept to develop such a system which we can use by eye blink to automate our home electrical appliance. Though, there are many prototypes developing earlier but most of them are not user friendly or not innovative solutions. The Project aims to develop a system eye blink based sensor for home automation which is compact hardware and simple to use for control home electricity appliance. This will also help to reduce electricity wastage and help a paralysis patient to control light and fan without any assistance of other person.

II. LITERATURE SURVEY
Now-a-days, the rapid growth of technology has made our PC become outdated. The tasks that once we used to do with PC are now being handled by mobiles or other smart devices. Introduction of network enabled devices or IOT devices have led to advanced home automation systems. However, the usage is limited for people with physical disorders as remote control of an appliance becomes difficult. In this paper the project is about for those people who are suffering from Paralysis (As example, Tetraplegia Patients) and the difficulties which they face while controlling home appliances. Tetraplegia Paralysis is brought about by harm to the cerebrum or the spinal line this patient; client needs to control the appliance. We try to take care of their issue utilizing eye blink sensor. An eye blink sensor is a transducer which detects an eye blink, and gives a yield voltage at whatever point the eye is shut. This project is about eye blinking for instance, in systems that monitor a paralyzed human so that he/she can operate home appliances, such as light, fan, Air Condition and so on. Also, this is connected with Android Smartphone Bluetooth radio, so that patients can communicate with others in case of emergency via sending text SMS, just by blinking their eyes.

D. Taneral, 2016. Presents **Drowsy driver detection system using Eye Blink patterns [8]** that is based on monitoring the changes in the eye blink duration. In addition to tracking the face and the eyes to compute drowsiness index Garcia has also presented a nonintrusive approach for drowsiness detection based on computer vision. It is installed in the car and it is able to work under real operation conditions. In this an IR camera is placed in the front of the driver, in the dashboard .In order to detect his face and obtain drowsiness clues from their eyes closure.

H.S. Prashanth, 2012. **Assistance for paralyzed using Eye Blink Detection [9]**, The main aim of this paper is to design a real time interactive system that can assist the paralyzed to control

appliances such as lights, fans etc. or by playing pre-recorded audio messages, through a predefined number of eye blinks. Image processing techniques have been implemented in order to detect the eye blinks.

DeepBose, BRAC University, Bangladesh, 2017. **Home automation with eye blink for paralyzed patients [10]**, The constant demand to improve daily living standards for paralysis patients or general people serves as a motivation to develop newer technology. The tasks once performed by big traditional computers are now solved with smaller smart devices. The study here talks about the development of a blink sensor device which used for automated home designs for disable people.

III. PROPOSED SYSTEM

This project is done in two stages 1) Electrical 2) Coding. The system consists of five major embedded electronics: Eye Blink sensor, Raspberry Pi, Relay Circuit, Electrical Bulb, Speaker. Here, Eye blink Sensor is interfaced with raspberry pi and based on input given to the raspberry pi the relay circuit will get activates and corresponding application will get executes The Reflective Optical Eye blink Sensor which can measure the intensity of IR bounced back on the eye or eyelid. As of its cheap price and availability it suits best for our needs. When the eyes are closed the reflection value gets lower than when the eye lids are open. Therefore, we can easily identify whenever the user closes the eyes for a specific interval. Additionally, we can also detect eye blinks. As eye blink is a natural process of human body, therefore, we specified a pattern to activate the system. Whenever the user closes the eyes for 4 seconds, the system identifies it as the start for taking action and gets ready. Otherwise it will take the eye blink as usual unintentional human behavior and the system will do nothing. Here the input will take after the system is ready to take the action after triggering the IR sensor and this system will work as per instructions.
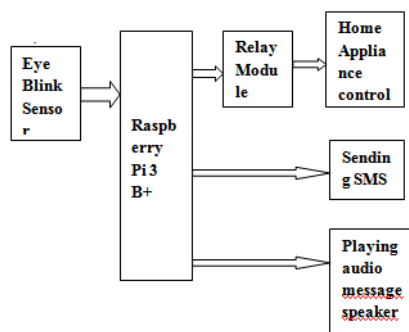

Fig. 1: Proposed system

Here the input is taken from eye blink sensor which is interfaced with Raspberry Pi . Based on input taken from the sensor the relay circuit will activate and corresponding application is executed. In our project, Our first application is glowing on the bulb which is home appliances controlling. The second application is sending SMS to assistant if he is not in home and this is implemented using twilio programming module. The third application is playing pre recorded audio messages if the assistant is not nearer to patient.

1) EYE BLINK SENSOR

This Eye Blink sensor sense the eye blink using is infrared, The Variation Across the eye will vary as per eye blink, If the eye is closed the output is high otherwise output is low. The eye -blink sensor works by illuminating the eye and eyelid area with infrared light, then monitoring the changes in the reflected light using a phototransistor and differentiator circuit. The exact functionality depends greatly on the positioning and aiming of the emitter and detector with respect to the eye. The eye blink sensor is an IR based blink sensor. If the eye is closed, it means the output is high otherwise the output is low. Here the input is sampled three times per blink; these input blinks are classified as a short or long blink. Since eight appliances are being controlled simultaneously (which is also equal to 23 appliances), three blinks are used to control the appliance.

2) RASPBERRY PI

The Raspberry Pi 3 Model B+ is the latest product in the Raspberry Pi 3 range, boasting an updated 64-bit quad core processor running at 1.4GHz with built-in metal heat sink, dual-band 2.4GHz and 5GHz wireless LAN, faster (300 mbps) Ethernet, and PoE capability via a separate PoE HAT.

The Raspberry Pi 3 Model B+ maintains the same mechanical footprint as both the Raspberry Pi 2 Model B and the Raspberry Pi 3 Model B. Adafruit made/brand cases will still fit but some other cases may not, especially ones that depend on component location or have a built in a heat sink.

3) RELAY MODULE

A relay can be termed as different type of switch which can be operated electrically. Generally, relays are mechanically operated as switch using an electromagnet and these types of relays are termed as solid-state relays. There are various types of relays and are classified based on various criteria such as based on operating voltage, based on operating technology, and so on. Various types of relays can be listed as latching

relay, mercury relay, reed relay, Buchholz relay, vacuum relay, solid state relay, and so on. Before discussing in detail about types of relays, let us discuss how relay works.

4) TWILIO MODULE

Using Twilio's REST API, you can send outgoing SMS messages from your Twilio phone number to mobile phones around the globe. A SMSAPI is well-defined software interface which enables code to send short messages via a SMS Gateway. As the infrastructures for SMS communications and the internet are mostly divided, SMS APIs are often used to 'bridge the gap' between telecommunications carrier networks and the wider web. SMS APIs are used to allow web applications to easily send and receive text messages through logic written for standard web frameworks.

With phone numbers available in over 30 countries, Twilio's inventory lets you pick the right numbers with the right capabilities for your project. For every message to reach its destination, a lot has to go right. We don't leave that up to chance. Twilio handles ever-changing telecom logic and carrier specific rules to ensure your message reaches its destination.

5) INTERFACING
EYE BLINK SENSOR WITH RASPBERRY PI 3B+

The circuit diagram for connecting Raspberry Pi with IR based eye blink sensor is shown below. As you can see the circuit diagram is very simple. We have directly powered the IR module from the 5V and Ground Pin of Raspberry Pi. The Vcc pin of eye blink sensor is connected to second pin of raspberry pi and the ground pin of eye blink sensor is connected to ground pin of raspberry pi (i.e to 14th pin). The output pin of the IR based eye blink sensor module is connected to the GPIO18 of Raspberry Pi.

Interfacing Eye Blink Sensor with Raspberry Pi

Since the GPIO pins of Raspberry Pi are 5V, a current limiting resistor is not mandatory. The whole circuit is powered by a 5V mobile charger through the micro USB port of the Raspberry pi. Eye blink sensor has an operating voltage of 5v DC regulated and operating current of 100 mA and gives the TTL level as output data level. The eye blink is indicated by LED and gives high output pulse. It also gives and instant digital output signal for directly connecting to microcontroller and it maintains very compact size.

RELAY MODULE WITH RASPBERRY PI 3B+

The circuit diagram for connecting Raspberry Pi with Relay module is shown below. As you can see the circuit diagram is very simple. We have directly powered the relay module from the 5V and Ground Pin of Raspberry Pi. The positive pin relay module is connected to fourth pin of raspberry pi and the ground pin of relay module is connected to ground pin of raspberry pi (i.e to 34th pin). The control pin of the relay module is connected to the GPIO12 of Raspberry Pi.

Interfacing Relay Module with Raspberry Pi

Since the GPIO pins of Raspberry Pi are 5V, a current limiting resistor is not mandatory. The whole circuit is powered by a 5V mobile charger through the micro USB port of the Raspberry pi. The relay switch connections area usually labelled as com, Normally closed and Normally open. Common is the moving part of the switch. Normally closed, COM is connected to this when the relay coil is off and Normally open, COM is connected to the switch when the relay coil is on.

## IV. SOFTWARE SOLVENCY
ALGORITHM

This is a step wise procedure of how the eye blinks are captured and applications run one after the other through eye blink sensor. The software code written in the raspberry pi3 B+ according to this algorithm. The software program used in this raspberry pi is python.

Step1: Patient will provide the intentional eye blink to operate the system by IR based eye blink sensor.
Step2: Blink duration is counted through Raspberry Pi.
Step3: If blink duration ranges in between 1sec to 3sec then increment the count value
Step4: If patient starts another blink then go to Step2 or else pass the count value.
Step5: Based on the value of count the applications are executed.

Total number of blinks	Applications Executed
1	Electrical Bulb will glow on
2	The SMS will be sent to the assistant mobile
3	It will play pre recorded audio messages

Based on the intentional blinks, the count value increases and the corresponding application gets executed. If the count value is one, then the home appliance(bulb) will glow and if we repeat the same the bulb gets off. If the count value is two, then the SMS will be sent to the assistant mobile. If the count value is three, the pre recorded audio messages will be sent.

FLOWCHART
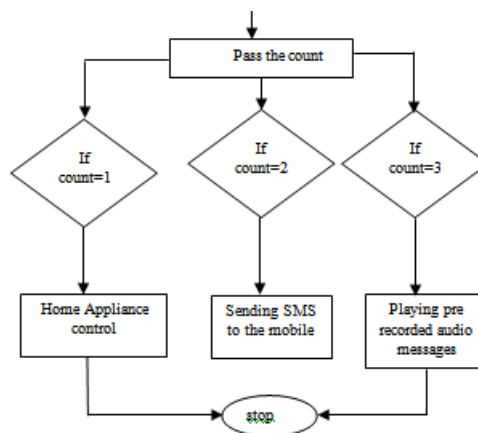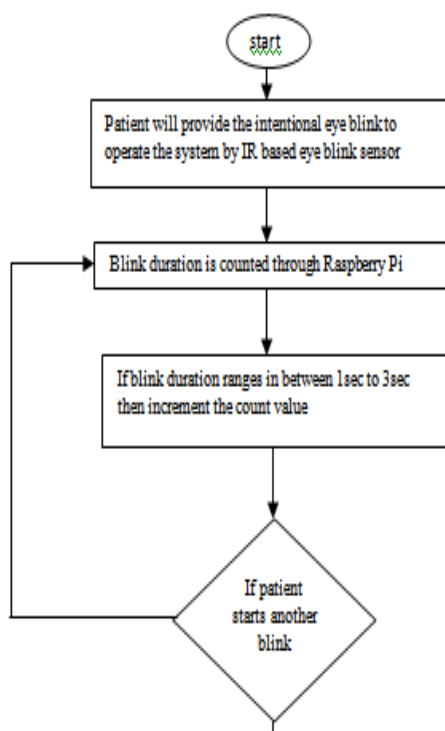
CALCULATING TIME LAPSE

Time lapse is calculated by taking input from the eye blink sensor where the input value is stored in variable "i". The starting time of blink value is stored in "s1". When the eye is opened, it is considered as the ending time and it is stored in "s2". Hence the difference is calculated which gives the blink duration. If the blink duration ranges between 1sec to 3seconds it is considered as intentional blink where the "count" value gets incremented. The applications get executed according to the "count" value.

CONTROLLING HOME APPLIANCES

Based on the control pin of relay circuit given to the raspberry pi, the switching action get performed. In the program, electrical bulb is taken as the application which can controlled using relay module. Initially the output is set to 0,whenever the "count" value becomes "1" the relay gets high and also when the same action is repeated the variable "l" value changes and the output is set to low.

SMS SENDING THROUGH TWILIO

Twilio is a developer platform for communications. Software teams use Twilio APIs to add capabilities like voice, video, and messaging to their applications. This enables businesses to provide the right communications experience for their customers. Behind Twilio APIs is a Super Network, a software layer that connects and optimizes communications networks around the world. This is what allows your users to reliably call and message anyone anywhere. With Twilio, you can reach customers in the ways they prefer, and engage with them effectively using context related to that interaction. Twilio has taken the global telecom network and turned it into a cloud communications platform with these capabilities and more: API and SDKs to build calling capabilities within web and mobile apps. Connect to landlines, mobile devices or even WebRTC clients to make calls from apps or power multinational call centres.

V. RESULTS

After complete assembly and dumping of code into Raspberry Pi a prototype of Electronic assistance for paralyzed is made which can be able to control the home appliances through their eye blinks. It can also play pre recorded audio messages and also send sms to assistance if he is not nearer to patient.
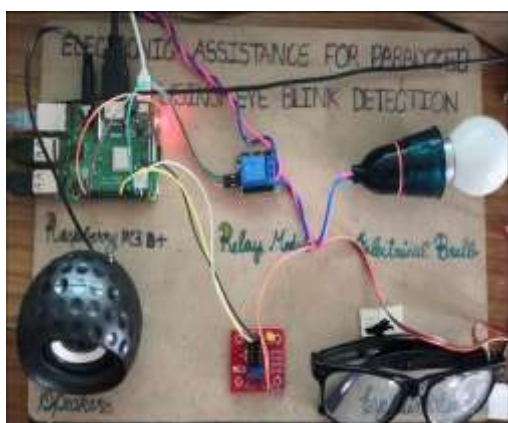

Fig 5.1 Electronic Assistance for Paralyzed using Eye Blink Detection

Figure 5.3 Application 1 'Bulb glows on'

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BIOGRAPHY

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