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EYE CONTROLLED WHEELCHAIR USING BRAINWAVES WITH HOME AUTOMATION AND ALERT

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Abstract - *The purpose of this eye-controlled wheelchair is to eliminate the assistance required for the disabled people. In this system controlling of wheelchair depends on eye blink and using a joystick. Eye controlled wheelchair is to enable paralyzed patient as well as elderly to make their life more accessible. People who are unable to walk and are using wheelchair exert great amount of energy using physical strength to turn the wheels. This wheelchair provides flexibility to choose different modalities to command the wheelchair, in addition to be suitable for people with different levels of disabilities like partially paralyzed, by birth disabilities, accidental injuries etc. Users can command and control the wheelchair based on their eye blink. Also, the user can control some of the home appliances. An alert message is passed to the relative's mobile whenever there is an emergency. This device is capable of lighting the room by using Node MCU.*

Key Words: **Wheelchair, Eye blink, Joystick, Alert Message, Node MCU**

1. INTRODUCTION

There are millions of disabled people in this world who are always in need of helping hands. Independent mobility reduces the dependence on caregivers. Disabled people always find themselves challenging to go out independently because of their physical deficiency or inability to move in a normal fashion. A wheelchair is a mechanical device which improves the lifestyle and increase the mobility of disabled people, allowing them to explore their surroundings. As all the people cannot use the traditional electric wheelchair, there should be some communication between the user and wheelchair to control it. It is very difficult for the disabled user to drive the wheelchair with their arms [1]. However some people really feel difficult to manipulate the direction of wheelchair with hands because of paraplegic, old age, handicapped. If there is a partial disability due to any limb malfunction, the person feels a certain degree of restriction to develop as per best of his or her capabilities. In this case the patient is unable to navigate through the arena i.e. workplace or home, even in worst cases hands or legs may be partially or completely paralyzed. Hence we have made an effort to develop a prototype wheelchair to overcome all those. As there are various techniques to control the electric wheelchair, e.g. voice recognition technique, EMG signal technique. There is at least one disadvantage for each technique i.e. in the case of voice recognition and guidance technique it is not applicable for dumb people and it is also not applicable in noisy areas.

In this proposed work, we control the wheelchair using brain sense and also with a joystick. This control system will drive based on movement of eye blink of the user. In this type of controlling mode the user can look around the surroundings freely during the navigation to their goal point. We have also incorporated home automation and alert system to help the patient.

2.RELATED WORK

Several studies had been conducted for analyzing the number of people in the wheelchair and the consequences of placing them in a conventional wheelchair. By promoting the independent mobility, it develops the feeling of self-reliance by reducing dependence of any assistant. A person having any difficulty in functional mobility suffers from aloofness as they decrease their participation from various social activities that lead to cause stress, isolation and fear of negligence. Manual forms of wheelchairs are designed in such a way that it offers mobility for those individual having physical impairments [2]. Basically for rotating the wheelchair one should apply a minimum amount of energy to achieve the goal. In order to reduce the physical strength for a weak patient many

researchers have used technologies to develop power wheelchairs. Our project is designed in a different way such as assuring safety travel, we are implementing alert system in case of emergency, control the home appliance while sitting on the wheelchair itself. This paper is about wheelchair that makes disabled people life more comfort, simple and independency which pay to the development of a modern society.

3.PROPOSED WORK

The aim of this project is to help physically challenged people to move without assistance, control various appliances in his/her house and alert relative in case of emergency.

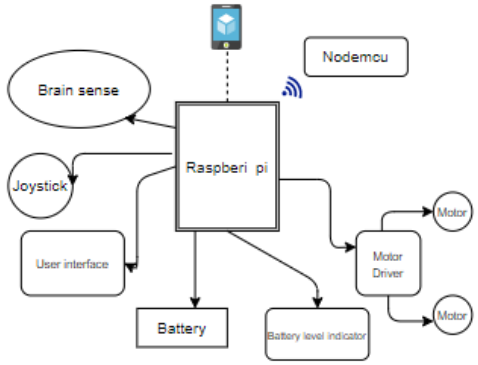


Fig-1: Overall Block diagram

This project uses Raspberi pi 4, Arduino, geared dc motors to create movement of wheelchair. The patient can move either using eye blinks or by using joystick. The user can select the mode of control .The eyeblink is captured by the Brainsense [3]. The GUI is designed in such a way that the user can easily identify and operate the chair.A touchscreen is used as the control interface. A battery level indicator is used to indicate battery level. Home automation is achieved through the control interface. Communication takes place through Wi-Fi over MQTT Protocol. It reduces human efforts by controlling the appliance from the place we are in.An app is developed to receive alert messages sent from the wheelchair to inform relatives in case of emergency.

4. HARDWARE DESCRIPTION

The hardware consists various components such as Raspber pi 4, Arduino mega, L298N motor driver; gear motor, Brain sense, Joystick.

4.1 Geared Motor

A geared motor is used to produce high torque sufficient to carry load. This is achieved by an integrated series of gears or a gearbox (arrangement of gears) which is being attached to the main rotor and the shaft through a second reduction shaft. This is then connected to a series of gears or gearbox to create a series of reduction gears.

Fig:2-Geared DC motor

4.2 L298N Motor Driver

Motor drivers acts as an interface between motors and control circuits .Control circuitry works on low Current whereas motor requires high current so it is the function of the motor driver to convert the low Current control signals into high current signal. In this project L298N motor driver which is a low current driver is used.L298N board is a dual motor driver which help to interface motors which draw up to 2A of current.

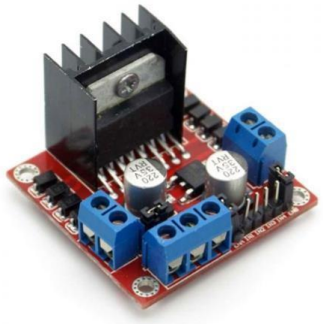


Fig 3. Motor driver

4.3 Brainsense

The brain sense safely measures and outputs the EEG power spectrums (alpha waves, beta waves, etc), esense meters (attention and meditation) and eye blinks. The device consists of a headset, an ear-clip, and a sensor arm. The headband reference and ground electrodes are on the ear clip and the eeg electrode is on the sensor arm, resting on the forehead above the eye. It uses a single AAA battery with 8 hours of battery life.

Fig 4. Brainsense

4.4 Relay

A relay is a switch which can be electrically operated. The need of relay is when it is necessary to control a circuit by an independent low power signal or many circuits can be operated by one signal. It has a set of input ports for a single or multiple control signals.

4.5 NodeMCU

NodeMCU is a low-cost open source IoT platform. It comes with ESP8266 WiFi Module which is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. It communicates over MQTT protocol, which is widely used in IoT (Internet of Things) embedded applications, where every sensor is

Fig 5. NodeMCU

Connected to a server and we have access to control them over the internet.

4.6 TFT Display

TFT stands for Thin Film Transistor. TFT (Thin-Film-Transistor) Liquid Crystal Display is a thin display type, where a transistor embedded into each crystal gate; these transistors are then printed on thin-transparent film. The technology was designed to improve image qualities, such as contrast and addressability.

Fig 6.TFT Display

5. CONTROL INTERFACE

A touchscreen is used as the control interface. The user can select mode of control. The wheel chair is controlled either using eyeblink or by joystick. The GUI is very user friendly. It has also provision for selecting various operations like home automation, and alert passage. The battery level is indicated on the screen when the battery icon is pressed.

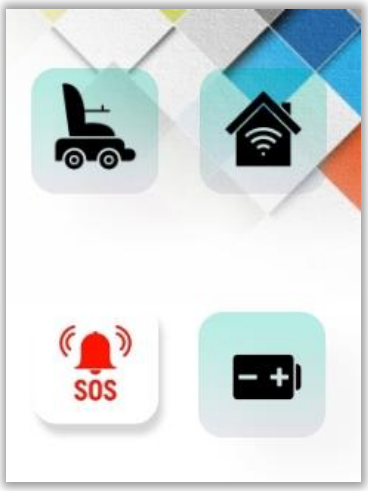


Fig 7.Control Interface

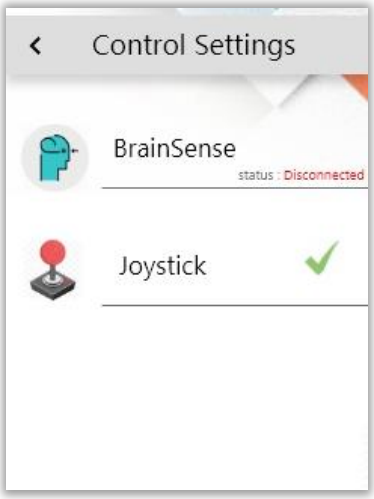


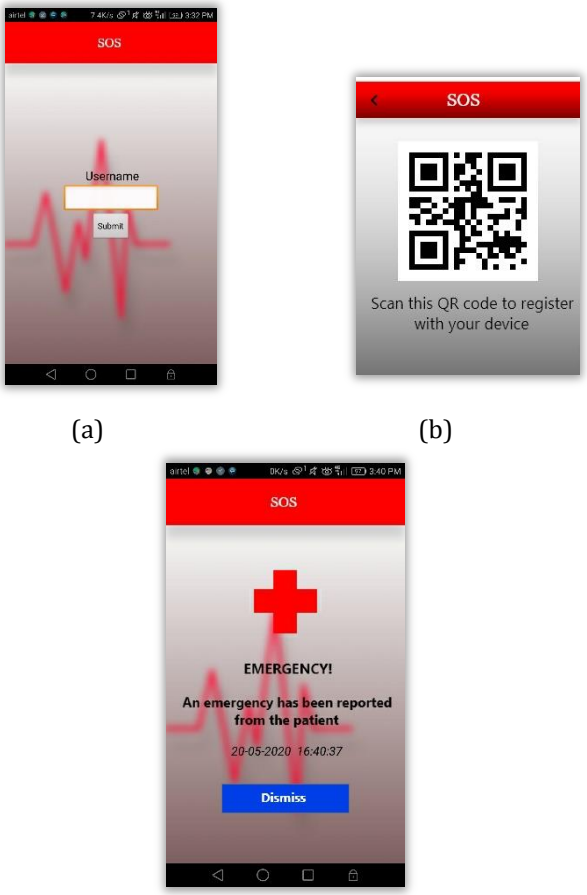
Fig 8. Selection of mode of control

6. MOTION USING BRAINWAVES

With the help of Brain computer interface it serves as an efficient assistive technology that can help disabled people in their routine life. The wheel chair can be started and stopped by the eye blink movements. The patient can move from one place to another by blinking eyes which is detected by using EEG signals in the brain. This allows the user to control the direction for four movements left turn, right turn, forward and backward movement, of the wheel chair. Therefore the BCI system is used to improve the quality of life of such disabled patients [4, 5]. Brain sensor senses whether the eye is open or closed. For every indication there will be respective movements.

7. EMERGENCY ALERT

This feature is added in order to ensure the patient's safety. If the patient is feeling any sort of discomfort he/she can pass the predefined messages to their relatives which is done by using this alert system. So that they can take necessary actions at the right time itself. Raspberry pi is used to control the whole system. On the LCD display there are many icons such as battery level indicator, home automation, Save Our Ship (SOS). Here push notifications pops up on the relative phone as soon as the patient presses on the SOS. On clicking the SOS icon, pi recognizes some action had taken placed. Based on the programming what we have done it will passes the specified action to the server which is a firebase. Firebase is a Baas (Backend as a service) which comes as a start-up and became a next generation app development platform on Google Cloud [6].



(a) (b)

(c)

Fig 9. Steps for sending alert message

There are various steps for configuring the app. The relative must install the app and he should register his name as shown in fig (a).Then he should scan the QR code displayed on the screen of the wheel chair as in fig (b) to complete the configuration. Now, the relative shall receive only the alert from the registered wheel chair. When the patients press the SOS icon a message as shown in fig(c) is displayed.

8. HOME AUTOMATION

Home automation takes place by the use of NodeMCU, through Wi-Fi over MQTT protocol. It is designed as a lightweight messaging protocol that uses publish/subscribe operations to exchange data between clients and the server.

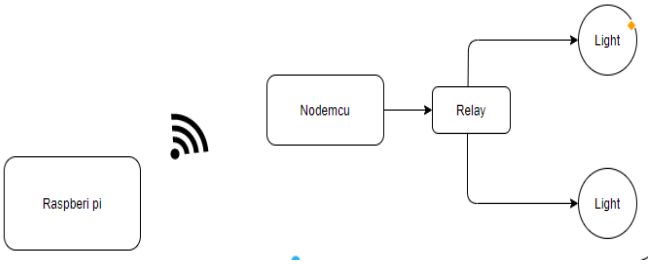


Fig 10. Schematic of home automation

Control Messages are published by the Raspberry Pi under a Subscribed topic. The MQTT Client module of NodeMCU is as according to version 3.1.1 of the MQTT protocol [7]. In MQTT broker (server) contains topics. Clients act as a publisher and send messages from brokers. When a client publishes to a topic, the data is sent to the broker, which then is distributed to all the clients that are subscribed to that topic.

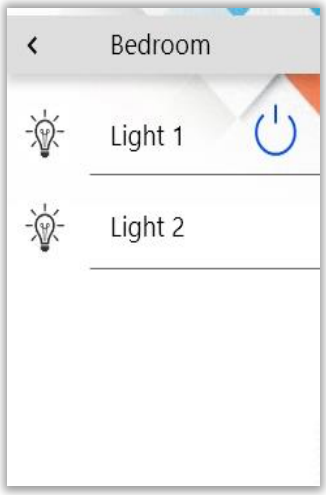


Fig 11. Control interface for home automation

The subscriber client will listen for incoming messages from the subscribed topic and react to what was published to that topic, such as "on" or "off"[8, 9].
This implementation provides an intelligent, comfortable and energy efficient home automation system. It also assists the old and differently abled persons to control the appliances in their home in a better and easier way.

10.RESULT

It is an overall implementation of the proposed hardware system. We have successfully designed and made a prototype of the proposed design. The figure. 11 shows the front and side view of the wheel chair we implemented.

Fig:11-Prototype of wheel chair

11.CONCLUSION

The implemented system will be allowing the disabled persons to control the wheelchair movement without the assistance from other persons. Raspberry Pi is the latest of the technologies available in the modern world. But what makes Raspberry Pi special is that it has its own Operating System, thereby reducing the circuitry on the person's body. Cost also reduces a lot compared to other systems [10]. Therefore, this method works as a boon for disabled persons. Also with the help of joystick the entire operation of the wheelchair can easily perform. Self-Reliance is what we want to reinstate in disabled persons. We have developed a wheelchair system which enables the disabled patient to move their wheelchair independently in their own direction.

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