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Controlling Smart Home with Brain and Computer Interface

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Abstract

Paralysis is one amongst the major neural disorder that causes loss of motion of one or more muscles of the body, wherein depending on the cause, it may affect a specific muscle group or region of the body, or a larger area may be involved. In pursuit of rehabilitation, the eye can be regarded as one of the organs that can help a paralyzed person to communicate suitably. Eye movement can be used by the paralysis patients and armless persons to perform simple tasks.

INTRODUCTION

Types of disabilities:

Disability is a situation and inability compared to the normal humans. Mainly it includes various functionality including physical, sensory, cognitive, intellectual illness, and various types of never-ending disease. Mobile devices have been a great aid to such people but interaction with mobile devices by disabled people can be a really challenging task. This chapter discusses a low cost EEG based mobile application for the disabled people to perform various tasks. Let us quickly have a look of various types of disabilities for which this m-learning based system can be helpful. There are various types of disabilities ranging from partial to full disabilities like Mobility and Physical Impairments, Spinal Cord Disability, Head Injuries - Brain Disability, Vision Disability, Hearing Disability, Cognitive or Learning Disabilities, Psychological Disorders, Invisible Disabilities cognition etc.

Background

Healthy mobile users uses device keypad to send a text message or a remote control to change the TV channels or to control home appliances but it becomes very difficult and almost impossible for the disabled person to use mobile device or remote control. An effort has been made in the direction to use simply the brainwave frequencies to fulfill the task. Nowadays, many handy low cost EEG hardware are available with wireless connectivity like Bluetooth and access to raw brainwave is also possible. There are many popular products from Neurosky and Emotiv which allow access and measurement of various brainwaves to analyze them for research and development. Emotiv EPOC and Brainband/B3 Band are few of the popular and widely used products among universities and research institutions.

About Brainwaves

There are mainly alpha, beta, gamma and delta brainwaves available all the time having some significant EEG power based on the current state of the humans. Brainwave frequencies range from 0 Hz to 30 Hz and more. Researchers have recognized various states of mind based on the frequency measured. Delta Brain Waves ranges from 0.5 to 4Hz, Theta Brain Waves ranges from 4 to 8 Hz, Alpha Brain Waves ranges from 8 to 13Hz and Beta Brain Waves ranges >13Hz.

Electroencephalography (EEG) is the recording of electrical activity along the scalp. EEG measures voltage fluctuations resulting from ionic current flows within the neurons of the brain. In clinical contexts, EEG refers to the recording of the brain's spontaneous electrical activity over a short period of time, usually 20–40 minutes, as recorded from multiple electrodes placed on the scalp. Diagnostic

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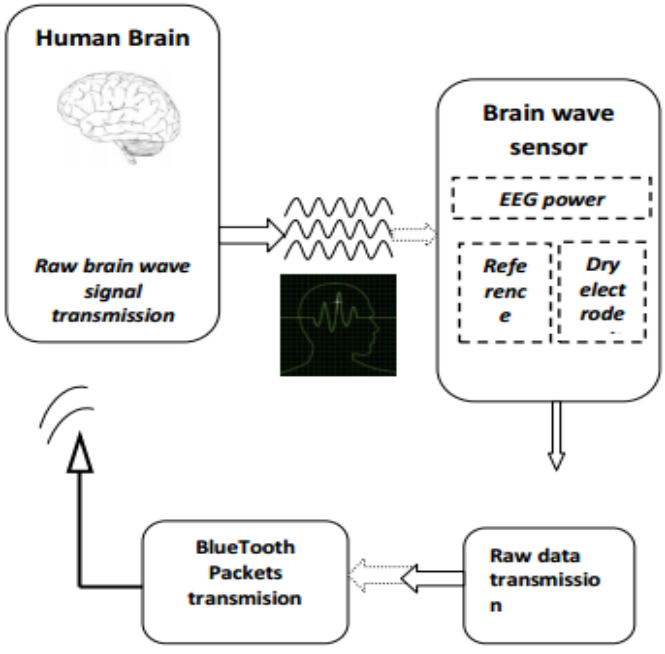
applications generally focus on the spectral content of EEG, that is, the type of neural oscillations that can be observed in EEG signals.



Brain computer interface section

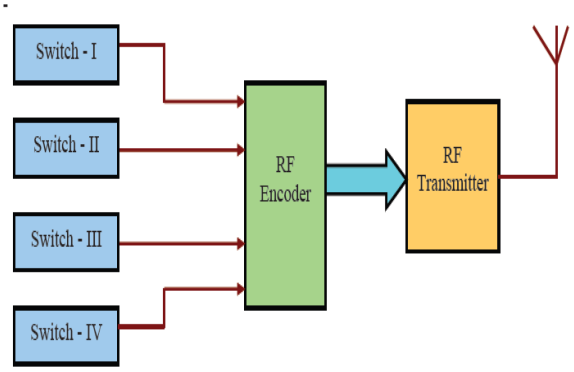
Existing method

Controlling industrial / home appliances is a very interesting and useful project. This project is designed to control up to four electrical appliances. This project used popular RF encoder and decoder IC's.

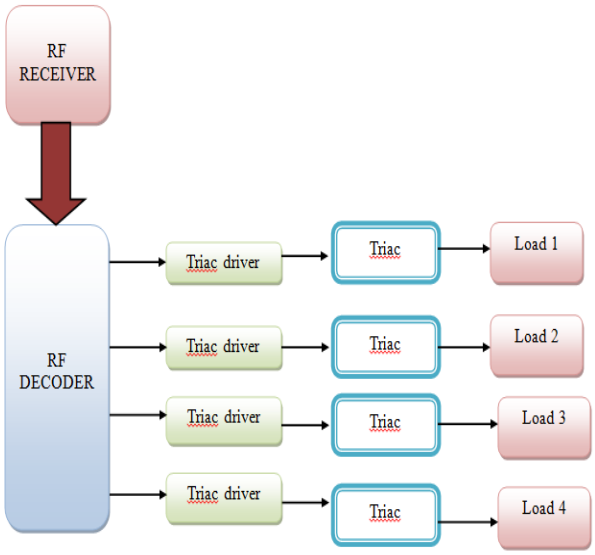
Four Switches are connected to the RF Encoder. This encoded data is transmitted through a RF transmitter module. In the receiver side, the RF receiver module receives the encoded data and decodes using an RF Decoder. This decoded output data is given to triac driver. Loads are driven through triacs. Up to 7A load can be connected to these loads.

Block diagram

Transmitter



RECEIVER:



Draw backs

Few patients who are unable to move their hands cannot operate the loads through above mentioned procedure.

Proposed method

This project describes the acquisition and analysis of Eye blink signals for activation of home appliances for paralysis patients. The proposed method here uses a minimum number of electrodes for signal acquisition thereby reducing the occurrence of artifacts, further following a simple circuitry for implementation of signal conditioning which is also cost effective from the user point of view.

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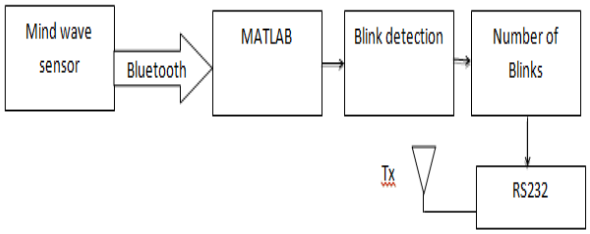
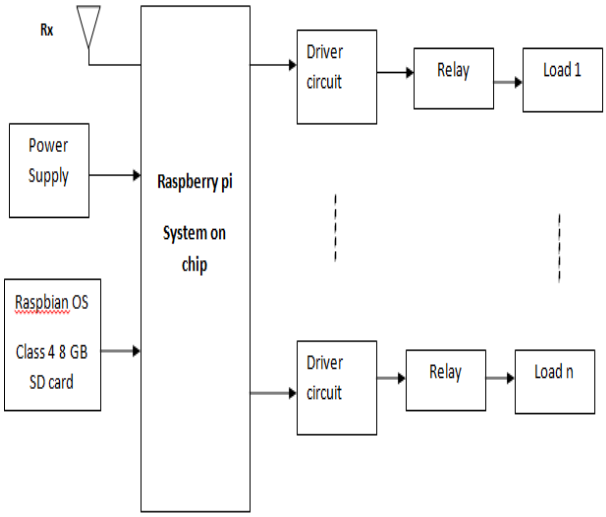
The standing potentials in the eye can be estimated by measuring the voltage induced across a system of electrode placed middle the eyes as the eye-gaze changes, thus obtaining the blinks. And this blink signal can be used as an input for a MATLAB in PC and perform classification and interfacing to microcontroller in order to control home appliances through RS232.Here we are using Raspberry pi as heart of entire system.

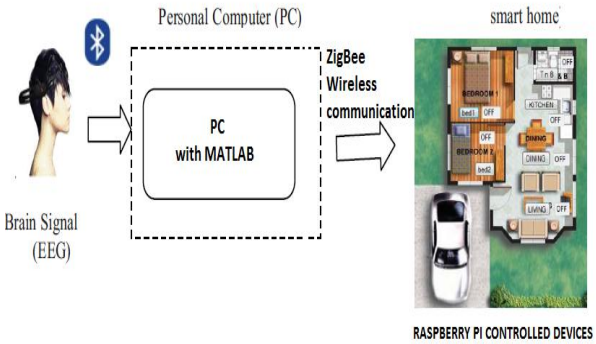
Block Diagram:





The aim of this project is to acquire and identify the EEG signal that is related with the user intention to operate a device in the smart home. Hence for event detection it is necessary to have a unique profile for each user to map the user's brain patterns. In this study we have used a simple feature i.e. an eye blink to create an event. So whenever the user will blink, signal will be activated. While wearing the sensor it takes the potential difference between two electrodes placed in two different places near brain.

Architecture



RASPBERRY PI CONTROLLED DEVICES

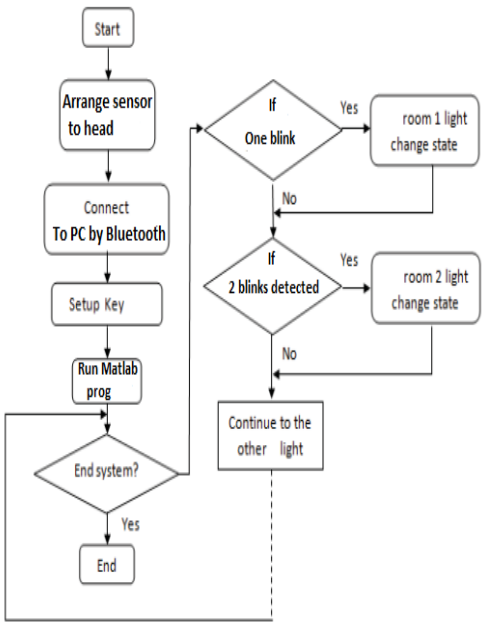
Advantages:

- Ease of operation
- Low maintenance cost
- Fit and forget system
- No wastage of time
- Durability
- Accuracy

Applications

- Hospitals
- Local monitoring applications
- Designed for Home and Clinical Applications

Flow chart of event detection and control in a smart home



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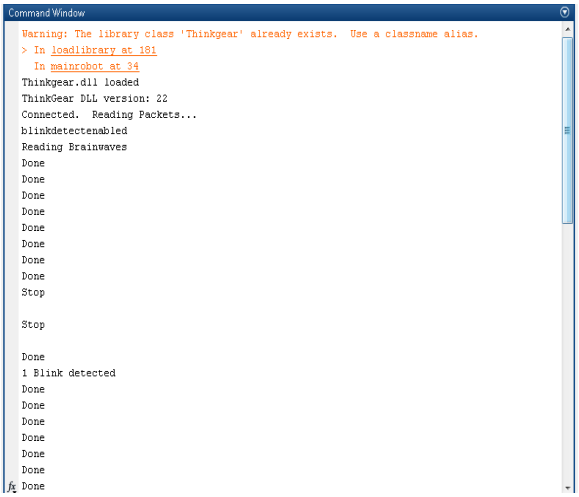
Window displaying the output of blinks



CONCLUSION

By using sensor, automation is being achieved. Experimental work is done carefully. This project is implemented using advanced Raspberry pi. The preliminary results show a thought controlled smart home system can become a reality in the near future. It will result in a drastic change in the type and quality of life of individuals and disabled and elderly people. In addition it will also result in an increase in demand of consumer electronics devices that can be easily interfaced with systems.

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