

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI-590014**



**Mini Project Synopsis on
“BRAIN-CONTROLLED HOME
AUTOMATION”**

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1.ABSTRACT

A brain-computer interface (BCI) is a new communication channel between the human brain and a digital computer.

The ambitious goal of a BCI is finally the restoration of movements, communication and environmental control for handicapped people.

An electroencephalogram (EEG) based brain-computer interface was connected with a Virtual Reality system in order to control a smart home application.

It offers an alternative to natural communication and control. It is an artificial system that bypasses the body's normal efficient pathways, which are the neuro muscular output channels.

Different brain states are the result of different patterns of neural interaction. These patterns lead to waves characterized by different amplitudes and frequencies.

This neural interaction is done with multiple neurons. Every interaction between neurons creates a minuscule electrical discharge. This project deals with the signals from brain.

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The signal generated by brain was received by the brain sensor and it will divide into packets and the packet data transmitted to wireless medium (blue tooth).

the wave measuring unit will receive the brain wave raw data and it will convert into signal using MATLAB GUI platform. Then the instructions will be sending to the home section to operate the modules (bulb, fan). The project operated with human brain assumption and the ON/OFF condition of home appliance is based on changing the muscle movement with blinking.

2.INTRODUCTION

Brain computer interface or mind machine interface is a computer-based system that acquires brain signals, analyzes them, and translates them into commands that are relayed to an output device to carry out a desired action .

A BCI is a computer-based system that acquires brain signals, analyzes them, and translates them into commands that are relayed to an output device to carry out a desired action. Thus, BCIs do not use the brain's normal output pathways of peripheral nerves and muscles

The Brain-Computer Interface (BCI) is one of the communication channel used to make an interaction between the human brain and a digital computer. BCI which monitors EEG waves from the Brain.

EEG –Electroencephalography which monitors an Electrical property of the Brain along with the Scalp (Non-invasive). The Neuro sky Mindwave mobile / Brain Sense measures intentionally directed EMG activity (blink strength).

A brain-computer interface (BCI) is a new communication channel between the human brain and a digital computer. The ambitious goal of a BCI is finally the restoration of movements, communication and environmental control for handicapped people

Arduino is an open-source hardware. Arduino UNO is a micro controller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button.

Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer. arduino is used to read data from sensors and produce output corresponding to it.

3.LITERATURE SURVEY

Mayo Clin Proc. 2012 Mar; 87(3): 268–279 Brain-Computer Interfaces in Medicine Jerry J. Shih, Dean J. Krusienski:

“The advance of functional neuro imaging techniques with high spatiotemporal resolution now provides potential new methods for recording brain signals to control a BCI. Magnetoencephalography (MEG) measures mainly the magnetic fields generated by electrical currents moving along pyramidal cell axons.”

Sonam, Yashpal Singh

Paper ID : IJERTCONV3IS10102

Volume & Issue : NCETEMS – 2015 (Volume 3 – Issue 10):

“ A braincomputer interface (BCI) is a proficient result in the research field of human-computer synergy”

Recent Advances in Brain-Computer Interfaces(Invited Paper)Ulrich Hoffmann, Jean-Marc Vesin, Touradj EbrahimiSignal Processing InstituteEcole Polytechnique F´ed´erale de Lausanne (EPFL), Switzerland:

“NEUROPHYSIOLOGIC SIGNALSTo control a BCI, users have to acquire conscious control over their brain activity. Two fundamentally different approaches exist to achieve this. In the first approach, subjects perceive a set of stimuli displayed by the BCI system and can control their brain activity by focusing onto one specific stimulus. The changes in neuro-physiologic signals resulting from perception and processing of stimuli are termed event-related potentials (ERPs) and are discussed together with the corresponding BCI paradigms”

Advanced EEG Monitor

Ergonomic Issues in Brain-Computer Interface Technologies: Current Status, Challenges, and Future Direction View this Special Issue

Volume 2019 Hyun Jae Baek ,1 Min Hye Chang ,2 Jeong Heo ,3 and Kwang Suk Park 4

Academic Editor: Pietro Aricò

“Technological advancements have greatly simplified the measurement and assessment of biopotential signals, particularly electrocardiograms. However, the sites for EEG electrodes are mostly covered with hair, and EEG signals are weaker than those used in other bio-potential measurement tools, which makes the use of dry electrodes in EEG difficult. Most dry EEG electrodes make signal measurements by penetrating the outermost layer of the skin, the stratum corneum, using microelectromechanical or carbon nanotube (CNT) techniques [25–28]”

4.PROBLEM STATEMENT

- Movement related disabilities have a negative effect on the people who suffer from them, since, it reduces the ability to do tasks on their own.
- In many cases, very simple tasks such as turning on a television, light bulb and other devices of daily use, become difficult to do without the help of another person.
- The use of home automation devices has increased the quality of life for many individuals by providing them the ability to control home devices such as light bulbs, fans, garage doors, and thermostats.
- Unfortunately, a subsection of individuals are not able to take advantage of these advancements in technology.
- There are individuals who suffer from speech and motion related conditions such as Aphasia, Aphrodisiac, Arthritis, Hemiplegia, Palsy, Paraplegia, as well as other motor neuron related diseases.
- Paralysis is the loss of ability to move some or all of the body.
- It is difficult for the paralysis people to live an independent life.

5.OBJECTIVES:

- Allow an independent performance of people with difficulties or motor disabilities (but with an intact intellectual activity) into their home, and to improve their keepers services helping the tasks accomplishment by an automation an access of the house's present devices through a Brain Computer Interface.
- Brain Computer Interface (BCI) has given the opportunity to not only take advantage of advancements in home automation technology but also improve the overall quality of life for individuals who are suffering from speech and motion related conditions.
- BCI is a method of communication with a computer using the electroencephalogram (EEG) signals obtained from the user's brain activity. Considering EEG signals are independent of the normal pathways of the nerves and muscles [1], EEG signals can be used to implement a home automation system.
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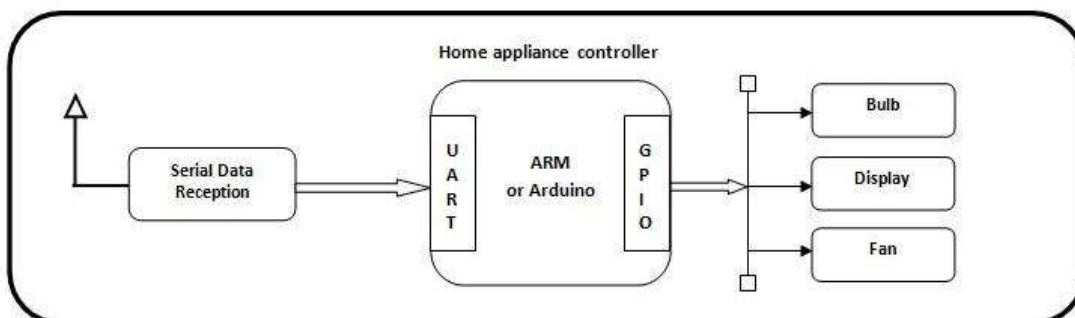
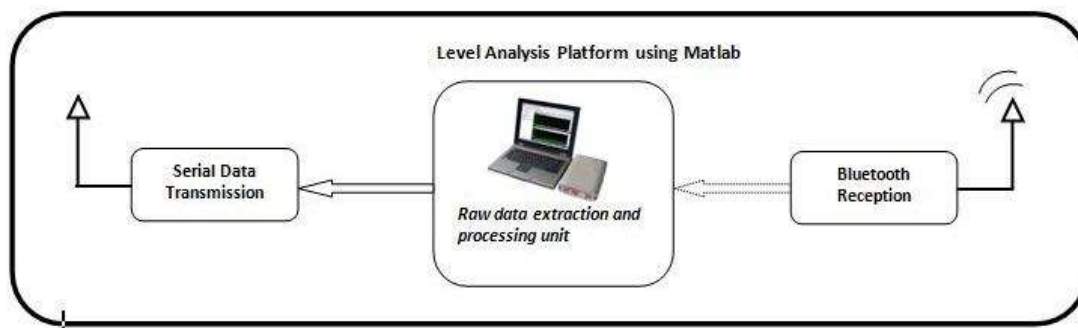
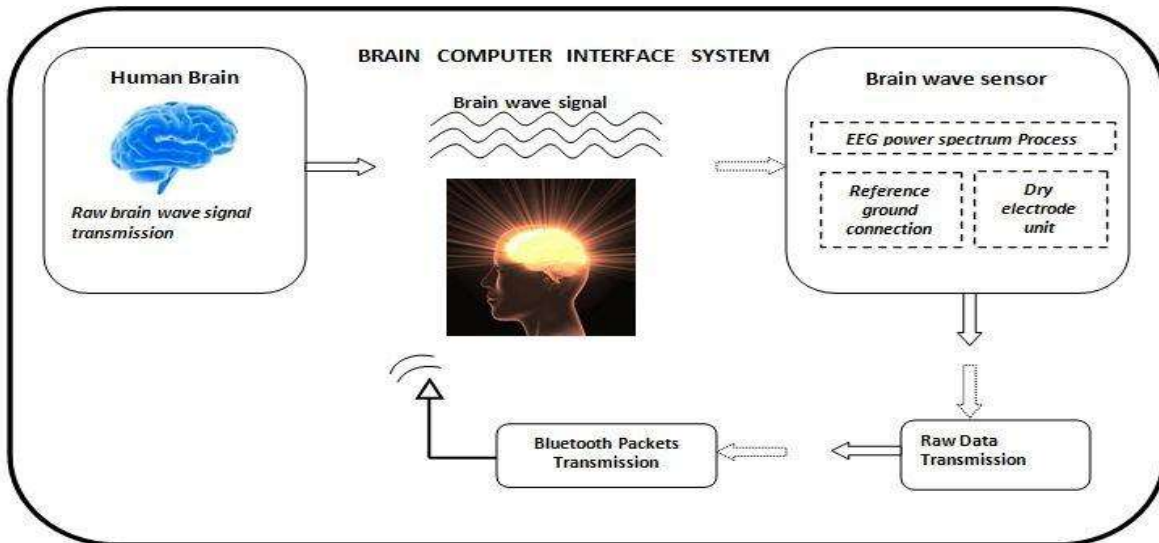
- The home automation system design uses a BCI to capture EEG signals, convert these signals into analyzable data, and then turn these signals into useful inputs that can be used to operate a home automation device that is easy to use and is independent of voice control from the user.
- Specific Objectives
 - To study the operation of the Acquisition Signals' device, Mind Wave.
 - To design the implementation system.
 - To make a software application, including: - Acquisition of the sensed values. - Based on these values, to execute the choice of a particular action (such as turn on a lamp). - Send to an Arduino board a value representing the selected action.
 - To program an Arduino: - get the value that represents the action selected from the previous software. - To set the corresponding state (1 or 0) in every pin of the Arduino board according to the action to perform. Each pin will have a device housing associated. - To modify the operation of various devices located in a conventional home so they can be handled by the Arduino.

6.PROPOSED METHODOLOGY

- The proposed system provides people with disabilities an easy way to control electronic devices by using EEG signals generated when the user blinks. The blinks of the user is detected by the EEG and such information is transmitted to the computer that executes a BCI application with filters and classifies the raw blink signals.
- Once understood the command that the user wants to execute the BCI applications sends the command to the IoT devices through the communication server. Using the proposed system, the user can have the control of IoT devices (such as SmartTV, Lightbulbs and Fans) without being close or having physical interaction.
- In order to achieve this, we have used the brain sense a Mind Wave NeuroSky ® based commercial device. It is affordable, portable and wireless, that senses and delivers to the computer the electroencephalographic signals produced in the frontal lobe and the levels of Attention, Relaxation and Blinking to the computer.
- In order to determine the efficiency of the obtained signals a Test Software was designed, which verified the operation's device with different persons. We concluded that the easiest way to control the Attention levels of attention is concentrating in a certain point, and the way to control the Relaxation levels is by closing the eyes.
- As a second step we developed a software that takes the signal from the EEG (Electro Encephalo Graphy) sensor, processes it and sends signals via USB to an Arduino board which is associated with electronics that complies the different tasks.
- The user chooses the action by managing the Attention levels. When they are higher than a particular threshold value, the action is executed.
- In order to disable this action, the user must lower the threshold level and over-come it again. This is the simplest and fastest way to handle but it brings with several problems: if the user concentrates for any other reason and this signal exceeds the threshold, it causes the activation of an involuntary action. To solve this problem, we use a three variables combination that can become independent of each other thru training properly.

- These variables are Attention, Meditation and Blink. When you comply three simultaneous previously established conditions, the action is executed, and when they return to fulfill the conditions the action is deactivated. The software also has the feature of personalizing its conditions, so it can be best for any user, even a novice one.

7.BLOCK DIAGRAMS



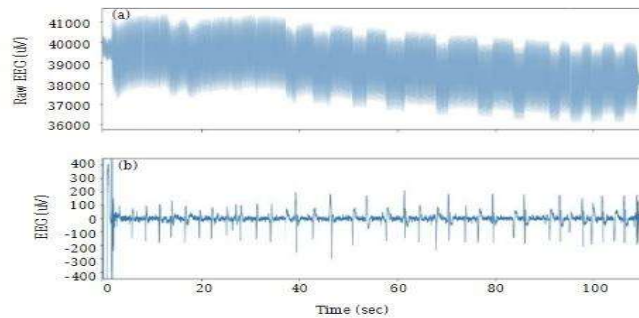


Fig. 6(a-b): Extracted raw data vs. filtered data, (a) Raw data and (b) Filtered data

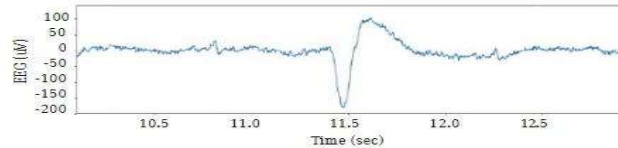


Fig. 7: Short blink

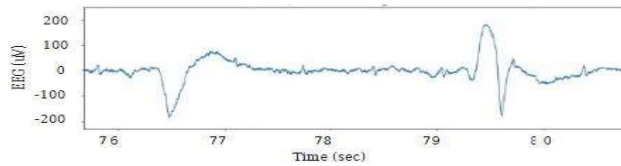


Fig. 8: Composed long blink

8.OUTCOMES

- A home automation system which is controlled by brain signals
- home appliances like fan light motor etc which are controlled using brain signals

9.APPLICATIONS :

- To automate home
- Control home appliances using brain signals
- For paralyzed people
- For specially abled people

9.ADVANTAGES

- Allows paralyzed people to live independent life
- Less physical work
- Since it uses only brain signals and doesn't involve voice or physical commands, it has wide range of applications

10.TIME LINE

- 15 days development of prototype
- 10 days testing and training
- 15 days correcting errors and implementation
- 5 days final working project
- Total 45 days

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