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# Smart Home Control for Disabled People

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***Abstract*: This paper deals with the signals from the brain. Different brain states are the result of different patterns of neural interaction. These patterns lead to waves characterized by different amplitudes and frequencies. The signal generated by the brain was received by the brain sensor and it will be divided into packets and the packet data was transmitted with the help of wireless medium (blue tooth). The wave measuring unit will receive the brain wave raw data and it will convert it into a signal using MATLAB gui platform. Then the instructions will be sending to the home section to operate the modules (bulb, fan). This system is based on human brain assumption and the on off condition of home appliance is based on the muscle movement.***
***Keywords: Brain sensor, brain-computer interface, wireless medium.***

## I. INTRODUCTION

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 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 neuromuscular output channels. An EEG defines the brain's response by recording the waveforms evoked by the excitation of neurons when subjected to stimuli [1]. The stimuli can be images, videos, sounds, or even reactions to certain events. Deoxyribonucleic acid (DNA)and ribonucleic acid (RNA) proteins are the driving source for uniqueness in an individual [2]. Therefore, one-dimensional signals such as EEG evoked by the excitation of tissues comprising these proteins exhibit the uniqueness characteristic, thus qualifying to be a potential biometric trait. The potential of using EEG as a biometric trait stems from the fact that it achieves a moderate to high performance on all the performance criteria considered in previous sub-section.

EEGs can be recorded as long as the brain is functional and receptive, hence making it highly permanent. Collectability and acceptance are two areas where EEG currently has medium performance since measurement of EEG signals is not something that has reached the desired levels of sophistication and ease when compared to other seemingly non-invasive biometrics like face or fingerprint recognition. However, it is almost never possible to circumvent an EEG because spoofing a brainwave is not possible. Liveness detection is inherent in the measurement phase, and an impostor cannot force a person to generate the kind of brainwave the system looks for since aggression and fear tend to morph the brainwaves[3].

Brain-computer interface technology allows users who are impaired or paralyzed to communicate with the external environment such as controlling home appliance which includes switching on/off fan, lights, television, changing television channels, etc. The disabled individuals can therefore convey their intentions or operations to these interfaces. The basic idea of BCI is to translate user produced patterns in EEG. To operate home lighting systems manually using switches may be difficult to be performed by some paralyzed people. Even though using a remote control may also be a difficult task. Nowadays, a lot of improvement has been made in the development of lighting system. It is also believed that eye blink is one of the mechanisms to help disable people in their everyday routines. This eye blinking activity can be detected from EEG (electroencephalography) signal via a brain computer Interface (BCI) that allows people to communicate without using many gestures.

## II. EEG WAVES

An electroencephalograph (EEG) is the recorded electrical activity generated by the brain. In general, EEG is obtained using electrodes placed on the scalp with a conductive gel. In the brain, there are millions of neurons, each of which generates small electric voltage fields. The aggregate of these electric voltage fields create an electrical reading which electrodes on the scalp are able detect and record. Therefore, EEG is the superposition of many simpler signals. The amplitude of an EEG signal typically ranges from about 1 uV to 100 uV in a normal adult, and it is approximately 10 to 20 mV when measured with subdural electrodes such as needle electrodes.

The FFT (Fast Fourier Transform) is a mathematical process which is used in EEG analysis to investigate the composition of an EEG signal. Since the FFT transforms a signal from the time domain into the frequency domain, frequency distributions of the EEG

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can be observed. EEG frequency distribution is very sensitive to mental and emotional states as well as to the location of the electrode(s). Two types of EEG montages are used: monopolar and bipolar. The monopolar montage collects signals at the active site and compares them with a common reference electrode. The common electrode should be in a location so that it would not be affected by cerebral activity. The main advantage of the monopolar montage is that the common reference allows valid comparisons of the signals in many different electrode pairings. Disadvantages of the monopolar montage include that there is no ideal reference site, although the earlobes are commonly used. In addition, EMG and ECG artifacts may occur in the monopolar montage. Bipolar montage compares signals between two active scalp sites. Any activity in common with these sites is subtracted so that only difference in activity is recorded. Therefore some information is lost with this montage. EEG is generally described in terms of its frequency band. The amplitude of the EEG shows a great deal of variability depending on external stimulation as well as internal mental states. Delta, theta, alpha, beta and gamma are the names of the different EEG frequency bands which relate to various brain states, as described in the table I and figure 1.

Table i
Eeg frequency bands and related brain states

| Waves | Frequency | Brain States |
|---|---|---|
| Delta | 0.1Hz to 3Hz | Deep, dreamless sleep, non-REM sleep, unconscious |
| Theta | 4Hz to 7Hz | Intuitive, creative, recall, fantasy, imaginary, dream |
| Alpha | 8Hz to 12Hz | Relaxed, but not drowsy, tranquil, conscious |
| Low Beta | 12Hz to 15Hz | Formerly SMR, relaxed yet focused, integrated |
| Midrange Beta | 16Hz to 20Hz | Thinking, aware of self & surroundings |
| High Beta | 21Hz to 30Hz | Alertness, agitation |
| Gamma | 30Hz to 100Hz | Motor Functions, higher mental activity |

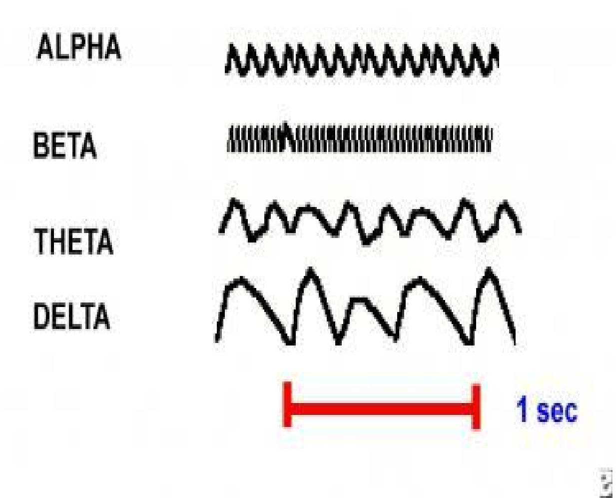


Fig. 1 Normal EEG Wave Forms

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## III. PROPOSED SYSTEM

The aim of this paper is to control home devices using a non invasive brain computer interface (BCI). The Electroencephalographic signals (EEG) recorded from the brain activity using the Mind wave headset are interfaced with the help of Arduino and HC-05 Bluetooth module. The user will control various devices in a smart home by using their attention and eye blink values. In order to control and operate the home using brain signals, a virtual home environment has been created. In the virtual environment there is indoor and outdoor access, it consists of many rooms, each having many devices like TV, MP3, lights, temperature control, and doors to operate.

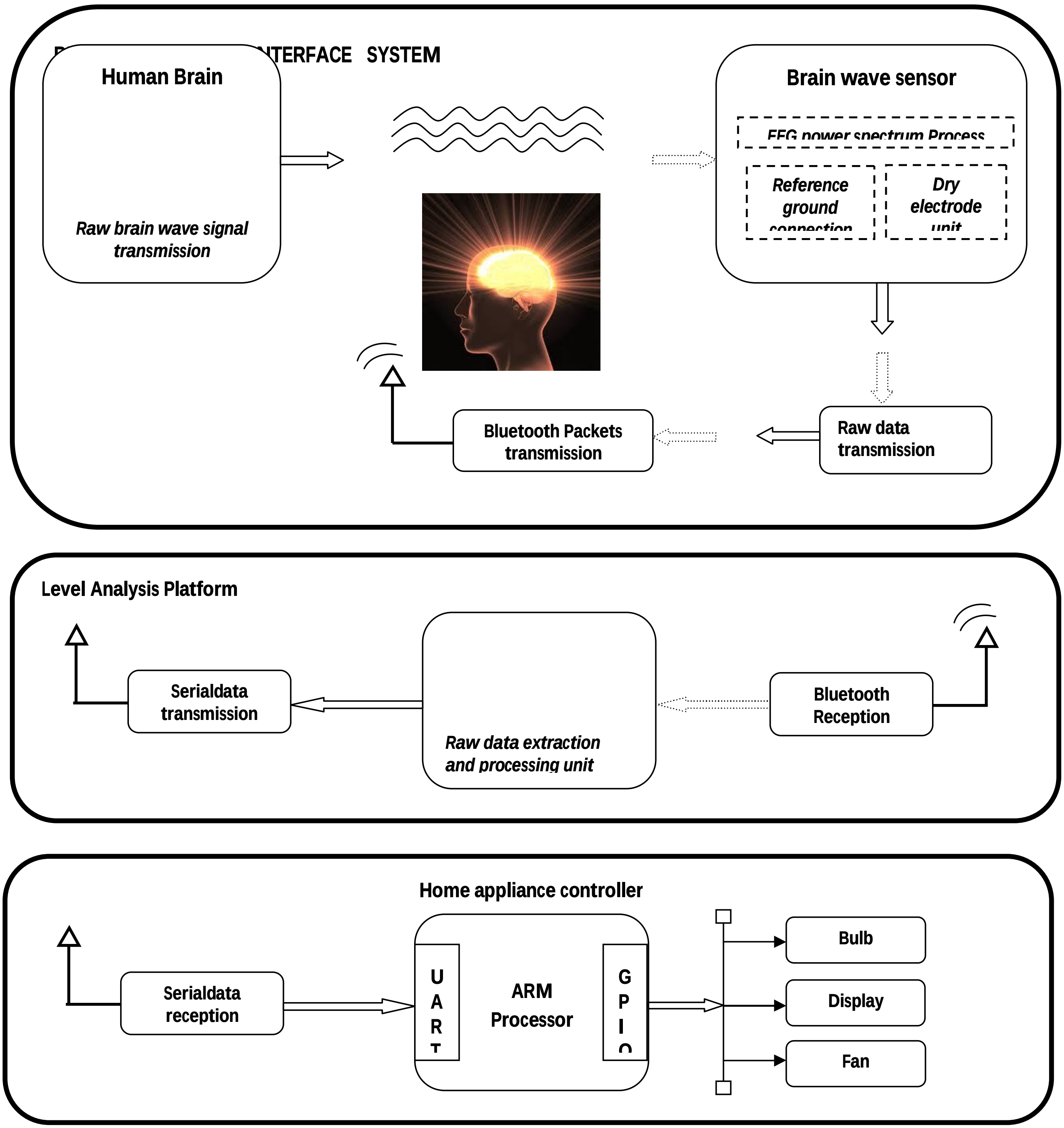


Fig. 2 Block Diagram of Proposed System

an eye blink (or a smirk, or a combination of actions if needed and to increase the sensitivity of the system), that will cause a select on the desired control device, as a result the control device will be toggled. For example, the subject can turn on the light of a room by selecting the light device using eye blink. 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.

The EEG signal received from the brain was sent to the brain sensor and it will be divided into packets and the packet data was transmitted with the help of wireless medium (blue tooth). The receiver will receive the brain wave raw data and it will convert it into a signal using MATLAB gui platform. Then the instructions will be sending to the home section to operate the modules (bulb, fan).The block diagram of the proposed system is shown in figure 2.

## IV. CONCLUSION

The proposed system helps paralyzed and disabled people efficiently as it do not require any sort of complex wiring and no such muscular power to operate it. It will prove to be beneficial to these people as only eye blink and head movement are needed in this proposed system, which are much easier gestures as compared to other gestures of the body. An alarm is provided for any emergency cases which will eliminate chances for the occurrence of accident. Therefore, communication will be done between the disabled person and external environment through which a paralyzed and disabled person can communicate efficiently.

## V. ACKNOWLEDGMENT

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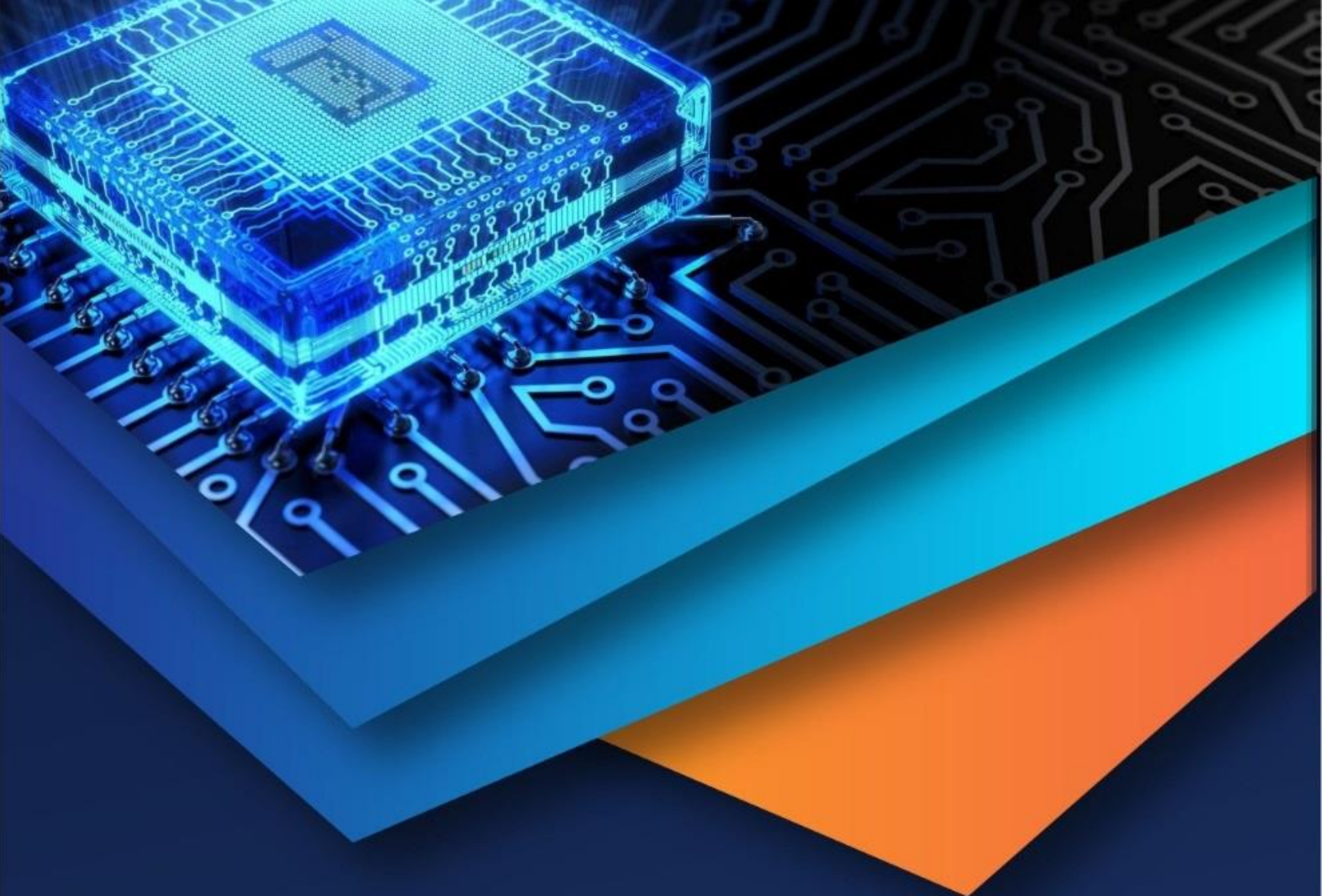

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