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# INNOVATIVE BRAIN WAVE BASED CONTROL SYSTEM

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*Abstract*— **This paper describes the development and testing of an interface system whereby one can control external devices by voluntarily controlling alpha, beta and theta waves, that is through concentration & eye movement. Such a system may be used for the control of prosthetics and external devices like wheelchairs or other household devices using the alpha brain waves. The response generated through the movement of the eye (detecting and controlling the amplitude of the alpha brain waves) is interfaced and processed to smart home control. Three electrodes are required to measure brain wave. The electrodes perform the function of capturing the brain waves and also converts the captured EEG signal into a JSON format. This signal format is transmitted via Bluetooth to computer and a Java programming is used as it is compatible to JSON format. Eye blink signal along with the concentration signal is used to control the device. The eye blinks are used as a counter or to select the device while the concentration signal are used to toggle the device i.e. to switch ON/OFF the devices.**

**Keywords — Brain–computer interface (BCI), electroencephalograph (EEG), wireless communication, Electrode.**

## I. INTRODUCTION

The device consists of eight main parts, ear clip, flexible ear arm, battery area, power switch, adjustable head band, sensor tip, sensor arm and inside think gear chipset. Fig.1 represents the frequencies generated by different types of activities in the brain. The principle of operation is quite simple. Two dry sensors are used to detect and filter the EEG signals. The sensor tip detects electrical signals from the forehead of the brain. At the same time, the sensor pick up ambient noise generated by human muscle, computers, light bulbs, electrical sockets and other electrical devices. The second sensor, ear clip, is a grounds and reference, which allows thinkgear chip to filter out the electrical noise. The device measures the raw signal, power spectrum (alpha, beta, delta, gamma, theta), attention level, mediation level and blink detection. The raw EEG data re- ceived at a rate of 512 Hz. Other measured values are ma- de every second. Therefore, raw EEG data is a main source of information on EEG signals using Mindwave headset. A Brain-Computer Interface (BCI) enables communication under such circumstances. Using data recorded from the brain, the BCI processes it, interprets the intention of the user, and acts on it. The BCI has a robust and flexible design that can be expanded in the future to encompass more complex communication schemes. An *electroencephalogram (EEG)* is a measure of the brain's voltage fluctuations as detected from brain signals. It is an approximation of the cumulative electrical activity of neurons.BCI research programs have began and encouraged new understanding of brain functions.

| Brainwave type | Frequency Range | Mental states & Conditions |
|---|---|---|
| Delta | 0.1Hz to 3Hz | Deep, dreamless, non-REM sleep, unconscious |
| Theta | 4Hz to 7Hz | Intuitive, recall, fantasy, imaginary, dream |
| Alpha | 8Hz to 12Hz | Relaxed, but not drowsy, tranquil, conscious |
| Low Beta | 13Hz 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 |

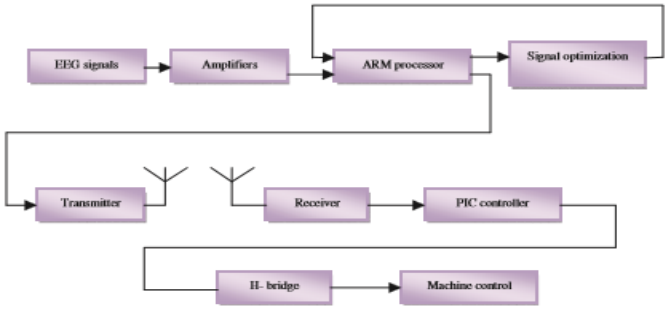
( Fig.1 Frequencies Generated By Different Types of Activities in the Brain.)

## II. LITERATURE SURVEY

Electroencephalography (EEG) is the measurement of electrical activity in the living brain. The first electrical neural activities of the human brain were registered by Hans Berger (1924) using a simple galvanometer. On the human scalp was placed only one electrode and one wave was identified. It was alpha wave (also called Berger's wave). Nowadays in clinical use of EEG, 21 electrodes are used to identified 5 fundamental waves, but this kind of the device costs thousands of dollars. In recent years, inexpensive mobile EEG devices have been developed by Avatar EEG Solutions, Neurosky, OCZ Technology, InteraXon, PLX Devices and Emotiv Systems. These devices are not used in clinical use, but are used in the Brain Control Interface (BCI) and neuro feedback (one of biofeedback type). The BCI is a direct communication pathway between the brain and an external device. The cheapest EEG device is single-channel MindWave headset produced by Neurosky Inc., San Jose, CA. It cost only around $80[1].

## III. EXPERIMENTAL SETUP

In this an EEG based brain computer interface system is the proposed system has been implemented for making the people by combining the brain commands to the machine. Hence, the machine can be controlled by the brain commands (thoughts) which make the system move. The commands used in this proposal are right and left. The system is designed with an aim of natural and direct navigational control of the machine[2]. Hence, our system employed thought-dependent control architecture that can perform right and left movements with respect to the appropriate user's intentions. This is the semi DSP system. Three electrodes are used, in this 2 are placed on the forehead and another one which is ground is placed near the right side of the neck for the user, the signal is extracted according to the thought through that device. The signals from the electrodes are nearly a milli volt it is amplified in the first stage[3]. Output of the amplifier selection, the analog signal is formed. It is the first stage output in this system.




(Fig.2 Architecture of this proposal[1])

Crystals are commonly used to provide a stable clock source for micro-controllers. This has a freq. tolerance of +-50ppm, temperature stability of +-50ppm and load capacitance of 18pF.Here are 22pF ceramic disc capacitors commonly used with this crystal to provide a clock source to micro-controllers. When installing, be sure that the case does not make contact with any other conductors; i.e don't push it all the way flush with the board.+-5ppm (parts per million) per year aging drift. The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed[4].

Display:- Drive method: 1/16 duty cycle, Display size: 16 character * 2 lines, Character structure: 5*8 dots., Display data RAM: 80 characters (80*8 bits), Character generate ROM: 192 characters, Character generate RAM: 8 characters (64*8 bits),Both display data and character generator RAMs can be read from MPU. Internal automatic reset circuit at power ON., Built in oscillator circuit.

LM7805 (VOLTAGE REGULATOR):- Output current in excess of 1A,Internal thermal overload protection, No external components required, Output transistor safe area protection,

Internal short circuit current limit, Available in the aluminum TO-3 package[5].

Brain waves: The last century of neuroscience research has greatly increased our knowledge about the brain and particularly, the electrical signals emitted by neurons firing in the brain. The patterns and frequencies of these electrical signals can be measured by placing a sensor on the scalp. The Mind Tools line of headset products contain Neurosky Think Gear technology, which quantify the analog electrical signals, commonly referred to as brainwaves, and exercise them into digital signals.

Recently, research and development of brain-controlled robots have received a great deal of attention because of their ability to bring back to people with devastating neuromuscular disorders and improve the quality of life and self- dependence of these users. It includes various applications such as a cursor on the screen, selecting letters from virtual keyboard, browsing internet, and playing games.

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