Brainwave Controlled Robot

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Abstract— The Brain-computer interfaces (BCI) system is interfaces brainwave with computer. Brain generates Electroencephalography (EEG) signal. The BCI should be capable to provide more controlled variable commands with increased accuracy to the user. The resolution of the BCI is mainly depends on the sensor, amplifiers and filter used. We are using Neurosky mindwave sensor to capture brainwave from scalp. And Filtering done by using Matlab program. For robot moment we use filtered signal. By using this command we can move robot left, right, forward and backward direction. The BCI can be used to discover the emotion which is also use to control the surrounding environment such as controlling the interior of the car or house.

Key words: Brain-Computer Interfaces (BCI), Electroencephalography (EEG)

I. INTRODUCTION

By use of this kind of robot we can reduce human work load. We work on BCI system and by using EEG command to operate this robot. So the EEG potential differences between each scalp mounted electrode and a reference electrode represent a single EEG signal originating directly beneath the active scalp electrode supports much EEG analysis and BCI design. Electrode supports much EEG analysis and BCI design.

For data transmission process we are using Neurosky mindwave component. This component operates on low frequency. The range of low frequency upto 60Hz. The signal intensity of EEG activity is quite small which is usually measured in microvolts (mV) and the Signal frequency are categorized in delta, theta, alpha, and beta.

The data transmitted by mind wave headset will receive by computer Bluetooth receiver and then all these data will be analyzed by the Level Analysis platform. The Level Analysis platform will extract the raw data using the MATLAB.

By using three mental states like meditation, attention and eye blinking we can move robot left, right, forward and backward. In future we can operate robot on different mental states for other application which used for human life.

II. EXISTING SYSTEM

Referring several reviews on Brain computer interface ,look out or the performance of BCI existing system .for development, techniques used Presimulus Sensorimotor Rhythms influence of BCI working on modulation of sensorimotor rhythms (SMR).This access pre-stimulus SMR activity influence the successive task executions quality and consequently classification performance. Thus ongoing SMR activity can influence the dynamics of brain process leading to increase SMR based BCI performance this can be helpful around 70%-80% classification accuracy in BCI system.

Many more advancement coming in future for BCI system practice is going on visual and auditory BCI which exhibits high communication speed and classification accuracy in recent BCI .Also focus on critical parameter of BCI in which number of dimensions a user can control independently by the multimode BCI.

Existing BCI is useful for entertaining environment purpose. Application like game i.e. BCI Game which more enjoyable for players , so brain computer game interaction strategies are going to help for developing the field and allowing game developers to engage in BCI game prediction.

III. PROPOSED SYSTEM

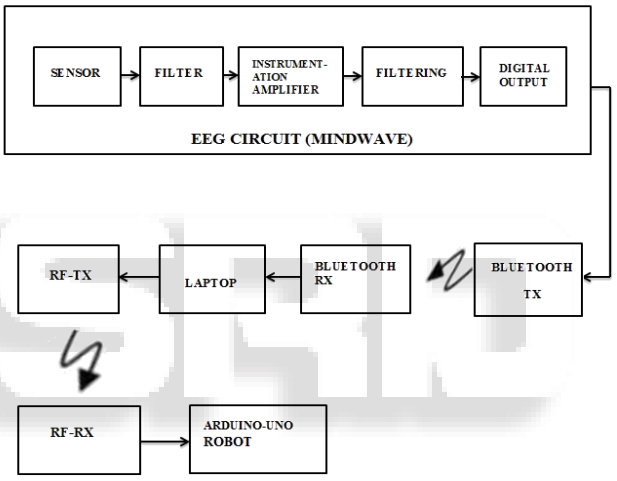

Fig. 1: Block diagram of Brainwave controlled robot

There are different types of sensor to use for EEG extraction over the scalp but in this robot we can used dry sensor which is inbuilt in neurosky mind wave device. In filter section we can used high pass filter which is filter out alpha and beta wave monitored at output. Which range from above 7Hz to 30Hz. Low pass frequency is used to eliminate the frequency which exceed above 31Hz frequency. EEG circuit as the signal strength is in µV the noise from EEG electrode should be eliminate to give proper output which is brain signal only by using instrumentation amplifier. Notch filter is used to reduce noise as well as gain of one particular. Bluetooth TX is transmits a mindwave signal which is in proper digitized manner to laptop Bluetooth receiver. By using laptop Bluetooth RX it receive signal which comes from mind wave headset. For serially data transmission RF module is used. This module used free frequency band which is ISM 2.4GHz. Here we are using RF module to connect Robot with the Computer wirelessly through a logic-level asynchronous serial port. The computer will transform the data which is analyzed by using the Level Analyzer unit using MATLAB. The data which is transmitted by the RF module from the computer will be received by the RF receiver which is connected to the

Arduino processor. Then robot changes its moment by accepting command from mind wave.

IV. MECHANISM

The Mind wave thankfully dispenses with the traditional hair-net of sensors and conductive jelly, instead utilizing a single electrode pressed against your forehead, and reference electrodes attached to your left earlobe via a clip. This makes the device comfortable and easy to use, at the expense of some accuracy. The headset's Thinkgear chip amplifies the raw brainwave signals, removes noise and outputs proprietary 'attention' and 'meditation' levels along with eye blink strengths.

It's possible to access more common EEG frequency data: delta, theta, alpha, beta and gamma brainwaves, which are also updated every second and to read the raw data coming from the Mind wave, at a rate of about 512 packets/second approximately.

Now by using EEG signal we get different frequency which is categories in delta, theta, beta and alpha. In Table 1 given the frequency ranges allocated to above mention frequency type with mental states.

Frequency type	Frequency range	Mental states
Delta	0.1 to 3Hz	Unconscious
Theta	4Hz to 7Hz	Imaginary, dream
Alpha	8Hz to 12Hz	Relax, meditation
Beta	13Hz to 30Hz	Attention, focus

Table 1: Generated frequency by brain

EEG is an electrophysiological monitoring method to record electrical activity of the brain. It is noninvasive, with the electrodes place along the scalp. EEG measures voltage fluctuations resulting from ionic current within the neurons of the brain. Multiple electrode are placed on the scalp. When the wave of ions reaches the electrodes on the on the scalp, they can push or pull electrons on the metal in the electrodes. Since metal conducts the push and pull of electrons easily, the difference in push or pull voltage between any two electrodes can be measured by a voltmeter. Recording these voltages over time gives us the EEG. Scalp EEG activity shows oscillation at a variety of frequencies This frequency are characteristic into several band and associated with different states of brain activity like walking and the various sleep stages. Electrode location and names are specified by the international 10-20 system for most clinical and research applications. In most application, 19 recording electrodes are used. We are using only front panel electrode.

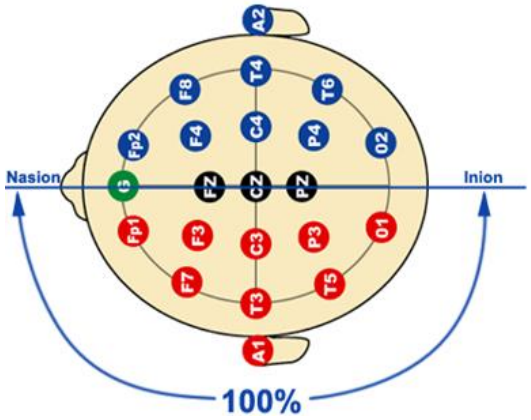

Fig. 2: Electrode location on the scalp

The typical adult human EEG signal is about 10uv to 100uv in amplitude when measured from scalp and is about 10-20 mV when measured from subdural electrodes. So for processing on this signal we need to amplify it. Typically instrumentation amplifier is used and requires high signal-to-noise ratio (SNR). The common-mode rejection ratio (CMRR) is usually used to evaluate amplifier instruments, i.e., an amplifier with a higher CMRR reduces the common-mode noise in measurements. The traditional implementation of amplifiers uses a three op-amp configuration, which requires precise matching of the resistors used in the feedback network to achieve a high CMRR. Such matching usually requires expensive laser-trimmed resistors that consume a significant amount of chip area. One technique for overcoming this problem is to use current feedback instrumentation amplifiers, which requires two resistors to adjust the gain, but the resistors are not required to be matched.

We need to divide this signal into different band so for this high pass and low pass filter are used. Typical settings for high pass filter and a low pass filter are 0.5-1Hz and 35-70Hz, respectively. The high pass filter typically filters out slow artifact whereas the low pass filter filters out high frequency artifacts. An additional notch filter is typically used to remove artifact caused by electrical power lines of 60Hz.

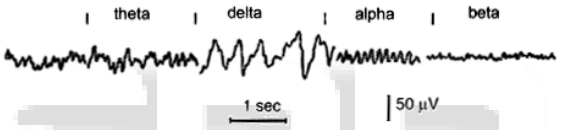

Fig. 3: Basic EEG signal component.

Amplified and filter signal are analog in nature. Analog signal converted into digital using analog to digital converter. Analog to digital sampling typically occurs at 256-512Hz. Digital signal are grouped into packets. This packets of EEG signal are transmitted to laptop using Bluetooth module. wireless technology such as Bluetooth, 802.15.4/ Zigbees or RF transmitters. Bluetooth was developed as a replacement for cables and is a common feature in laptops and cellular phones. However, it also has a heavy protocol stack and high power consumption. In contrast, the protocol stacks of RF transmitters and 820.15.4/ Zigbees are light and more efficient in terms of their power use, but they are less common in laptops.

Then using MATLAB coding we set the threshold point. When the threshold point meets we send the character for each threshold using RF TX-RX module. RF TX-RX transmitter module is connected to one of the port of laptop and receiver module on robot. According to character received robot will move forward or backward and right or left. In meditation state the robot will stop moving. In attention it will move forward or backward according to threshold point set by us. On the eye blinking it will move right or left.

V. RESULT

In the fig.4, it shows the graph of time Vs throughput of receiving data packet. The data is update at every 5second upto 256 point. Amplitude of attention graph is less than eye blinking graph as shown in fig.4.

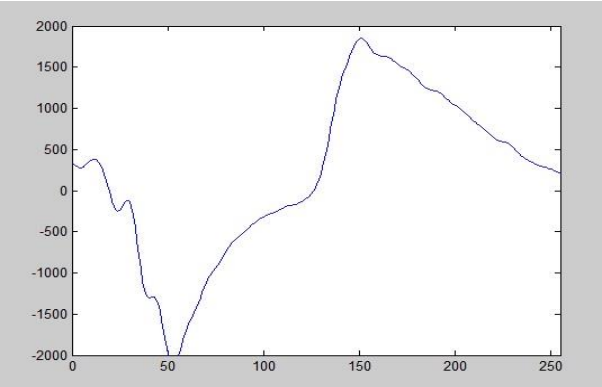

Fig. 4: Attention graph

In fig.5, it shows the eye blinking graph of time Vs throughput of receiving data packet. The threshold value for eye blinking graph is high than other two mental states like attention and meditation graph. As shown in fig.5. eye blinking graph magnitude is very high than attention graph.

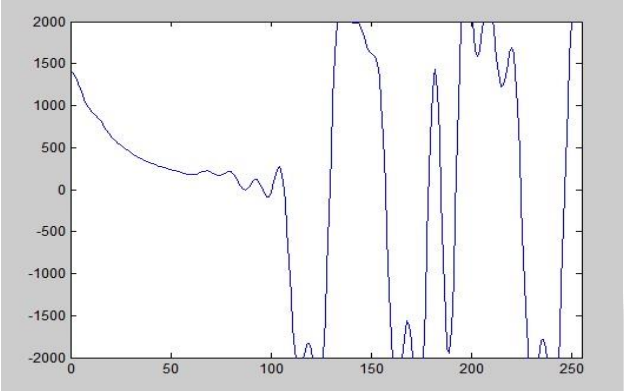

Fig. 5: Eye Blinking graph

In fig.6 shows the meditation graph of time Vs throughput data packet. At very low threshold value it gives the meditation graph at every 5second it also updated. And the magnitude of meditation graph is minimum or zero as shown in fig.6.

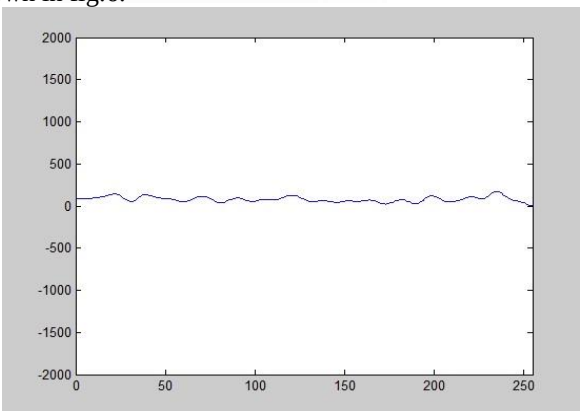

Fig. 6: Meditation graph

VI. CONCLUSION

This paper presents that by using concept of BCI system the interfacing of brain signal with robot successfully done. And the robot can be controlled by accepting command signals from brain.

ACKNOWLEDGEMENT

The authors would like to thank Prof. Dr. S. R. Patil HOD of ENTC department and Our internal guide Prof. K. R. Choudhari for help in their busy schedule to successfully complete this project paper.

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