INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume3, Issue3)
Available online at www.ijariit.com

Brainwave Controlled Robot

Jismy Shibu
Rajagiri School of Engineering & Technology, Kerala
jismyshibu1994@gmail.com

Akash .J
Rajagiri School of Engineering & Technology, Kerala
akashjayanandan@gmail.com

Athul Johnny
Rajagiri School of Engineering & Technology, Kerala
athuljohnny008@gmail.com

Felicia Hyacinth Chelat
Rajagiri School of Engineering & Technology, Kerala
feliciachelat12@gmail.com

Abstract: In the world, a number of people are handicapped. Currently, they use different technologies which give physically impaired, the ability to move around. But still there are a number of people who are fully handicapped and paralyzed but their mind still works properly. So our task for those people who are physically handicapped and little disturb from mine site is to help them so that they can move around the world using their mind power. For this, we have to try to design a robot, which is fully automated and controlled using Beta waves (human brain attention) with the help of a Mind wave sensor, which detects brain signal and also uses an Arduino to control the robot.

Keywords: Mind Wave Sensor, Beta Wave, NeuroSky, Arduino, Matlab, LabVIEW.

I. INTRODUCTION

The patterns of interaction between these neurons are represented as thoughts and emotional states. According to the human thoughts, this pattern will be changing which in turn produce different electrical waves. A muscle contraction will also generate a unique electrical signal. All these electrical waves will be sensed by the brain wave sensor and it will convert the data into packets and transmit through Bluetooth medium [1]. Level analyzer unit (LAU) will receive the brain wave raw data and it will extract and process the signal using the Matlab platform. Then the control commands will be transmitted to the robotic module for processing. With this entire system, we can move a robot according to the human thoughts and also it can be controlled in a blink muscle contraction.

Signal intensity: This EEG action is small, measured in microvolts (µV).

Signal frequency: The fundamental frequencies of the human EEG waves are:

Delta: It has a frequency of 3 Hz or below. It tends to be the highest in amplitude and the slowest waves. It is typical as the dominant beat in infants. It is typically most prominent frontally in grown-ups (e.g. FIRDA - Frontal Intermittent Rhythmic Delta) and posterior in children e.g. OIRDA - Occipital Intermittent Rhythmic Delta).

Theta: It has a frequency of 3.5 to 7.5 Hz and is classified as "moderate" movement. In the beginning were part of the delta waves, but scientists discovered the importance activity of these waves. Its region of interaction is between the thalamic region and play a dominant part in childhood and infancy. The normal adult walking of theta waves is a few or a few these frequencies observed in drowsiness and sleep. A lot of theta waves is associated with different amounts of pathologies.

Alpha: It has a recurrence somewhere around 7.5 and 13 Hz. It is generally best found in the back districts of the head on every side, being higher insufficiency on the overwhelming side. These are originated on the posterior half back of the head and are from occipital and parietal regions. These waves are observed during conditions of awareness, physical relaxation, and mental inactivity.

Beta: Beta movement is "quick" action. It has a recurrence of 14 and more prominent Hz. It is generally seen on both sides in symmetrical conveyance and is most clear frontally. It is emphasized by narcotic trance-like medications particularly the benzodiazepines and the barbiturates. It might be non-attendant or lessened in zones of cortical harm. It is largely viewed as an ordinary beat. It is the prevailing cadence in patients who are ready or restless or have their eyes open.

Gamma: Gamma waves are in the recurrence scope of 31Hz and up. It is believed that it mirrors the instrument of awareness. Beta and gamma waves together have been connected with consideration, recognition, and insight.

II. DESIGN CONSIDERED

There are multiple parts for this project. The main goal is to develop a robot with all of the aforementioned capabilities. The overall system design is divided into four interconnected subsystems as shown in figure 1. The four subsystems and their desired functions are:

1. **Mind Activity Monitoring System**: This system records electric activity in the brain using an EEG sensor. The main goal of this system is to perform signal processing on the raw signal obtained. This is achieved by filtering the original signal by passing through multiple band-pass filters. These filters then output Alpha, Beta and Theta waves. These waves are then inputted to an analog-to-digital converter and are digitized. Further processing is performed on digital Alpha, Beta and Theta waves and the values of attention and meditation levels are extracted [2]. The digitized EEG signal, Alpha, Beta and Theta waves along with attention and meditation level are arranged in discrete data packets. These packets are serially transferred to the Processing System.
2. **Processing System**: This system acts as the brain of the robot. It communicates with all other subsystems and initializes them. The desired function of this system is to obtain digitized EEG signal including attention and meditation level from Mind Activity Monitoring System and determine the direction and motion of the robot. The motion and direction data is then given as the output to Motion Control System. This system verifies the functionality of other systems on reset and notifies the user if there are any errors. This system is also responsible for detecting any obstacles in the path of motion. It changes the direction of the robot if it detects an edge of the surface it is moving on or any obstacle in its path.
3. **Motion Control System**: This system is responsible for controlling the motion of the robot. The desired function of this system is to take digital information pertaining to robot motion and direction from the Processing System and move the robot accordingly.
4. **User Interface (UI) System**: The goal of this system is to provide essential functions to the user in order to control the operation of the Mind Control Robot.

It displays mind attention or medication level on an array of LEDs. The user can change the mode of operation using input peripherals of the UI system. This system informs the user when the mode of operation is changed and also alert the user if an error has occurred.

Each subsystem is individually designed and tested. A comprehensive part evaluation for each subsystem was performed and suitable components were chosen which are reliable and also cost-effective. The components of each subsystem and their functions are:

A. EEG Sensor

This component is an essential part of Mind Activity Monitoring System. Traditional EEG sensors are expensive and their use is only limited to hospitals and laboratories. The electrodes of traditional EEG sensors require using conductive gel to facilitate reading of the signals.

For this project portable, EEG brainwave headset from NeuroSky was used. NeuroSky, Inc. is a manufacturer of Brain-Computer Interface (BCI) technologies for consumer product applications [2].
Neurosky's Hardware uses a dry active sensor technology to read brain signals. This doesn't require conductive gel on the skin in order to record brain electric activity. For this reasons, headset based on Neurosky technology are cost-effective and easy to handle.

Neurosky offers three headsets for recording brain signals: MindSet, MindWave and MindPlay Band. These three headsets were compared in order to determine suitable headset for this project. The major difference between these three headsets is that MindWave uses RF transmitter and receiver to transmit EEG signal while other two use Bluetooth. The NeuroSky's Mindwave is cost effective and was chosen for Mind Activity Monitor System.

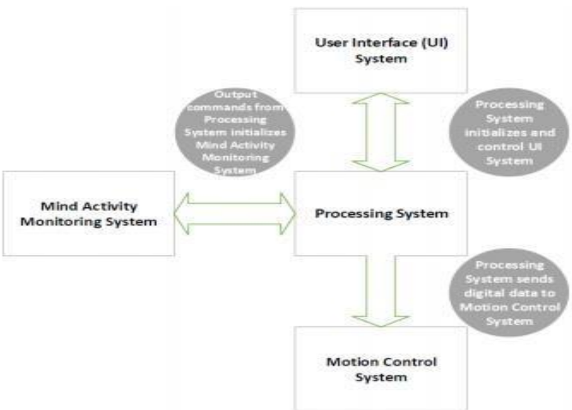

Figure 1: Interconnected Subsystems

The MindWave headset sends EEG signal to an RF USB adapter. The on board ThinkGear IC process raw signal filters the noise and digitizes the signal using the above-mentioned algorithm. The RF USB dongle is made for use with computer applications provided by NeuroSky. The data signals of the RF USB dongle are connected to Processing System for further processing.

Microcontroller
The microcontroller is the most important component of the Processing System. There are many microcontrollers available that can be used for this subsystem. For this project, Arduino Uno was chosen. Arduino Uno is microcontroller board based on ATMEGA328 [3]. It provides 14 digital I/O pins and 6 analog I/O pins which are sufficient for this project. The Arduino Uno operates at 16 MHz.

At reset, Arduino initializes all other subsystems. The Arduino takes digital data from USB dongle and stores it in an array for further processing. The firmware then takes these data packets and parses them to obtain mind attention and meditation level. This approach is further explained in the software section. The Arduino determines the status of the robot and computes the direction of the motion. This information is stored in digital packets. The Arduino outputs these packets to User Interface (UI) subsystem and Motion Control subsystem.

A. L293D Motor Driver IC
L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive in either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC.

It works on the concept of H-bridge. Bridge is a circuit which allows the voltage to be flown in either direction. For this project, H-bridge IC manufactured by Texas Instruments was used. The Bridge takes digital data from Arduino and drives the DC motor accordingly. The Arduino outputs two data signals for each DC motor and one control signal to enable the IC. The functions of these signals are shown in table 1.

EN	**1A**	**2A**	**Function**
H	L	H	Turn Right
H	H	L	Turn Left
H	L	L	Fast motor stop
H	H	H	Fast motor stop
L	X	X	Fast motor stop

Figure 2: H-Bridge Control Signals

H = High, L = Low, X = Don't Care

C. DC Motor
The robot was moved using two DC motors. These DC motors are attached to the front wheels of the robot. The H-bridge supplies required drive current to DC motor.

D. Software
The Arduino Integrated Development Environment (IDE) was used to program Arduino. This IDE is a cross-platform application written in Java and is derived from the IDE for the processing programming language [4]. A program written for Arduino is called Sketch.

The firmware developed for this project allows Arduino to communicate with other subsystems. This firmware stores and parses EEG data to obtain mind attention or meditation level. These levels are further scaled to display on LED Bar-Graph. The firmware also reports any error it encounters during execution.

(1) **Matlab**- MATLAB, short for MATrix LABoratory is a programming package specifically designed for quick and easy scientific calculations and I/O. It has literally hundreds of built-in functions for a wide variety of computations and many toolboxes designed for specific research disciplines, including statistics, optimization, a solution of partial differential equations, data analysis. For CME200, you need a solid knowledge of basic MATLAB commands and several more advanced features including two- and three-dimensional graphics, a solution of algebraic equations, a solution of ordinary differential equations, calculations with matrices and solutions of linear systems of equations.

(2)**LabVIEW**- LabVIEW (short for Laboratory Virtual Instrumentation Engineering Workbench) is a platform and development environment for a visual programming language from National Instruments. The graphical language is named "G". Originally released for the Apple Macintosh in 1986, LabVIEW is commonly used for data acquisition, instrument control, and industrial automation on a variety of platforms including Microsoft Windows, various flavours of UNIX, Linux, and Mac OS X.

IMPLEMENTATION

One major difference that we are working on EEG wave and they are working on EOG wave after that eye rotation and fluctuation continues and mind we can put it stand on meditation way. We can also operate the whole body in paralysis because the mind is continues operated.

NeuroSky Mind wave device forwards brainwave signals to the software application. This information will then be used to train a classification system. It can learn to recognize and thus map different brain patterns to action and the classification system will continuously analyze the incoming brainwaves and map them into the appropriate actions.

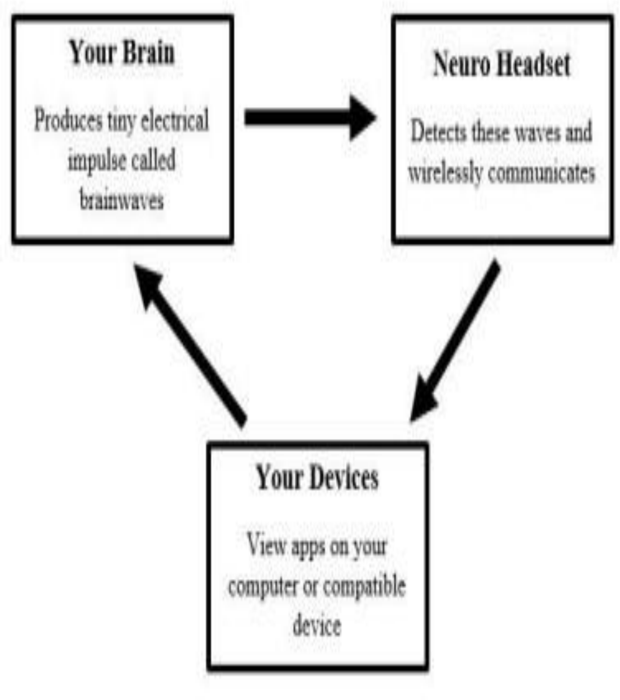

Figure 3: Working of Mind Wave device

NeuroSky gadget catches the Beta wave signals which are originated from our mind then it is sent to HC06 Bluetooth beneficiary module. This HC-06 module interfaces with Arduino and robot is associated with Arduino.

CONCLUSION

The design of the overall system for mind control robot is divided into small subsystems that were designed and tested independently using computer models of the other subsystems. The computer model generates stimulus input values to the subsystem under test. The presented system records electric activity of the brain and the robot moves according to mind attention or medication level depending on the mode of operation.

ACKNOWLEDGMENTS

The authors would like to thank Assistant Professor Mr. Abhishek Viswakumar from the department of Electronics and Communication Engineering at Rajagiri School of Engineering & Technology for helping with the publication of this paper.

REFERENCES

1. Luzheng Bi, Xin-An Fan, Yili Liu “EEG-Based Brain-controlled Mobile Robots: A survey”, Human-Machine Systems, IEEE Transactions on (Volume: 43, Issue: 2), pp. 161-176, Mar 2013. "Uncle Milton and NeuroSky Announce Exclusive Partnership for Science Toys.". Journal of Technology. 2009-07-28. Retrieved 201007- 31.
2. Adruino Uno, http://arduino.cc/en/Main/arduinoBoardUno.
3. Arduino Development Environment, arduino.cc/en/guide/Environment.

