International Research Journal of Engineering and Management Studies (IRJEMS)
Volume: 03 Issue: 05 | May -2019 ISSN: 2395-0126

MIND CONTROLLED ROBOT

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Abstract-: The Mind Controlled Robot is a mobile machine that works on the principle of Brain-Computer Interface (BCI) which enables brain to communicate with external devices. This project is aimed to benefit the partially or completely disabled patients with fully-functioning brains whose neuron movements are impaired. The system consists of an Arduino Board to simulate a brainwave-controlled Robot. The robot is able to move in forward, right and left direction under the control of the user and it is not required to predefine any map or path. This project uses a Neurosky Mindwave Mobile-2 brainwave-reading headset, which has two electrodes. First one touching forehead and another used as a reference point touching earlobe. EEG signal collected by TGAM-1 chip. BCI will be developed by sending the EEG signal to the Arduino Uno. Arduino collects all the EEG signals and control the directional movement of the robot on the basis of EEG signal. Robot is able to detect the obstacles and is restricted to move in the given arena only.

Keywords: Neurosky, Mindwave mobile-2 brainwave, BCI, TGA-M1, EEG, Arduino Uno.

I. INTRODUCTION

There are millions of neurons present in human brain. They are internally connected with each other. The neuronal interaction is affected by Human mind states and thoughts. Interaction between the neurons leads to electric discharge. Measurement of electric discharge is not possible with current technology. Activity of number of neuronal electric discharge form waves, which are measurable. Neuronal interaction forms different brain states which produce waves of different frequencies and amplitude which are used as EEG signal. The integration of brainwave technology into modern-day wheelchairs will give doctors and patients alike new options in addressing motor neuron related handicaps.

In addition to the traditional manpower-driven wheelchairs, electric and battery-powered wheelchairs are now also available. Moreover, wheelchairs can still be taken a step further with the power of brainwaves. EEG is at the core of brainwave technology. It is a way of recording and monitoring brain activities with the use of electrodes attached to a person's head. Basically, the electrodes records activity via electrical impulses that the brains neurons emit tssso communicate with the rest of our bodies. Up until the last few years, EEG has for the most part, only been available in hospitals and other medical institutions where technicians use very expensive EEG equipment that can cost thousands of dollars. These are otherwise unavailable to mainstream consumers and developers. However, the past few years have seen the advancement is done and improvement of more affordable EEG-related products such as Neurosky's Mindwave Mobile 2.

II. LITERATURE REVIEW

Brain Controlled Robot is based on Brain Computer Interface BCIs are systems that can provide conventional channels of communication between the human brain and physical devices that translate the different patterns of brain activity into commands in real time. With these commands a mobile robot can be controlled. Robot that can assist the disabled people in their daily life to do some work independent on others. Here a single robot is used for multiple purposes thereby reducing cost for designing multiple robots.[1]

Millions of people are handicapped. Number of different technologies are developed for controlling the robot move around. Robot or wheelchair is fully automatic and controlled using Beta wave and sensor sense Mind wave which is detected from brain signal.[2]

The objective is to control the direction of an electric wheelchair using only EEG signals. The BCI is a system that acquires and analyzes neural (brain) signals with has a goal of creating a direct high-bandwidth communication channel between this brain and computer. Such systems are envisioned to have huge potentials for a wide ranging areas of research and applications such as brain signal acquisition and processing, bio-engineering.[3]

EEG-based brain-controlled mobile robots that can serve a powerful aids for severely disabled people in their daily life. Specially to help them for moving voluntarily.

Comprehensive review of the complete systems, key techniques, and evaluation issues of brain-controlled mobile robots related future research and development issues. Current challenges and future research directions are required.[4]

The usage of Artificial Neural Network in expectation the heading of electric wheelchair from mind flag contribution for physical versatility weakness. The control of the wheelchair as an exertion in enhancing crippled individual life quality. The connection from debilitated individual is encouraging in connection to public activity with others. Due to the portability weakness, the wheelchair with cerebrum flag input is made. This wheel seat is purposed to encourage the handicapped individual and elderly for their everyday movement.

ANN builds up the mapping from contribution to target. ANN is created in 3 level: input level, one concealed dimension, and yield level (6-2-1). There are 6 motion from Neurosky Mindset sensor yield, Alpha1, Alpha2, Raw flag, Total time flag, Attention Signal, and Meditation flag. The reason for this examination is to discover the yield an incentive from ANN: esteem in turning right, turning left, and forward. From those yields, we can demonstrate the importance to the objective. One of the primary issue that meddling with progress is the issue of appropriate neural system preparing. Arduino Uno is executed the learning program calculation since it is a famous microcontroller that is monetary and proficient. The preparation of fake neural system in this exploration utilizes 21 information bundle from crude information, Alpha1, Aplha2, Meditation information, Attention information, add up to time information. At the season of the test there is an estimation of Mean Square Error (MSE) toward the finish of preparing added up to 0.92495 at age 9958, esteem a relationship coefficient of 0.92804 demonstrates that precision the aftereffects of the preparation procedure great.[9]

A mind PC interface (BCI) is a direct neural interface between a human or creature cerebrum and an outside world. The framework is displayed in which wheelchair is controlled utilizing EEG signals acquired from the human cerebrum. The Neurosky item i.e. mindwave gadget headset is utilized to quantify the human brainwave signals. The signs are then mapped and contrasted and the reference estimation of consideration and contemplation level alongside flickering eye flag. The wheelchair moves in various ways and can be controlled successfully utilizing considerations of the individual correctly. So the human capacity is utilized adequately to control the given wheelchair utilizing exactness of about 95.[7]

Multi sensor based mind PC interface for impaired as well as elderly individuals is proposed. Created framework comprises of a wheelchair, a powerful engine controller card, a Kinect camera, electromyogram (EMG) and electroencephalogram (EEG) sensors and a PC. The Kinect sensor is introduced on the framework to give safe route to the framework. Profundity outlines, caught by the Kinect's infra-red (IR) camera, are handled with a custom picture preparing calculation with the end goal to recognize snags around the wheelchair. A Consumer review EMG gadget (Thalmic Labs) was utilized to acquire eight channels of EMG information. Four diverse hand developments: Fist, discharge, waving hand left and right are utilized for EMG based control of the mechanical wheelchair. EMG information is first grouped utilizing counterfeit neural system (ANN), bolster vector machines and irregular woodland plans.[8]

III. PROPOSED SYSTEM

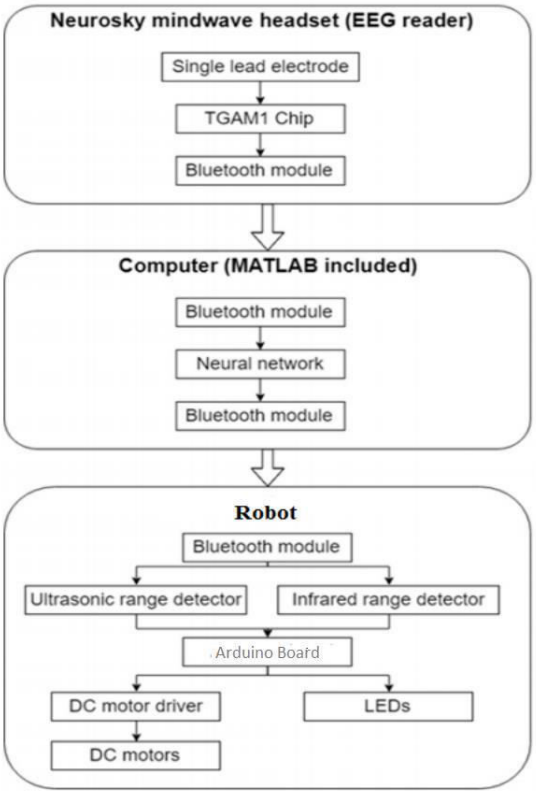
Herewith we propose a system which can be used as a prototype model for brainwave controlled wheelchair. System architecture is shown in Figure below (3.1). The system is formed by a Neurosky headset (EEG reader), a computer included MATLAB and an Arduino Uno Development Board Based robot car. The EEG reader contains a TGAM1 chip that can capture the human brain signal. TGAM1 also provided the signal filter and signal amplification, signal acquisition and signal processing after that EEG signal will be digitized and sent to the Bluetooth transmission module (HC-06). Finally, the EEG signal will be transmitted to the computer for further analysis. MATAB in the computer will be used for noise filtering. It will check whether the user is sending a robot controlling command, or the blinking is just natural blinking of human. If the blinking is belonging to a robot controlling command, MATLAB will also determine which command does the blinking representing. The robot is consisting of 5 components. They are Arduino Board, one Bluetooth HC-05 module, two DC motors, and one L298N DC motor driver. When the Bluetooth HC-05 module received the controlling command from the computer, Arduino commands motor to drive in that direction.

Electroencephalography(EEG):

Electroencephalography or EEG is a method of recording the brain's electrical activity. EEG is done by placing electrodes on the user's scalp. It measures voltage fluctuations within the neurons of the brain. Previously EEG was confined to medical institutions, but the development of cheaper, more consumer-friendly EEG devices have put it in the mainstream market. EEG signal open the gateway for Mindwave robotics. EEG provide values of attention to the controller Arduino Uno.

Neurosky Mindwave Mobile2 Sensor:

Neurosky's Mindwave Mobile is an EEG headset that measures and transmits brainwave data via Bluetooth. It can monitor attention and meditation levels as well as detect blinks. The Mindwave Mobile is one of the most affordable Brain-Computer Interfaces available. Sensor detect all the required values alpha, beta and gamma waves, filter the waves and amplify it and send it to the Arduino Uno via Bluetooth.



Detailed System Architecture

Bluetooth:

Bluetooth has a major role in system. The communication between the Mindwave mobile-2 and the Arduino Uno, with the help of serial communication. Bluetooth is a global wireless communication standard for connected devices wirelessly over a certain distance. Bluetooth devices in use worldwide. Bluetooth devices, depending on the class, can transmit up to 100 m. However, the most common transmission distance for Bluetooth devices is 10 m. The HC-06 Bluetooth module is one of the most common Bluetooth modules used by hobbyists and professionals alike. It is a serial port protocol Bluetooth module that only acts as a slave. HC-06 modules can transmit up to 10 m.

Arduino Uno:

The Arduino Uno is one of the most popular Microcontrollers around. It is based on the ATmega238p. Arduino work as controller in system. It takes input from Mindwave Mobie-2, IR sensor, Ultrasonic sensor and decides the path of the robot accordingly. The Uno has fourteen digital input/output pins with six of those doubling as PWM outputs.

Ultrasonic sensor:

HC-SR04 used as a ultrasonic sensor in the system. It detects the obstacle. If presence of obstacle is detected, it informs controller and robot stops. Ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception.

IR Sensor:

System is a mainly used for handicapped people so robot must move in some perfect arena, so IR sensor is used. It is useful for boundary detection and and restriction of robot in particular arena. In IR sensor emitter and detector are present. Emitter emits the IR rays and detector detects it. IR sensor used in project to restrict the movement of robot in given arena.

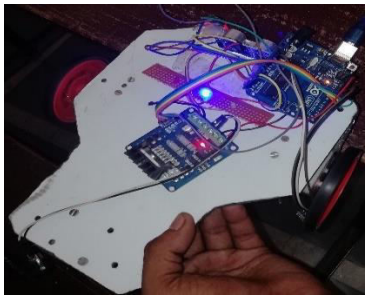
L298N Motor Driver:

The L298N Motor Driver enables the control of DC motors by amplifying the low-current signal from the Arduino into a higher-current signal suitable for motor control.

IV. Experimental data & Results

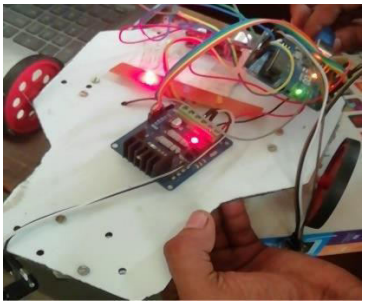
The Forward movement of Robot is totally dependent on the attention level of the user and the movement in right or left direction attain with the help of deflection in the attention level which occurs due to the eye-blink. There is sudden change in attention level occurring due to the intentional eye-blink. Arduino decides the path of robot on the basis of change in attention level. Ultrasonic and IR sensor is provided for the extra accuracy and productive use, with the help of ultrasonic sensor robot is able to detect the obstacle and stop. Using IR sensor robot is able to move in given arena. Robot also provided with the UI (user interface). UI consist of the 3 different LED's which shows us the current status of robot's directional movement.

1) Attention: Above 50



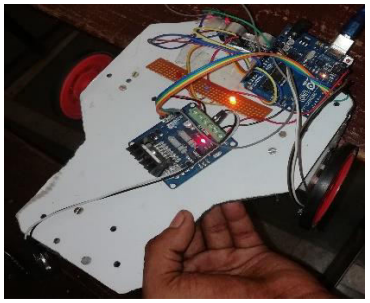
Movement: Forward

2) Eye blink: Once



Movement: Right

3) Eye blink: Twice



Movement: Left

System's Test Results:

Presence of Obstacle	Is Boundary detected	Blinking Frequency	LED Status	Movement of Robot
Yes	No	0	Off	No Movement
No	Yes	0	Off	No Movement
No	No	0	Blue	Forward Direction
No	No	1	Yellow	Left Direction
No	No	2	Red	Right Direction

V. CONCLUSION

In Brain-Computer Interface technology Mindwave Mobile-2 is possibly the most affordable EEG-sensor which is available to developers in the market today even though having less features than other super-expensive, similar devices.

The widespread availability of affordable EEG sensors has opened the doors to the limitless possibilities in the field of brainwave technology. Sensor is more effective on stable mind. Perfect level of attention and meditation can be derived from the stable mind. Robot is able to move under the command of user perfectly, if it get perfect level of attention and change in attention level due to eye blink. Current EEG and brainwave technology, while effective to a certain extent, But not that perfect. Blink detection is still not 100% accurate, an issue that will most likely be solved when the blink detection technology gets better and better. As for brainwave detection, the inconsistencies and fluctuations in brainwave data can mostly be attributed to humans' inability to have complete control over their brainwaves. Algorithms that calculate usable values from raw brainwave data can get better, but until human beings learn how to control and manipulate individual brainwave. This System does hold promise though for the future of EEG and brainwave related products. Brainwave technology will undoubtedly get better over time and we are very confident that the day will come when they can be effectively integrated.

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