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Neural Signal Controlled Wheelchair Based On Electroencephalogram

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***Abstract*—** Every movement of an individual is triggered by the neurons in the brain. With the right equipment and recent developments in both brain imaging technologies and cognitive neuroscience, it is possible to read and record these processes .This has led to the rapidly growing field of brain computer interfaces (BCI). BCIs are systems that can bypass conventional channels of communication (i.e., muscles and thoughts) to provide direct communication and control between the human brain and physical devices by translating different patterns of brain activity into commands in real time The Brain Computer Interface (BCI) helps unblessed people to make use of the devices and applications through their mental activities. Thus, people believe that BCI technology is a blessing for the unblessed persons who may be suffering from severe neuromuscular disorders like paralysis. So, by brain computer interface (BCI) such people are able to use anything like wheelchair, drones, robots etc. with their brain. So in this paper we are developing a cost effective mind controlled wheel chair so physically disabled people can control the chair without any help from others thus self-independent. It works on the concept of Electro encephalogram (EEG). EEG is basically a procedure which is used to track and records brain wave patterns. The EEG signals are captured from user's brain activity using Neuro-sky Mindwave EEG sensor which is placed on the user's forehead. The direction on which wheel-chair has to move is decided based on the processed EEG signal.

***Keywords*—** Brain computer interfaces; electroencephalogram; neuromuscular disorder; neuro-sky mindwave.

I. INTRODUCTION

The human brain is made up of billions of interconnected neurons, the patterns of interaction between these neurons are represented as thoughts and emotional states. Every interaction between neurons creates an electrical discharge. However, the activity created by hundreds of thousands concurrent discharges aggregates into waves which can be measured. Different brain states are the result of different patterns of neural interaction creating different signals of different amplitude and frequencies such as Alpha (7.5-12.5Hz), Beta (12.5-30Hz),Theta (4-7Hz) and Delta waves(1-4Hz). [1] Beta Waves are associated with concentration whereas when a person relax it result into Alpha waves. Here a wheelchair is controlled automatically according to the brain signal. [2] The brain signals are collected using a brain wave sensor. Using these signals wheelchair can be moved. This brain wave sensor consists of 3 main parts. They are dry electrodes, signal conditioning circuit and inbuilt RF transmitter. Dry electrodes are used to absorb the brain waves. This signal is analog in nature. For further processing these analog signals should be converted to digital form. Signal conditioning stage will do this conversion. The next part is inbuilt RF transmitter. It converts this digital signal into packet of data. This data packet is transmitted through Bluetooth transmitter. Attention means the robot is moving forward. Blinking is used for rotation of robot. This output is given to robotic module for automatic movement of robot. [3], [4]

II. METHODOLOGY

The person who is going to use this wheel chair, firstly wears the Neurosky Mind Wave Head-set .This head-set basically sense the brain signals. It consists of an electrode positioned in frontal position of the user scalp. The electric activities of brain are sensed by the electrode and the corresponding values are recorded. The brain waves are firstly collected from 'Neurosky Mind Wave Head-set' which are analog in nature. So, the analog signals are converted to digital signals using signal conditioning unit .These signals are mapped at a rate of 512 SPS (samples per second). [5], [6] The recorded values are then transmitted via USB cable and through Bluetooth and wheel chair performs certain movements like left, right, forward, backward. The controller identifies the command and generates corresponding control signal, and sends it to motor control circuitry. Motor control circuitry initiates corresponding activity of the motor driven wheel chair. Thus the user is able to maneuver the wheel chair safely. For the working of wheelchair we require an electric wheelchair, a laptop computer, an Arduino, an interface circuit, an EEG headset, and a collection of ready-made and custom software.

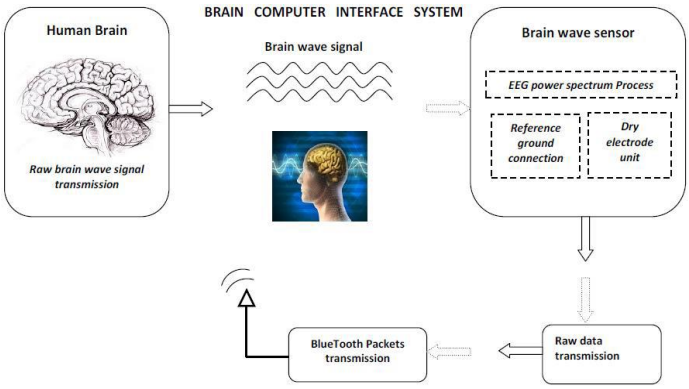

Fig. A: Block diagram of transmitter section.

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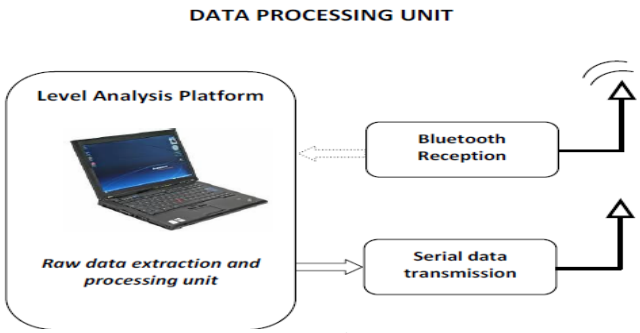

Fig. B: Block diagram of receiving section.

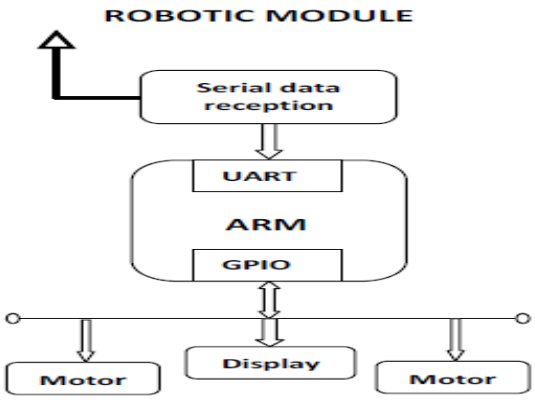

Fig. C: Robotic module.

III. Hardware Module

- *HC-05 Bluetooth Module*

It is a class-2 Bluetooth module having serial port profile, which can configure as either master or slave. A drop in replacement for wired serial port connection, transparent usage. We can use it simply for a serial replacement connection between MCU, PC and to our embedded project etc.

HC-05 Specification

1) Bluetooth protocol: Bluetooth specification v2.0+EDR.
2) Frequency: 2.4 GHz, 15M band.
3) Modulation: GFSK (Gaussian frequency shift keying).
4) Emission power < 4dBm, Class-2.
5) Profiles: Bluetooth serial port.
6) Power supply +3.3VDC 50mA.

- *Neurosky Mindwave Headset*

Fig. D: Neurosky mindwave headset.

Figure D shows neurosky mindwave Headset which safely measures and outputs the EEG power spectrums (alpha waves, beta waves, etc.), Neurosky eSense meters (attention and meditation) and eye blinks. The device consists of a headset, an ear-clip, and a sensor arm. The headset's reference and ground electrodes are on the ear clip and the EEG electrode is on the sensor arm, resting on the forehead above the eye (FP1 position). It uses a single AAA battery with 8 hours of battery life.

- *ATMEL Microcontroller (16 BIT)*

It uses low power has high performance and feature 128Kb self-programming flash programming memory. It features 44 pin package. Specification also include 8KB SRAM, 2048-Byte EEPROM, external bus interface, 4-channel DMA controller, 8-channel event system, and up to 32 MIPS throughput at 32MHz

IV. Software Module

The open source Arduino software (IDE) makes it easy to write code and upload it to the board. It runs on windows, Mac OS X, and Linux. The environment is written in java and based on processing and other open source software. This software can be used with any Arduino board.

V. Initialization Process

The Nuerosky mind wave EEG headset sensor is interfaced with the laptop via Bluetooth link to one of the COM ports of the laptop. The program access the data sent to the COM port by the headset with function "Think Gear Create Task" which is used before initialization of any task related to headset. The COM port is assigned as the source file to the "Think Gear Create Task" function. This function clears any open connection at the COM port, and creates new connection with headset. Prior to the above process function "Think Gear Clear Connection" is used to disconnect any connectivity between headsets and any other program or device. The function "Think Gear Enable Blink Detection" is initiated to detect blink made by the user. The blink acts as an important response from the user for case selection in the program. Now the function "Think Gear Start Task" is initiated; this function starts the think gear tasks by establishing stable communication with the headset without any large delay. Thus pairing of headset and laptop takes place. Next function "Think Gear Signal Quality" is used to determine the signal quality available which is indicated on the front panel tab for the user.

VI. CONCLUSION

The Brain Computer Interface (BCI) helps unblessed people to make use of the devices and applications through their mental activities. The unblessed persons who may be suffering from severe neuromuscular disorders like paralysis .So, by brain computer interface (BCI) such people are able to use anything like wheelchair, drones, robots etc. with their brain. The proposed system uses an EEG to overcome the previous challenges and to achieve higher accuracy. Stability

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of system depends upon user thoughts so users have to take more training of system.

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