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# Implementation of Brain Controlled Robotic Car to Assist Paralytic and physically Challenged People by Analyzing EEG Signals

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***Abstract:***
***In our society, many people are suffering from paralytic diseases which causes several disabilities like they are unable to talk , move physically and also to express their needs. Still, they mostly move their heads and blink their eyes. Based on their ability to blink, we have designed our project which is working under the principle of Brain-Computer Interface (BCI). BCI is based on the direct communication path between the Brain and digital computer. The BCI system enhances the quality of paralytic patients life. BCI which monitors EEG waves from the Brain. EEG –Electroencephalography which observes an Electrical property of the Brain through the Scalp (Noninvasive). The NeuroskyMindwave mobile measures intentionally directed EMG activity (blink strength).***
***Our proposed system helps them to control the robotic car to the desired place by their eye blink. So they don't need any caretaker to drive them, they can drive their robotic vehicle themselves. The robotic car starts moving when we run the program; then the direction is chosen by having eye blinks.***

***Key Words: Brain-Computer Interface, (BCI),Electroencephalography (EEG), Raspberry Pi.***

## 1. Introduction:

### 1.1 Raspberry pi:

Raspberry Pi is a mini Computer with inbuilt functions founded by United Kingdom foundation. The original model becomes far more popular than anticipated sealing outside of its target market, for uses such as robots. The central unit of the Raspberry Pi is a Broadcom System on Chip (SOC) which includes ARM-compatible CPU and on-chip graphic processing unit and Vediocore IV. Raspberry Pi has mainly three generations Raspberry Pi 1, Raspberry Pi 2, Raspberry Pi 3 and also a reduce simple inexpensive Raspberry Pi zero. The Raspberry Pi is a single computer, or SoC uses the ARM1176JZF-Score. SoC, or System on a Chip, is used for placing all required electronics for operating a computer on a single chip. Raspberry Pi supports an Operating system to configure. To reduce the cost, the Raspberry Pi neglects non-volatile memory to store the bootloaders, Linux Kernels and file systems which are embedded systems. We use an SD card for memory purpose. After bootload, as per the application program, Raspberry Pi is executed.

### 1.2 Architecture:

The heart of the Raspberry Pi processor is a Broadcom BCM2837 system-on-chip (SoC) multimedia processor. The processor components include its central and graphics processing units with the audio and communications hardware, embedded in a single part hidden beneath the 256 MB memory chip present at the centre of the board.The design of SOC which makes the Broadcom(BCM2837) different to the processor found in the desktop or laptop. Instruction set architecture (ISA), known as ARM, is differently used here. The CM2837SoC is present beneath a Hynix memory chip founded by Acorn Computers back in the late 1980s; the arm architecture is not commonly used in the desktop world.

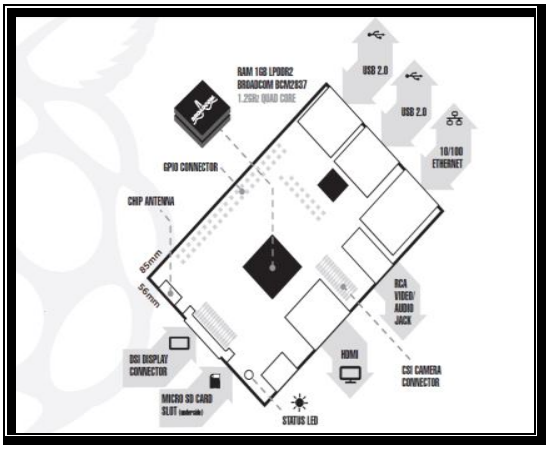



Fig 1 Architecture of Raspberry pi

In mobile devices: the phone in your pocket almost has at least one ARM-based processor hidden within. Its uses the combination of a simple reduced instruction set (RISC) architecture and complex instruction set (CISC) architectures low power draw make it the perfect choice over desktop chips with high power demands. The secret of how the Raspberry Pi can operate on just the 5V 1A power supply is because of the ARM-based BCM2837 provided by the onboard micro-USB port. This device does not require any heat-sinks: during complicated processing tasks, the chip's low power obtained directly translates into very little waste heat. Raspberry Pi isn't compatible with traditional PC software. The software used in desktops and laptops is x86 instruction set architecture, as present in processors from the likes of AMD, Intel and VIA. Hence, the software does not support ARM-based Raspberry Pi. The BCM2837 uses a generation of ARM's processor design known as ARM11, which in turn is designed around a version of the instruction set architecture known as ARMv6. It is a lightweight and sturdy architecture but has an opponent in the more advanced ARMv7 architecture used by the ARM Cortex family of processors. Software developed for ARMv7, like the software developed for x86, is sadly not compatible with the Raspberry Pi's BCM2837—although developers can usually convert the software to make it suitable. Nevertheless, the user is not restricted to choices. There is much software available for the ARMv6 instruction set; hence the Raspberry Pi's popularity progresses to grow. In our paper, we would learn how to create our software for the Raspberry Pi even if we don't have any experience in programming.

**1.3 Windows VS Linux:**

The main distinction between the Raspberry Pi and our desktop or laptop, other than the size and price, is the operating system(OS) which is the software that allows us to control the computer. Most desktop and laptop computers which are in accordance today runs one of two operating systems: Microsoft Windows or Apple OS X. Both platforms are closed source, developed in a hidden environment using exclusive techniques. Windows and Apple operating systems are called a closed source because of their source code, and the computer-language initiates the order about how to proceed. In closed-source software, the instruction is kept confidential. We can able to obtain the finished software, but never the procedure remains invisible. The Raspberry Pi is designed to run an operating system called GNU/Linux which is also called as Linux. Unlike Windows or OS X, Linux is open source we can download the source code for the complete operating system and make the desired changes. Nothing is hidden, and all changes are made for a full view of the public. The porting is known as the open-source development, which allows the Linux to quickly alters to run Raspberry Pi, this process is known as porting. At the time of this writing, several versions of Linux-known as distributions-have been ported to the Raspberry Pi's BCM2837 chip, including Debian, Fedora Remix and Arch Linux. The different distributions serve different needs, but they consist of some everyday things: which is open-source. They are large, compatible with each other software is written on a Debian system which operates on Arch Linux and vice versa.

Linux does not use the recipe to Raspberry Pi. We found there are nearly hundreds of various distributions for desktops, laptops, mobile devices and Google's popular Android platform which is developed on a Linux core. If we want to enjoy the experience of using Linux on the Raspberry Pi, we could prefer attaching it to other computing devices to use as well. It coexists with our current operating system, allows us to enjoy the benefits of giving a familiar environment when your Raspberry Pi is not available. The difference between ARM and x86 is that there's a pivotal point to make about the real distinction between Windows, OS X and Linux is the software written for Windows or OS X won't support in Linux. Alas, there are plenty of compatible alternatives for the majority of common software products-but still, the many are free to use, and the operating system is an open-source itself.

**1.4 Features:**

- CPU speed ranges from 700 MHz to 1.2 GHz.
- Onboard Memory (RAM) ranges from 256 MB to 1 GB.
- USB slot differs from 1 slot to USB slots.
- HDMI, composite video output and 3.5mm phone jack.
- The low-level output is provided by GPIO pins which support standard—protocols like I2C (inter-integrated circuit).
- Ethernet 8 Position 8 Contact (8P8C) is another essential feature.

## 2. PROPOSED METHODOLOGY:

In our proposed system, we use Raspberry Pi 3 Model B+; it does not require Matlab for processing the signal. Raspberry pi consists of in-built Bluetooth, so there is no need for external Bluetooth to be connected. Raspberry Pi acts as a core, so these applications do not require any laptop/pc. In raspberry pi, the signal is self processed. When the system begins to run, the robotic car moves automatically, whenever one blink is detected car turns front if two blinks are detected car turns back if three blinks are detected car turns left, if four blinks are detected car turns right. If any abnormal or no blink is detected car stops automatically. The main application of this system is for paralyzed people; by this system, they can able to move their robotic car, without any dependencies.

## 3. BLOCK DESCRIPTION:

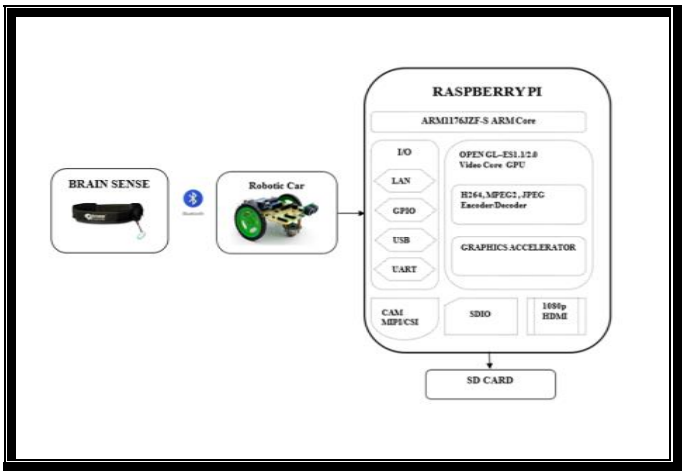


Fig 1.1 Block diagram

The block diagram consists of two components Robotic car and Brain sense. The robotic car consists of raspberry pi and L293D motor drive circuit. GPIO pins of Raspberry Pi are connected with the robotic car, which contains inbuilt Bluetooth. Mindwavemobile(brain sense)which also has inbuilt Bluetooth, it is connected with Raspberry Pi.

### 3.1 Brain sense:

Brain sense is a headset band and mobile app duo that tracks and helps out to improve our focus concerning activity, environment, emotions and any other behaviour we want.

Fig 1.2 Brain wave detecting headset

### 3.1.1 Specifications:

- It uses the Think Gear-AM(TGAM1) module, dry electrode and ear clip electrode.
- It makes automatically starts wireless pairing.
- The runtime of the battery is around 7 hours.
- It supports iOS and Android.

### 3.2 L293D driver circuit:

L293D is an integrated circuit chip Motor driver which enables the DC motor to move around on any direction. The L293D is a 16-pin driver IC which controls the DC motors connected to the circuit simultaneously in any direction, which means that the user can control two DC motors with a single L293D IC. Dual H-bridge *Motor Driver integrated circuit* (*IC*).The L293D motor IC could drive small as well as big motors and check the Voltage Specification at the end of the process. It is based on the idea of H-bridge. H-bridge is a dual motor drive IC circuit that makes the voltage to pass through either direction. As the energy is changed in either direction, the motor rotates in either clockwise or anticlockwise direction. Therefore, for this H-bridge IC is ideal for driving a DC motor. A single L293D motor circuit consists of two h-Bridge circuits placed inside the IC which can rotate two dc motors independently. Due to its size, it is highly used in a robotic application for driving DC motors. Given below the pin diagram of an L293D motor driver circuit.

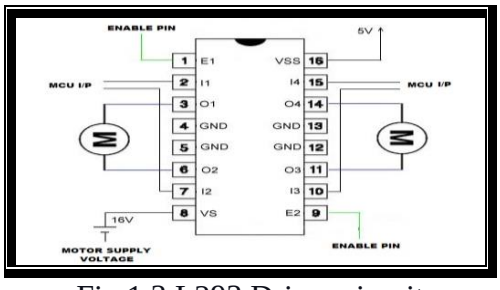



Fig 1.3 L293 Driver circuit

### 3.3 Robotic car:

The robotic car consists of raspberry pi three processors with an L293D drive circuit, which is used to drive dc motor.

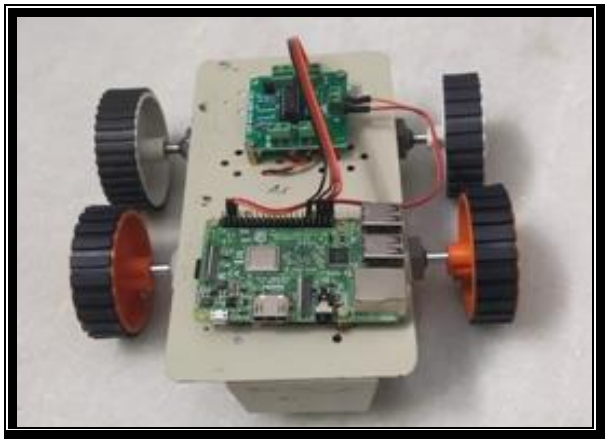


Fig 1.4 Robotic car

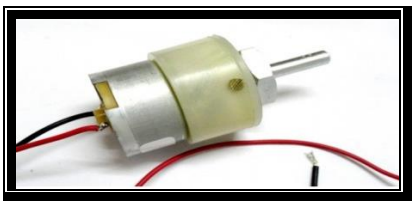


Fig 1.5 DC Motor

### 3.4 Electroencephalogram using BCI:

Electroencephalography (EEG) is the recording of the electrical activity of Brain with the scalp caused by the bombardment of neurons within the Brain. The working of BCI is connecting electrodes in the scalp, and it is recorded by an electroencephalogram (EEG). It appears to be an adequate alternative because of its proper time resolution and relative simplicity.

Therefore it is clear that observable changes in EEG result from performing given mental activities. The BCI system is divided into three subsystems. They are EEG acquisition, EEG signal processing and output generation.

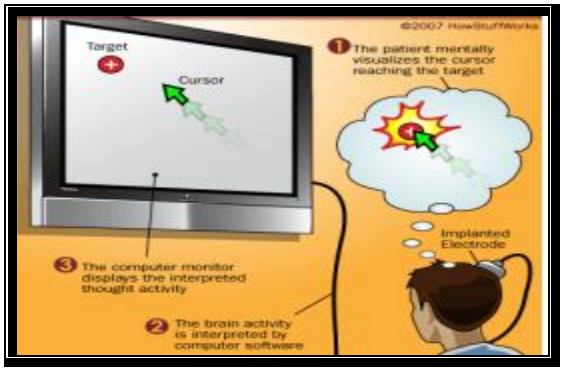



Fig 1.6 Working of BCI

### 3.4.1 How BCI Works?

At Present BCI uses EEG activity recorded in the scalp which controls cursor movement, select letters or icons, or operates a neuroprosthesis. The element present in the middle of each BCI is a translation algorithm which converts electrophysiological input from the user into an output that controls external devices. BCI operation requires effective interaction between two adaptive controllers: the first one is the user encoded in the electrophysiological input provided to the BCI, and the second is the computer which recognizes the command present in the input and expresses in the device control. The maximum information transfer rates of current BCI's are 5-25 bits/min.

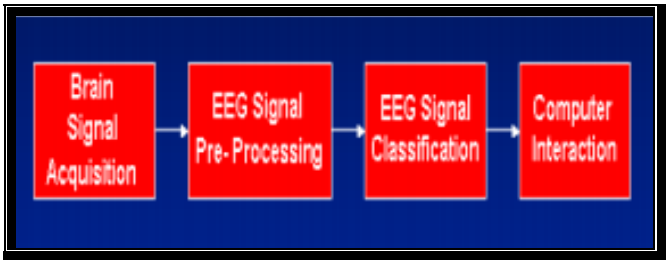



Fig 1.7 Steps involved in BCI

## 4. Software Description:

### 4.1 Programming languages:

There are numerous programming languages which have been tested for Raspberry Pi. Python programming language is being accepted for raspberry pi by The Raspberry Pi foundation, especially for the users in the beginning stage. Any programming language can be compiled for ARMv6 and can be executed on the Raspberry Pi. Therefore the users are not limited to use only the Python. On the other hand, in Raspberry Pi, there are preinstalled several languages, for example, C, C++, Java, Scratch and Ruby.

### 4.2 Python programming language:

Python programming language is developed in the late 1980s at the National Research Institute by Guido van Rossum. Python gained its popularity in recent years due to its features, and it is widely used for commercial purposes.

Python is an adaptable and powerful programming language which is easy to learn and follow. The syntax of Python makes the users as a valuable tool for those who want to learn to program. This is the main reasons for Python to be recommended by the Raspberry Pi Foundation. It is published under an open-source license, and it makes it available for all kinds of operating systems. Python supports on Linux, OS X and Windows computer systems.Cross-platform runs on guarantees that the programs which are written in Python are also configured in other platforms. There are few limitations where the programs are not compatible. For example, if the Python is configured to use specific hardware such as Raspberry Pi's GPIO.

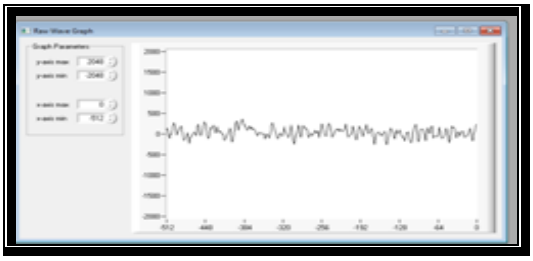
## 5. Result:

From this system, we use Brain Controlled interface technique to operate the robotic car with the help of raspberry pi. We have tested our system on different paralytic patients and found that they did not require any external dependencies. If any error is detected, it can be rectified quickly. For future development and visual signals if necessary, can be detected by brain sense.

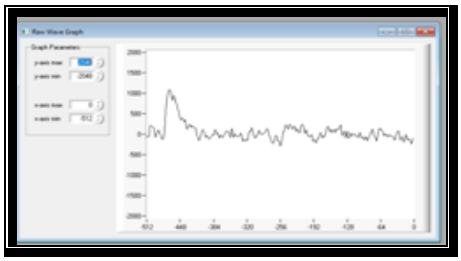
| S.No | Activity | Action |
|---|---|---|

| | | |
|---|---|---|
| 1 | 1 Blink | Front Movement (for 5 sec) |
| 2 | 2 Blink | Back Movement (for 5 sec) |
| 3 | 3 Blink | Left Movement (for 5 sec) |
| 4 | 4 Blink | Right Movement (for 5 sec) |
| 5 | No Blink | Stops (after 5 sec ) |
| 6 | Abnormal Blink | Stops (after 5 sec ) |

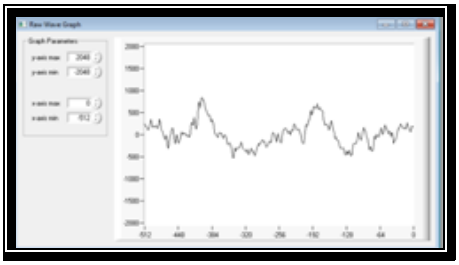
Table 1.0 Interpretation of blink signals



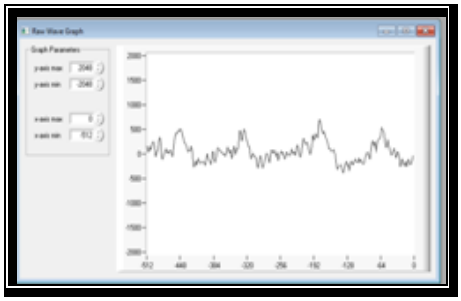
(a)



(b)



(c)



(d)

(a) when no blink is detected (b) when one blink is detected (c)when two blink is detected (d) when four blink is detected.

Fig 1.8 Snapshots of blink signals

## 6. Conclusion:

The proposed system is easy to reconfigure for other parameters like attention, meditation and adding several blinks for movement in various directions. The intensity of Eyeblink differs from person to person so that we can modify the code for high accuracy for blink detection.

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