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The Brain Signal Detection for Controlling the Robot

Krishnaveni Yendrapalli [1], S. S. Naga Pavan Kumar Tammana[2]
[1,2]Dept. of ECE, Vignan's Lara Institute of Science And Technology, Vadlamudi, Guntur dist (A.P), India
krishnaveni.yendrapalli@gmail.com[1],vlsipavi@gmail.com[2]

Abstract: ***This project discussed about a brain controlled robot based on 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. With these commands a mobile robot can be controlled. The intention of the project work is to develop a robot that can assist the disabled people in their daily life to do some work independent on others.***

Keywords: EEG, BCI and Robot movement.

1. Introduction

Here, we are analyzing the brain wave signals. Human brain consists of millions of interconnected neurons. 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 as show in the block diagram in fig a. 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. Level analyzer unit (LAU) will receive the brain wave raw data and it will extract and process the signal using MATLAB platform which is shown in data processing unit fig b in the block diagram. Then the control commands will be transmitted to the robotic module which is the vehicle section as shown in fig c in the block diagram to process. With this entire system, we can move a robot according to the human thoughts and it can be turned by blink thoughts and it can be turned by blink muscle contraction.

Electroencephalography (EEG) is the measurement of electrical activity in the living brain. In this project we used a brainwave sensor MW001 to analyze the EEG signals . This design discuss about processing and recording the raw EEG signal from the Mind Wave sensor in the MATLAB environment and through Zigbee transmission control commands will be passed to the Robot section. Mind wave sensors are not used in clinical use, but are used in the Brain Control Interface (BCI) and neurofeedback (one of biofeedback types). The BCI is a direct communication pathway between the brain and an external device 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 [3].

This project work consists of a Processor using ARM7 core, brain wave sensor and alert unit obstacle detection unit as hardware parts and an effective brain signal system using Mat lab platform. In this project initially the person's attention level or else the driver's drowsy level should be found out by the Brainwave Sensor. Whenever a person is starting the car, the brain wave sensor unit will calculate the blinking level and it will compare with the minimum attention levels of human when ever not sleeping. Set point then automatically vehicle will move without any problem.

In case if the blinking levels will cross the set point, then the vehicle will stop and vehicle driver will getting an alert. Most case, we can compare the owner's blinking levels with stored blinking levels. Now, the owner has to check whether the robot move or not. If he is a not walking then the robot will automatically start.. But if he is normal mode then the vehicle will run and there is no alert. Once the car received blinking command it will stop regardless the place. Further, if the owner wants to move the vehicle he has a need to come normal mode. This will help to avoid the movement during in person.

The existing system is not having any remote control operation, Depend on others to operate and No muscle contraction sensing and the proposed system is having the Brain wave analysis for the signal which are taken from the human brain as shown in the block diagram, is having controlling of the robot using Human thoughts, Self controlled and operating facility for not to depend on others to operate and having Bluetooth communication between the operating system and brain wave sensor

BLOCK DIAGRAM:

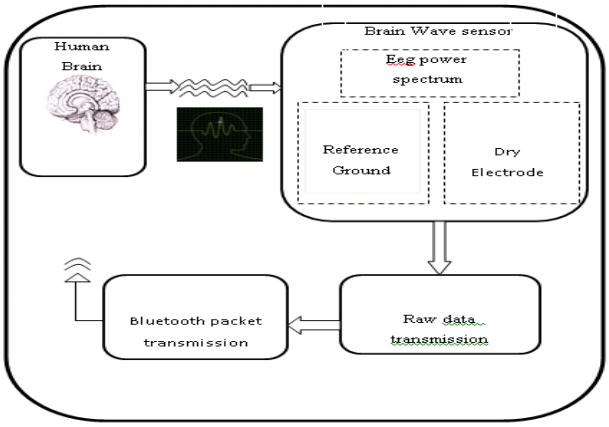

Fig a: Brain computer interface section

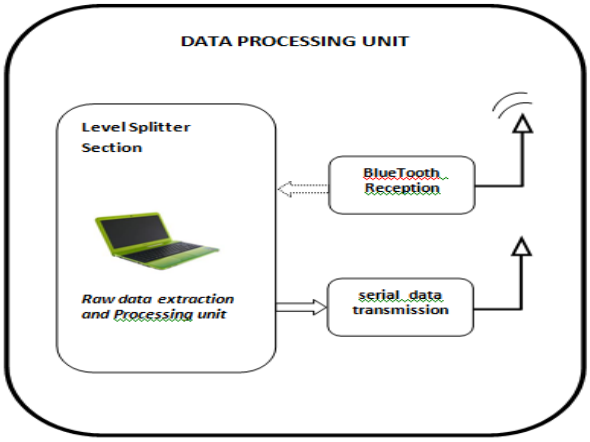

Fig b: Data processing unit

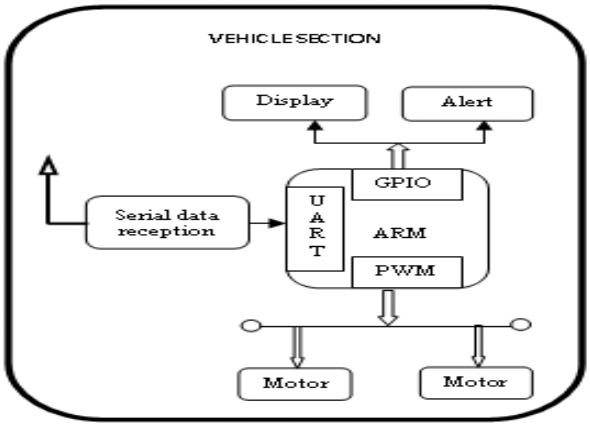

Fig c: Vehicle section

2. DESIGN AND IMPLEMENTATION

This project uses two important platforms. 1. Coding Platform and 2. Execution Platform. These platforms are discussed below

2.1 Coding Platform: In this project a brain computer interface system is used which will do the key role in the entire operation. For the BCI system, we are using the MATLAB and for brain wave sensor and Processor communication neurosky is used.. The BCI will process in the following way.

For calculating the blinking levels we need to use a brain wave sensor support a neurosky product which is called mindo4 initially we have to take the data from the brain by using neurons position and should store in the brain wave sensor. The supportable sensor in the MATLAB is given in the form of the following data function

connectionId1
=calllib('Thinkgear','TG_GetNewConnectionId');

Initially we need to check that sensor is connected or not. The mind wave sensor software will provide the information about the sensor connection. If the sensor is connected we are entering in to the MATLAB section for checking the blinking levels of person.

Once the blinking levels will calculated it will be send to MATLAB. Whenever MATLAB reads an blinking values it will convert into digital values because for micro controller understanding purpose the values should be in digital format. After calculating the blinking values, we need to check whether it will cross the set point in the database. As an acknowledgement we will get the following help dialogue

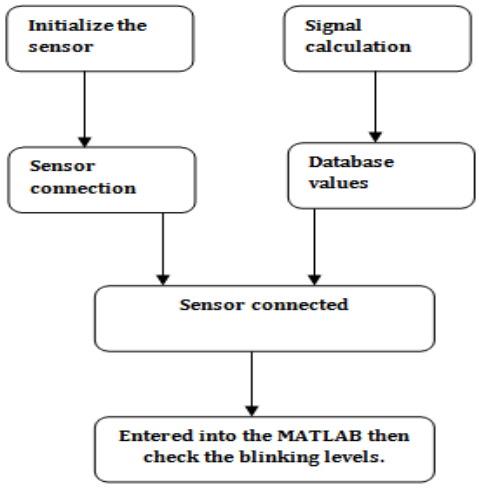

Fig d: BCI Software architecture

```
if(data_BLINK (j) > 90)
                    if(Drive mode == 1)
                    fopen(serial One);
                    fwrite (serialOne,'Q');
                    fclose (serial One);
                              End;
```

Then pre-processing will be done within the blinking levels and the database values which involves, Similarity checks and probability finding. Here similarity checking is nothing but the comparison between two blinking values by calculating the change between the input and data base values. Then the result will be shown on the MATLAB.

```
if(data BLINK (j) > 90)
    %              if(Drive mode == 1)
                    fopen (serial One);
                    fwrite (serialOne,'Q');
                    fclose(serial One);
    %              end
              end
```

Drowsiness, eyes open and eyes closed are closely connected to alpha activity. once sleepiness forces the eyes to shut, alpha waves are strongest encephalogram brain signals have reported that in sleepiness state alpha activity mainly seems in os space and particularly magnitude of alpha2 wave like a better alpha band (11~13Hz) increases. However, supposing traditional adults have their eyes open notwithstanding they drowse, alpha changes of can't be explain one thing logically.

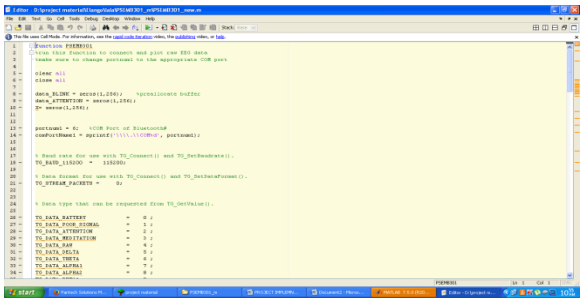

Fig e: BCI running image

2.2 Execution Platform:

This half consists of ARM core processor as a main unit, Brain wave device system, Ignition unit, PC, alert section and a show unit. This modules with coming up with and implementation technique is given below.

ARM processor is employed for dominant the system. Here we have a tendency to square measure victimization the LPC2148 series, which has 2 UART. In UART0 we'll interface the GPS receiver to induce the orbital info and in UART1 we will interface the computer for image process. Then the ignition driver circuit is connected to the GPIO pin of ARM. Interrupt routine code is employed to visualize whether or not we have a tendency to have gotten any serial interrupt (i.e.,) from owner any command is returning or not. For this project we have a tendency to square measure having some interrupt checking commands 'Q' and 'X'.The interrupt routine code for command checking is given within the column below.

Once ARM processor receives a command 'Q' through UART1, then the processor can move the motive force circuit. Attributable to this the engine is going to be move instantly. Next, if the processor receives a command 'X', then UART0 receiver interrupt is going to be enabled. So, this worth within the information base can compare mechanically the motive force management unit can stop. This interrupt routine code is going to be checked by the processor endlessly that will increase the potency of the project. These interrupt checking technique must tack the vector address. that the vector address configurations for each UART square measure given below. The Vectored Interrupt Controller (VIC) takes thirty two interrupt request inputs and directly programmable assigns them vectored IRQ. VICIntSelect may be a register that have the management of all interrupt registers. As we have a tendency to square measure victimization the UART0 interrupt and UART1 interrupt we've to simply modify the sixth and seventh little bit of the VICIntSelect register. When facultative for every interrupts separate slot ought to be enabled for process. thus whenever associate interrupt is returning from the device, then ARM processor will directly jump to the interrupt routine to process the command.. due to this facility ARM will handle the various interrupts from the device and might do the individual functions with none fault.

During this project the engine unit are going to be controlled by a driver circuit. the motive force circuit consists of a driver unit, electrical device and a semiconductor unit. If the automobile is started, the engine are going to be turned ON which implies ARM processor can offer the bias voltage to the semiconductor unit to modify on the relay that successively activate the automobile engine. Meantime the processor can check the interrupt routine. Once if it receives the interrupt 'X' through UART then the processor can cut the bias voltage to the semiconductor unit. So that, the engine is going to be turned off.

3 WIRELESS PLATFORM:

3.1 BCI system:

The main purpose of the current chapter is to review recent advances within the EEG field. to grasp these developments it'll initial be necessary to detail the physiological basis of the EEG signal. After, vital problems related to knowledge acquisition, signal process, and quantitative analyses are going to be mentioned. the most important portion of the chapter are going to be dedicated to reviewing rising supply localization techniques that are shown to localize EEG activity while not postulating a priori assumptions concerning the amount of underlying sources. As we are going to discuss, maybe the best advancements within the EEG field within the last 5-10 years are achieved within the development of those localization techniques, especially once utilized in concert with high-density EEG recording, realistic head models, and different purposeful neuro imaging techniques.

The time unit temporal resolution of electroencephalogram permits scientists to analyze not solely fluctuations of electroencephalogram activity (i.e., increases/decreases) as a operate of task demand or subject samples however conjointly to differentiate between practical repressive and excitant activities. Low frequencies (e.g., delta and theta) show massive synchronal amplitudes, whereas electroencephalogram frequencies (e.g. beta and gamma) show tiny amplitude owing to high degree of asynchrony within the underlying somatic cell activity. In adults, the amplitude of normative electroencephalogram oscillations lies between ten and a hundred (more ordinarily between ten and fifty; Niedermeyer, 1993). Within the following section, a quick review of varied electroencephalogram bands and their supposed practical roles are going to be given. The review of the muscular and physiological basis underlying the generation of varied electroencephalogram oscillations

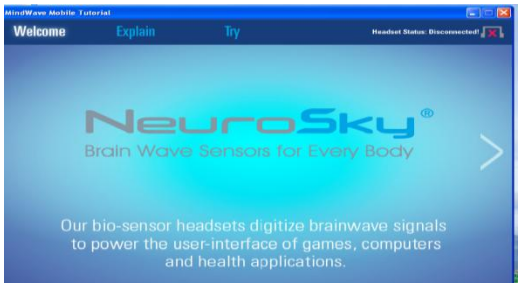

Fig f : Sensor status indicator

3. RESULTS AND ANALYSIS: The principle of operation is quite simple. Two dry sensors are used to detect and

filter the EEG signals. The sensor tip detects electrical signals from the forehead of the brain. At the same time, the sensor picks up ambient noise generated by human muscle, computers, light bulbs, electrical sockets and other electrical devices. The second sensor, ear clip, is a grounds and reference, which allows Think Gear chip to filter out the electrical noise. The device measures the raw signal, power spectrum (alpha, beta, delta, gamma, theta), attention level, mediation level and blink detection. The raw EEG data received at a rate of 512 Hz. Other measured values are made every second. Therefore, raw EEG data is a main source of information on EEG signals using Mind Wave MW001.The BCI software architecture gives the design flow for the execution of this project as shown in the fig d and the fig e gives the snap shot for the BCI running image.

In the Robot section we can read the value of raw EEG signal with the maximum frequency of 512 Hz. Sampling frequency is set on 512 Hz, and we control time delays in sampling. The value of the signal and time are written to the array data. The data which are stored in array will be compared with the threshold points given by the user. In this project, the MATLAB section waits for three consecutive blink in order to send the Robot activation signal. Then based on the attention level value Robot Move Forward Command will be send to the Robot module through Zigbee transmission. After three consecutive blink, the program will scan for a left blink and right blink to turn the Robot right and left respectively.

4. CONCLUSION

The research and development of brain-controlled mobile robots have received a great deal of attention because they can help bring mobility back to people with devastating neuromuscular disorders and thus improve their quality of life. In this paper, we presented a comprehensive of the brain-controlled mobile robot

This project work uses a brain wave sensor which can collect EEG based brain signals of different frequency and amplitude and it will convert these signals into packets and transmit through Bluetooth medium in to the level splitter section to check the attention level. Level splitter section (LSS) analyses the level and gives the robot movement for the person who is sitting in the wheel chair.

The major difference between brain-controlled mobile robots and other brain-controlled devices is that these mobile robots require higher safety because they are used to transport disabled people. Many researchers have developed various brain controlled mobile robots using different BCI techniques as well as other techniques such as intelligence techniques (in sensing situations, localization, and path planning) and shared control techniques so as to make these robots safer. However, much work remains to be done before brain-controlled mobile robots can be applied in practice, including finding ways to improve the performance (especially robustness) of BCI systems, to improve the overall driving performance given the constraints of the BCI system, and to establish standard evaluation method to facilitate the research and development of brain-controlled mobile robots.

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