REVIEW ON BRAIN CONTROLLED WHEELCHAIR

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Abstract: Being a responsible individual of the society, one should improve the quality of life for the disabled people. The crippled individual experiences various issues relying upon the degree of handicap. The scientists proposed and presented various tasks and research attempts to take care of the referenced issues through brain controlled wheelchairs using BCI. One of the major applications of brain computer interface is Electroencephalography (EEG) based wheelchair which permits an individual suffering from mobility impairments to perform day to day activities independently. The waves from BCI are detected with the help of sensors placed on the scalp of an individual and are analyzed using Neurosky mind wave device. This paper proposed a wheelchair development control framework dependent on Electroencephalography (EEG) signals of human cerebrum for disabled utilizing face activities, eye blinks, electrical signals, human thoughts, muscle contraction.

Index Terms **- BCI; Brain-controlled wheelchair; EEG; Embedded Systems; Control System; Mind wave**

I.INTRODUCTION

There have been a wide scope of advancements that help the impaired genuinely tested and it is basically designed to help the physically disabled people. The wheelchair also has grown fundamentally with an assortment of direction frameworks close by like utilizing the joystick and a material screen, and frameworks dependent on voice acknowledgment. These system are certainly used by upper body mobility of person. Those experiencing a more prominent level of loss of motion will most likely be unable to utilize these system since they require precise control. To help improve the way of life of the genuinely tested further, it is essential to build a wheelchair framework that moves in agreement with the signs acquired from the neurons in the mind. Since the brain includes a plenty of neurons which process the information, thus it targets investigating the signs gathered from EEG to help move the wheelchair. Real time Electroencephalography (EEG) signals from scalp are recorded .Small electrical current signals are measured in order to show activities in brain. EEG signal is composed of n number of frequency bands that are Delta δ, Beta β, Theta θ, Alpha α and Gamma γ which shows different activities of brain. The power of the frequency bands is changed regularly. Also, the degree of awakens and brain activity describes the strength of EEG bands. Numerous non-solid control and correspondence frameworks can profit by EEG signals recorded from the human scalp and those systems are said to be Brain Computer Interface(BCI). A handicapped individual is an individual who doesn't ready to move a few or the entirety of his appendages (the two arms and legs). Among the human bio signals, EEG signal is the most troublesome one to record. It is probably going to meddle with different signs that are on a similar scope of frequencies and it is one of the most fragile. Its amplitude is very low (0.5-100 micro volts). The development of quadriplegia wheelchair control system was done using EEG signals captured by Emotive Insight headset.The facial expressions are sampled at the rate of 128 or 256 samples per scepter channel and band pass filtered between .2 and 43 Hz.

Then the signals is sent to PC through Bluetooth, the headset utilizes Bluetooth 4.0 LE (Low Energy). The client needs to prepare his face activities so as to utilize the main qualified EEG information. Five outward appearances were embraced that are Blink, Wink left, Wink right, Raise brows (Surprise) and Furrow brows (Frown). The last sign is given to Raspberry Pi III by means of Wi-Fi. The Raspberry Pi controls the movement of the wheelchair through the approaching sign from the headset. Obstruction evasion was considered, two ultrasound sensors where added to stop the wheelchair. Brain Computer Interface (BCI) framework was acquainted with make an interpretation of human contemplations into activities without any muscles inclusion. This framework was utilized by the crippled individuals to improve their abilities at home.

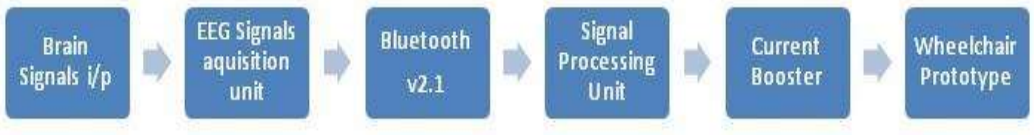

Fig1:Basic Block Diagram of Brain Controlled Wheelchair.

It was created in light of the fact that it has been seen that street mishaps are caused because of driver's physical exhaustion just as mental weariness. The driver was posed not many inquiries to evaluate his feeling of anxiety. In the interim, EEG signals were obtained with Emotive headset, pictured and recorded with Emotive control board. On the off chance that the driver was found intellectually lopsided, an alert would ring to caution him from driving.

II. METHODOLOGY

The point of making a brain controlled wheelchair is to utilize parameters accumulated by the headset to move the wheelchair in the ways the people needs, the fundamental being consideration and contemplation. The proposed system includes utilizing the wheelchair to move around utilizing neuron signals.

2.1 Signal Acquisition

Signal Acquisition includes the sampling of the physical real world signals into digital signals and controlled by computers. Acquiring the data from brain using EEG signal is usually done by placing different types of mindset on the scalp which consists of electrodes. The types of mindset used are as follows:

Emotive Insight Headset[1].It consists of 5 channels, two reference electrodes, and connectivity is through Bluetooth 4.0 LE, battery life is 4 hours minimum and no conductive gel required.

Mind Wave headset[2, 3, 4, 5].It consists of a ear clip and a sensor arm .The ear clip consists of reference and ground electrodes and sensor arm consist of EEG electrode placed on forehead(FP1 Position),battery life is 8 hours minimum.

Emotive EPOC headset[6].EEG signals are captured using the Emotive headset. Emotive EPOC is an EEG headset which supplies 14-channel EEG data and 2 gyros for 2- dimensional controls. Its features are adequate for a useful BCI (resolution and bandwidth). Our system uses upper face gestures for actuation commands; since most Emotive sensors are located in the frontal cortex, they are the most reliable signals to detect.

2.2 Pre Processing

The process in which the data is captured from the headsets to the computer system .The different pre processing techniques used in different papers are as follow:

[1]The EEG Signals captured by Emotive Insight Headset uses facial expressions which are sampled and then the signal processed is sent to PC through Bluetooth, the headset utilizes Bluetooth 4.0LE.Low Energy The client needs to prepare his face activities so as to utilize the main qualified EEG information. Five outward appearances were embraced right now, are Blink, Wink left, Wink right, Raise brows (Surprise) and Furrow brows (Frown).

[2] Dry electrode is used to record brain waves and the raw waves are sent using via Bluetooth to data processing unit whose output is in serial data. These data is sent to arduino for the further process and then to motor which will rotate with a command of arduino. The data processing unit is programmed using IDE i.e. mat lab and Arduino is also programmed by using an Arduino IDE Think gear Connector scans the ports for EEG signal and sends it to Mat lab for further processing

[3] EEG signals will measure the meditation levels and eye blinks, according to which the wheelchair will move. Thus it is a need to create an brain computer interface based wheelchair which will acquire EEG signals from Neurosky mind wave .These signals will be analyzed in terms of attention levels by using peak and average values.

[4]Brain controlled wheelchair is made with the help of Raspicam Image Processing based Raspberry pi .Image processing obtained from Raspicam sensors begins with capturing the image. The captured image is fed into pre- processing stage where the RGB image color format is converted into grayscale form. This is done in order to reduce the calculation time of each image.

[5]EEG estimates voltage variances coming about because of ionic current streams inside the neurons of the mind The Mind Wave Headset is utilized to get the EEG accounts. The headset takes many years of research facility brainwave innovation and places it into a packaged programming bundle processing of the inputs from the EEG headset to arduino is done through BCI.

[6]The EEG input signals are sent to the signal preprocessing unit for filtering and scaling and sent to the feature extraction block. In this block, the basic features are extracted and sent to the classification system. The classification block processes the input signals and outputs the control instructions

2.3 Operation

[1] Raspberry Pi 3 is used by means of Wifi. The Raspberry Pi controls the movement of the wheelchair through the approaching sign from the headset. Obstruction evasion was considered, two ultrasound sensors where added to stop the wheelchair for security reasons.) for remote transmission. The framework in, was acquainted with assistance individuals who lost their arms because of a mishap. A servo engine was appended to an Raspberry Pi 3 that controls the development of a prosthetic hand. At the point when the servo engine got a heartbeat from the PC, it would pivot at a 90 degree development and turns 90 degrees in reverse to its unique position when it gets the subsequent heartbeat. A BCI framework was created in to control the development of a quad copter by distinguished cerebrum fixation and eye flicker. Emotive headset was utilized to gather EEG information and afterward, was sent to an information handling PC to dissect it continuously. The analysts demonstrated that the created framework utilized less information and computational source when contrasted with the conventional BCI controlled quad copter frameworks. In a Brain-Computer Musical Interface (BCMI)system was executed with Emotive Insight headset as an information and sign preparing gadget. Information was gathered through Bluetooth at that point, steered over the system organized for convention. The scientists reasoned that Emotive Insight headset is an intriguing apparatus for a BCI because of its low cost and simplicity.

[2] In mind wave, dry electrode is used to record brain waves and the raw waves are sent using via Bluetooth to data processing unit whose output is in serial data. These data is sent to arduino for the further process and then to motor which will rotate with a command of arduino. The data processing unit is programmed using IDE i.e. mat lab and Arduino is also programmed by using an Arduino IDE Think gear Connector scans the ports for EEG signal and sends it to Mat lab for further processing.

[3] Brain controlled wheelchair is made with the help of Raspicam Image Processing based Raspberry pi .Image processing obtained from Raspicam sensors begins with capturing the image. The captured image is fed into pre- processing stage where the RGB image color format is converted into grayscale form. This is done in order to reduce the calculation time of each image. The next stage is to filter with a bilateral filter method to reduce noise digital images by preserving the edge of the processed image. The last stage is to extract the objects or image characteristic .At the end, the object detection is obtained with the help of classification method where hear like feature is used. The captured raspicam image is processed in raspberry pi along with the captured brain signal. Brain signal is captured using mind wave. The obtained brain signal is classified using frequency range .The signals are classified into four features: less then 7 Hz, 7 - 12 Hz, 12.1 - 13 Hz, and greater than 17 Hz to indicate stop, left, forward, and right, respectively. The wheelchair also consists of four ultrasonic sensors which detect obstacles using image processing. Here the developed Arduino is used as the main controller which detects the serial data. Based on this serial data the motors rotate in the desired direction.

[4] From programmed BCI, the arduino acquires the signal. Taking the help of a servo Motor an Arduino based wheel chair is developed. A rotator actuator helps to control of velocity, angular position and acceleration. A perfect fit motor is coupled for feedback of position. A sophisticated controller is also required. With the help of Arduino Programming language the arduino Microcontroller is programmed, the language is used to send the BCI output to perform different forward backward and rotational movements in the wheelchair.

[5] It processes the input signals and outputs the control instructions. Later, these control instructions are sent to the motors of the wheelchair. The EEG signals measured by Emotive headset are first processed by signal preprocessing and feature extraction blocks. Signal preprocessing block filters the noises and scales the signals in a certain interval. These signals are very long and need certain time for processing. Therefore, the feature extraction technique is applied in order to decrease the signal size and extract more important features for classification. In the paper, we used fast Fourier transform (FFT) for extraction of the features of the input EEG signals. The input signal received from the headset is divided into windows having 2 sec time interval with 50% overlap. The use of overlapping windows allows us to increase the accuracy of the classification. In this paper, the classification of the EEG signals is performed using FNN model. For this purpose, the FNN structure with hundred input and six output neurons is generated.

III.CONCLUSIONS AND RESULTS

[1]A wheelchair directional control framework dependent on EEG signals was proposed in this paper. Emotive Insight headset was embraced as a BCI framework to quantify the EEG signals utilizing five sensors covering the human scalp. The gathered EEG information was sent to a Raspberry Pi III for dissecting and controlling the development through its GPIO pins. Four face activities were utilized, they were shock, grimace, left wink and right wink. These signs were utilized to control the wheelchair progress ahead, in reverse, turn left and turn right, separately. Flicker activity was additionally used to enact/deactivate the framework. Two ultrasound sensors were joined for well being reasons and to stop the wheelchair if a snag was experienced. The outcomes got from the proposed framework indicated an acknowledged presentation as far as exactness up to 70% proportion. This could be a valuable instrument for quadriplegic people to assist them with coping with their environmental factors all the more no problem at all.

[2,5]Brain-wave is used to move wheelchair. Transmission of the information to wireless motors. Data could be store and retrieve later. Avoid dependence on others. Ultrasonic sensor are used to detects obstacles. There are many research foundations around the globe utilizing EEG tops to drive wheelchairs, and there likely could be business items arriving at the market in a couple of years as a after effect of these endeavors. The development of the wheelchair will be completely designed to the signs produced by the brain in this way refuting any physical power required.

[3]Utilizing this proposed framework the signs were sent from the headset to the arduino so as to actuate developments in the wheelchair dependent on the contributions from the mind. With the Implementation of above equipment engineering a wheelchair could be controlled effectively. This wheelchair utilizes two engines for its development. Despite the fact that this framework is crude it is a stage towards mind controlled development. The development of the wheelchair will be exclusively designed to the signs produced by the brain. Client based or explicit modules can be made therefore producing an exceptional impression. It utilizes forthcoming and consistently developing innovation that will empower simple and sensible emphases. The segments utilized are minimal effort yet have an ideal exhibition level. Outer assistance possibly required by individuals who experience the ill effects of loss of motion of the upper middle for position/ modification of the headset. Accurate contemplations can't be estimated utilizing the present headset.

[4]A canny cerebrum controlled wheelchair based shared control for improving the cripple personal satisfaction and giving them a need care at the opportune time is created. Adjacent to the utilization of the cerebrum flags as a control development bearing, the wheelchair likewise upheld by a few sensors to ensure the client security.

In the trial test, the identification procedure and its exactness of a hindrance objects (i.e., gap table, divider, and downstairs) is exceptionally influenced by the separation and light force. It is discovered that the permitted light force for indoor zone to be appropriately in object location is around 58 to 103 LUXs. This scope of force could be change rely upon the light power condition at the hour of catching the foundation picture. The separation of article identification is gotten about normal 95 cm what's more, it isn't influenced by the light power of the earth.

[6]The emotional and muscular states of the user are evaluated for control purposes. The design of BCI has been done to actuate a brain-controlled wheelchair using six mental activities of the user: move backward, move forward, turn left, turn right, turn on, start, and stop.

For classification of EEG signals, the FNN with 10-fold cross validation data set is used. The design of the FNN system is implemented using fuzzy means classification and gradient descent algorithm. The obtained 100% classification results prove that the used techniques are a potential candidate for the classification of the EEG signals in the design of brain-based control system. In the future, we are going to improve the number of commands for control of wheelchair and decrease detection
time of the EEG signal used for measuring brain activities and design efficient brain-controlled wheelchair.

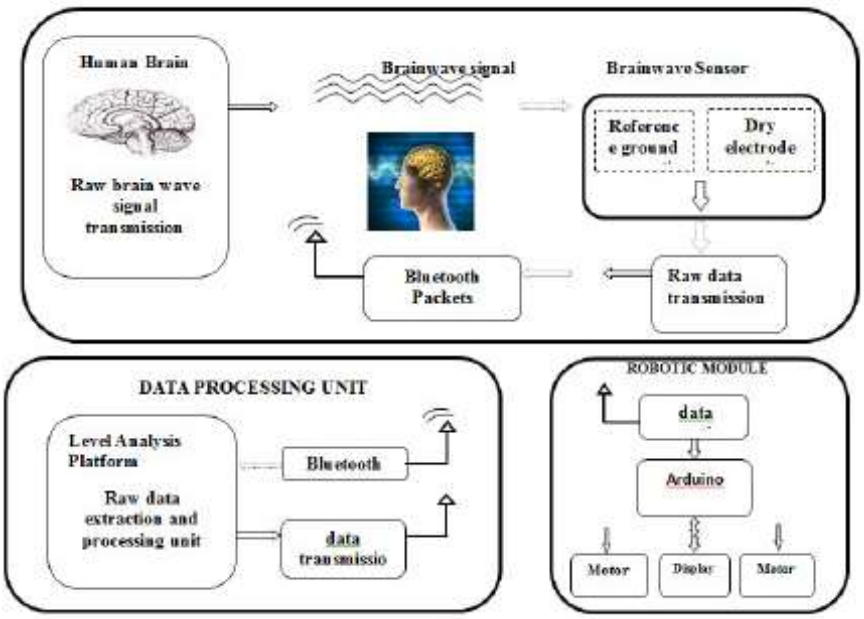

Fig 2:Working of Brain Controlled Wheelchair

IV.FUTURE SCOPE

Brain Computer Interface is an innovation of examining our mind waves and interfacing it with a machine that can do ponders with your cerebrum's signs. Here are a few applications on BCI innovation.

I. Brain Controlled wheel seat: This application is created for genuinely debilitated individuals in their development, all the framework need is client's focus. It permits the client to explore in a natural indoor condition inside a sensible time with the assistance of wheelchair.

II. Brain controlled Robotic ARM: Control Your Robotic ARM utilizing Brainwave sensor-Brainwave sensor can catch your mind signals for eye flicker, focus, contemplation and so forth., and can be utilized in different applications. Cerebrum controlled automated ARM is one of those application. Automated Arm is moved with EEG sensor dependent on a parameter gathered by it. • Brain Keyboard: Type with Eye squint Many incapacitated individuals attempts to speak with the environment yet can't. However, they can really do it with this Brain console and speak with their environment. EEG sensor peruses the eye flicker and in like manner content gets showed on the content box.

III. Drowsy driver location utilizing Brainwave: Driver's Drowsiness can cause mishaps, It is better in the event that somebody manage us. To forestall these mishaps BCI is utilized to recognize the adjustments in the Brainwaves. Utilizing this we can make an arrangement that controls your vehicle when sluggishness is recognized

IV. Emotion Recognition utilizing brainwave: Emotion is simply conveyed by brainwaves, EEG sensor gadgets can identify the human feelings through Brainwaves, process the information gathered and characterizes feelings felt by respondents and responses.

V. Brain controlled helicopter: Fly your copter with your brainwaves-this robot helicopter can fly as per your fixation, Meditation level when you concentrate it flies up, when you loosen up it will be back, isn't it intriguing.

VI. Password confirmation utilizing Brainwaves: Security with Brain-As brainwave example of each individual is one of a kind we use EEG in biometric recognizable proof. This can be utilized from high security zones to our Home.

VII. Epilepsy discovery utilizing Brainwaves: Epilepsy is a focal framework issue of human mind which cause times of unordinary conduct, sensations and once in a while loss of cognizance. EEG that peruses Brainwaves can identify clutters and aides in relieving it.

VIII. Brainwaves for neuromarketing: Leave Taking danger in your business-Neuromarketing is an innovation that looks at the feeling in purchaser's choice of an item. The EEG sensors and attractive reverberation imaging checks a few parameters in buyers cerebrum that causes the advertisers to pick the right item and Ad message to Boost Sales.

IX. Eye blink recognition utilizing Brainwaves: Using our brainwaves miracles should be possible. Brainwave headset can identify your Ocular-Eye flicker. Considering this parameter we can process and create many stunning tasks and can make our everyday lives more joyful.

X. Brain controlled Home mechanization: It will be extraordinary on the off chance that we have some gadget that will work itself with simply our brainwaves. Truly, we can.. EEG Sensor identifies the brainwaves and a unit forms those crude signs to work machines.

XI. Brain controlled programmed Braking framework: Here is the cool innovation where your EEG Headset/headband can follow your brainwave action and transmits its measurements to quickening, braking and guiding frameworks. Along these lines, Your Vehicle reacts before you make physical move. It is Brain to Vehicle innovation (B2V) that is presently drifting in car Industry.

XII. Neuro-clairvoyance: utilizing BCI to "associate" individuals' psyches It isn't a sci-fi, We can truly interface people groups mind without tangible observations. Scientists clarify that utilizing multi-channel cathodes individuals can chat with cerebrum.

XIII. Mental Task Classification utilizing Time-Delay Embedding and Sequential Evidence Accumulation.

XIV. BCI Player-Multimedia Player utilizing BCI: Unlike Normal individuals, People in secured state can work media player with envisioned development. In this way, Brain PC Interface innovation can help individuals to conquer their issues as well as urge them intellectually to be engaged.

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