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A Survey on "Brain Actuated Applications for Paralyzed People"

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Abstract: Each and every person in this world has a desire to live a normal human life but accidents, diseases, elder-ship make their desire into disability. Moreover, there are lots of handicaps and elders as well as the number of paralyzed people are increasing day by day. They always need another person in moving the wheelchair .The proposed system helps them to move freely & safely and also takes the activities in a cost effective manner.The intention of this work is to propose and develop a Brain-computer interface solution for people with movement disabilities. A smart wheelchair is developed by using Brain recognition system control the movement of wheelchair and also with Arduino interfaced. The proposed solution will read ,monitor and translate brainwaves generated from the central nervous system of a person with movement disabilities to replace/rehabilitate his/her natural movements or for allowing them to control different software and hardware applications such as password authentication, virtual keypad communication, emergency commands and wheelchair. The brain waves used in this work are those produced when a person blinks. This prototype uses a controlled mechanism based on the raw Electroencephalography (EEG) data extracted from a mind wave mobile/brain sensor for manipulating real life applications.

Keywords: Electroencephalography (EEG), Brain computer interface (BCI), Paralyzed, and Brainwaves.

I. INTRODUCTION

In India, there are about 5 million disabled people (in movement/motor functions). The disabled people affected with neuromuscular disorders such as multiple sclerosis (MS) or amyotrophic lateral sclerosis (ALS), brain or spinal cord injury, Myasthenia gravis, brainstem stroke, cerebral palsy, etc.; in order to express themselves one must provide them with augmentative and alternative communication. Brain Computer Interface (BCI) systems has been developed to address this need. Recent advancements in BCI have presented new opportunities for development of new prosthetic arm interface for such people based on thought or brain signals.

BCIs systems include the conventional channels of communication which is muscles and speech instead they provide direct communication and control between human brain and physical devices by translating the brain activity into commands in real time. Early prosthetics were simple. They were immovable prosthesis like wooden shaft, pegs and metal hooks. Later advances facilitate the movement of the prosthesis, but they looked very different from a human hand. Emphasis was given on the improvement in both the function and appearance of prosthesis. As technology advanced, the hands became more natural. An EEG sensor detects various waves from the brain such as alpha, beta, Gama, and theta by using these waves the Brain sense brainwave sensor measures attention, meditation and concentration values the values are assigned for the specific task to be performed by the 3D Print prosthetic arm which is controlled by servos.

Brain sense measures brainwaves and translates it into meaningful data to make the most of cognitive performance. The Brain wave sensor can measure, track and help you improve your Attention, Focus, Meditation, Eye blink. By using the parameters by wheelchair can be controlled.

II. BACKGROUND WORK

The health service sector has been continuously trying to improve the service given to the people in need of mobility assistance. As a result, more developers have been directed towards robotic wheelchairs. A robotic wheelchair is an intelligent wheelchair that has capabilities of navigating, detecting obstacles and moving automatically by utilizing sensors and artificial intelligence. We have developed a Robotic Wheelchair for the quadriplegic patients for mobility assistance operated using the head gesture [1]. The Robotic WheelChair includes accelerometer sensor, gyroscope sensor, ultrasonic sensor, relay, battery, DC stepper motor and raspberry pi. The MPU 6050 sensor detects the movement of the head and the signal is transmitted to the Pi. The controller processes the signal and enables the motion

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of wheelchair for its navigation. The ultrasonic sensors help to avoid obstacles, using the environment information gathered during navigation. The wheelchair is designed in a cost-effective way but ensures safety, flexibility, and mobility for the users.

BCI is a branch of science that combines the knowledge of neuroscience and the computer science providing ways to interact with computer and other devices by thought. This approach mainly focuses on the various fields of BCI. The major application of the BCI technology is providing a method of physical and digital interaction for severely disabled people. The ECG grids are directly attached to the brain in specific regions in order to capture the brain activity that corresponds to the actions patients are to perform. Emotion and emotional brain activity abstraction can also be performed using the BCI technology. When researchers want to study the mental effect of certain activity of human brain this technology is employed. Software developers also use this headset in order to measure the emotions during the game play. EEG is capable of detecting various changes in the emotions or the mood of a player so with this the software developers will be able to accurately detect the flaws in their design [2]. Doctors use the EEG method to keep a note on the condition of their patients irrespective of where they are .The data logged about the changes in different parts of the brain could be measured in real time. From this it is very sure that BCI is definitely maturing to provide various advantages to the mankind but further works are carried in order to reduce the risk and costs of the BCI technology.

This is an EEG based brain controlled wheelchair which has been designed using the brain computer interface BCI technology with the help of a neurosky mind wave EEG headset .Implementation of this device helps the patient to move on their own. Movement of the wheelchair is controlled by the variation levels of the patient's brain where the wheel chair will turn off by a double eye blink given by the patient [3]. The neurosky head set is attached to the patients head. The brain waves are collected by the dry electrodes placed on the forehead of the patient. To calculate the attention level of the patient.EEG data is processed through the low pass filter where a FFT algorithm is used to sample a signal over a period of time and then divides it into frequency components .The interrelation between the brain and the brainwaves is used to find the attention value.

The neurosky headset is attached to the patients head. The brain waves are collected by the dry electrodes placed on the forehead of the patient. To calculate the attention value of the patient. To calculate the attention level of the patient. EEG data is processed through a LPF where a FFT algorithm is used to sample a signal over a time and divides it into frequency components [4]. According to the working algorithm the patient has to blink eyes twice with the interval of 1.5 second and to do the same to stop the wheel chair .In general case human eyes do not blink within short duration so normal eye blink wouldn't be considered.

An automated wheelchair system designed, fabricated and enhanced with joystick capability for obstacle detection and autonomous stoppage. The system intelligence test was conducted using ANFIS [5]. A microcontroller unit known as Arduino Uno was built into the system architecture to synchronise the entire set-up by driving the DC motor for directional and linear motion of the wheel chair. The developed system would greatly improve the community of people who have lost some means of independent mobility thereby leading to an improvement in their self-esteem enabling them pursue their vocational and educational goals.

The advances in speech recognition technology have made it possible to control any electronics based device using voice command. This technology is capitalized for voice controlled wheelchair to assist those with both upper and lower limb disabilities. There are three main parts in the wheelchair: (1) wireless communication that incorporates voice recognition module, (2) microcontroller and (3) motor controller. The voice recognition module converts the voice from analog to digital with built-in digital signal processing system that recognizes the voice commands. This model is pre-programmed for each command and calibrated to the user's voice [6]. The microcontroller processes the voice recognition module output to control the left and right motors which in turn controls the movement of the wheelchair.

This approach shows a method of using voluntary blinks as a control tool in a BCI (Brain Computer Interface) based on the raw EEG (Electroencephalography) signal received from the NeuroSky Mindwave Mobile device using an Arduino with Bluetooth module "BlueSMiRF-Silver" as a receiver [7]. Raw EEG signal processing is based on the use of a medium filter as a pre-processing stage and a signal output mode filter with a large number of samples. A conditional signal is generated and then voluntary blink signals are recognized and involuntary blink signals are ignored by a simple algorithm that recognizes the corresponding pattern.

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Brain-computer interface (BCI) is a novel human-computer interaction model, which does not depend on the conventional output pathway (peripheral nerve and muscle tissue). In the past three decades, it has attracted the interest of researchers and gradually become a research hotspot. As a typical BCI application, the brain-controlled wheelchair (BCW) could provide a new communicating channel with the external environment for physically disabled people [8]. However, the main challenge of BCW is how to decode multi-degree of freedom control instruction from electroencephalogram (EEG) as soon as possible. The research progress of BCW has been developed rapidly over the past fifteen years. In this review, we investigate the BCW from multiple perspectives, include the type of signal acquisition, the pattern of commands for the control system and the working mechanism of the control system. Furthermore, we summarize the development trend of BCW based on the previous investigation, and it is mainly manifested in three aspects: from a wet electrode to dry electrode, from single-mode to multi-mode, and from synchronous control to asynchronous control. With the continuous development of BCW, we also find new functions have been introduced into BCW to increase its stability and robustness. It is believed that BCW will be able to enter the real-life from the laboratory and will be widely used in rehabilitation medicine in the future.

Many people across the globe born with physical disabilities. Some of them are born with disabilities which make them difficult for the movement and they need someone's assistance for their movement, finding someone who can assist them all the time is very difficult [9], so to overcome this difficulty Wheelchairs using few technologies have been developed in the past to overcome this problem but, completely paralysed patients feel it difficult to use the technology like joystick, electromyography arm, voice controlled wheelchair etc. So, in this paper to overcome the limitations of previously existing technologies we have used Electroencephalogram (EEG) signals to operate the wheelchair and this technology is called brain computer interface (BCI) in which the human brain interacts with the computer to perform a particular task. Here eye blinking is used to control the robot as it generates the significant pulse in EEG signals. The first objective of this project is to provide mobility for the completely paralysed patients. The second objective is to use the EEG signal to control the wheelchair. Hence this robot is programmed in such a way that it takes the EEG signal generated by the eye blinking as commands in a short period of time. In addition to this, the ultrasonic sensors are used to detect any obstacles and to stop the robot thereby ensuring the safety for the users.

We well-informed nearly explain four healthy one under authority of another exist ready to master control the shift of wheel single-seat furniture utilizing and not occurring at the same time motor, and for that reason the exercise exist fashionable computer program implementation [10]. Initially we apply this paper for the accomplishment of our first piece (EEG Sensor), (that is) the BCI connect from this paper. Brain data processing machine Interface (BCI) is working to extract the EEG signal from the user scalp.

The approximate mechanical architecture of our mind–actuated wheelchair happen writing. Then begin by talk over with another the very smart person data processing machine interface, because the human happens in the middle to our design philosophy. Then, the wheelchair tools and modifications exist explain in speech before, explain in what way or manner the joint order fuses the multiple news point of supply to plan the habit to execute appropriate manoeuvres all at once accompanying the human driver [11]. There is various methods available to discover energetic enterprise in intellect. One method exists Electroencephalography (EEG). EEG measures voltage vacillation ahead the take money that results from the interaction middle from two points the neurons inside the intelligence. These voltage vacillations exist treated and output to a microcontroller for one EEG sensor. The information packets get from the EEG sensor are stocked fashionable microcontroller. Analysis and meditation levels happen acquire from the treated data. These levels happen used to control the management and motion of the Wheelchair. Finally, bestowed the results of an experiment involving four in good condition issue and equate them accompanying those stated in contact other very smart person–actuated wheelchairs. Found that unending control approach offers a without a doubt good level of performance, accompanying knowledgeable BCI wheelchair one who operates a machine achieving a corresponding act thereto of a manual reference point condition.

The work presents the design of BCI establishes FNN for a wheelchair. The demonstrative about feelings and powerfully built states of the consumer are judge for control purposes. The design of BCI bear happen agreed upon to motivate an intellect-regulated wheelchair using six insane enterprise of the consumer: move foot to walk, move foot to walk, turn politically radical, turn right, excite, start, and stop [12]. For categorization of EEG signals, the FNN with 10-fold cross confirmation basic document file happen used. The design of the FNN arrangement exist put into action using out of focus wealth categorization and slope deterioration treasure. The get 100% categorization results prove that the used method happen a potential person desiring political office for the categorization of the EEG signals fashionable the design of intellect-based control structure. In the future, we happen make use of make or become better the number of commands for control of wheelchair and decrease discovery opportunity of the EEG signal used for measuring intelligence special interest or pursuit and design effective intelligence-regulated wheelchair.

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The system establishes very smart person computer connect bear been grown from past 30 age and now of age into the wide in range and diverse field. The first intelligence enterprise signal is written by Berger fashionable year 1942. The energetic signal that are produce by intelligence activity exist also known as Electroencephalogram (EEG). The system that depends ahead on Electroencephalogram should be capable to supply more regulated variable commands to the consumer [13]. The control ability to perform of this signal bear exist depends on the electrodes and the noise decline technique used for fitting the system. Now moment of truth the electrodes happen getting better and bear huge range of selection test depends ahead on application aforementioned as the gel-based electrodes are used to get the extreme sensitivity for better determination. Recently miscellaneous sensors (electrodes) are brought in for bearing high quality mind signal accompanying less distortion compared to coagulate located electrodes. The signal acquisition structure happens also recover by utilizing the op-amp located separate to refine circuits and composite instrumentation speaker joined circuit. The aim of BCI searches out control the electronics machinery accompanying better precision or correctness. The main use of BCI is to control the wheelchair or electronic appendage movement for the cripple human being and can be used to achieve security whole. The BCI maybe used to discover the mental state that is in addition to use to control the encircling environment to a degree ruling the interior of the car or house.

III.PROPOSED WORK

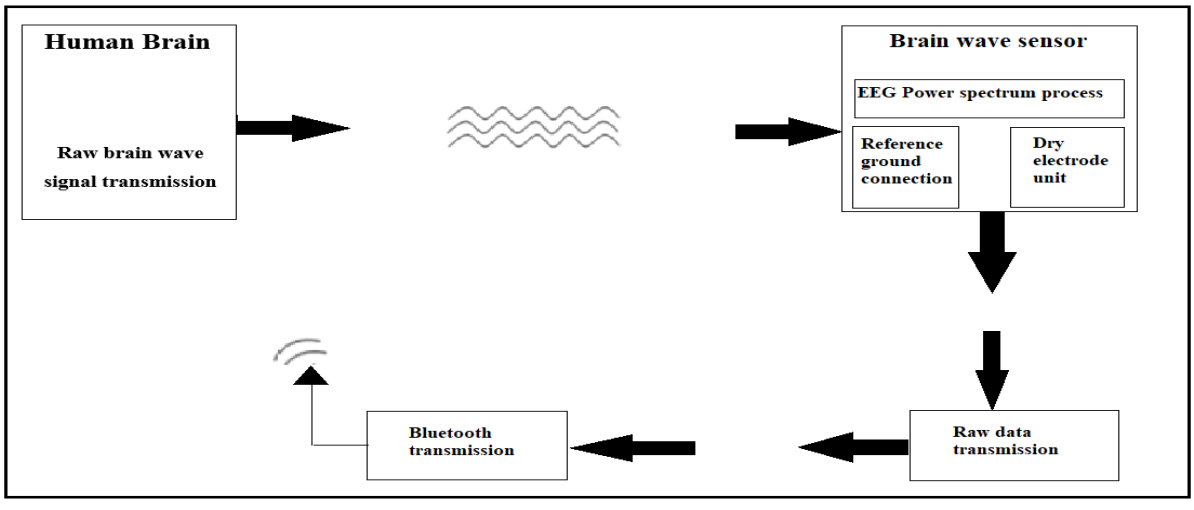
For our proof of concept, we have used an EEG headset called Neurosky Mobile 2. The headset is Bluetooth capable and transmits brainwave data with negligible latency. The EEG data is transmitted to a processor which uses neural networks to determine intent of thought and sends the command. It is basically a Brain Computer Interface (BCI) System. A BCI is a non-muscular communication channel that enables a person to send commands and messages to an automated system such as a prosthetic arm, by means of his/her brain activity.

The basic idea of BCI is to translate user produced patterns of brain activity into corresponding commands. One of the most important features in a BCI system is represented by acquisition. The most spread acquisition technique is EEG, and it represents a cheap and portable solution for acquisition. The EEG technique assumes brainwaves recording by electrodes attached to the subject's scalp. EEG signals present low level amplitudes in the order of microvolt and frequency range from 1 Hz up to 100 Hz. Specific features are extracted and associated with different states of patient brain activity, and further with commands for developed applications. Using EEG one more drawback can be eliminated (i.e. dangerous surgery can be avoided for invasive method where electrodes are placed inside of brain called implants).

The EEG Headset or the Brainwave Sensor detects the electrical signals from the brain and sends them in the form of data packets to a Bluetooth. This received data is processed and the control commands are then transmitted to the Arduino via RF. Based on the data received by the Microcontroller it performs certain predefined actions based on the level of concentration.

BLOCK DIAGRAM:

TRANSMITTING SECTION



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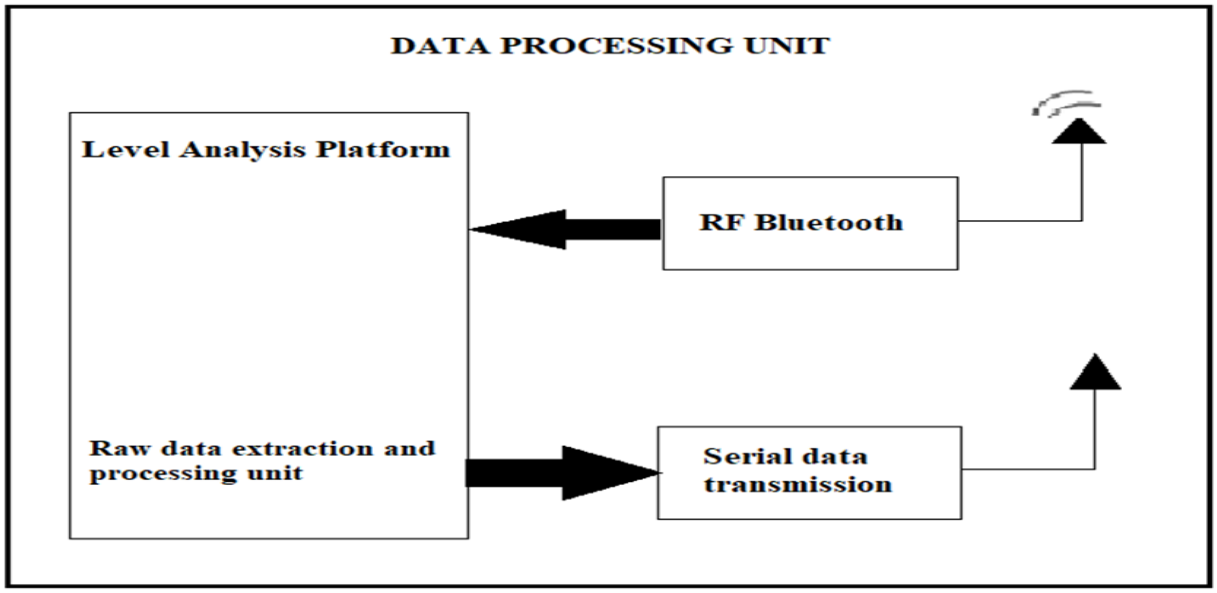
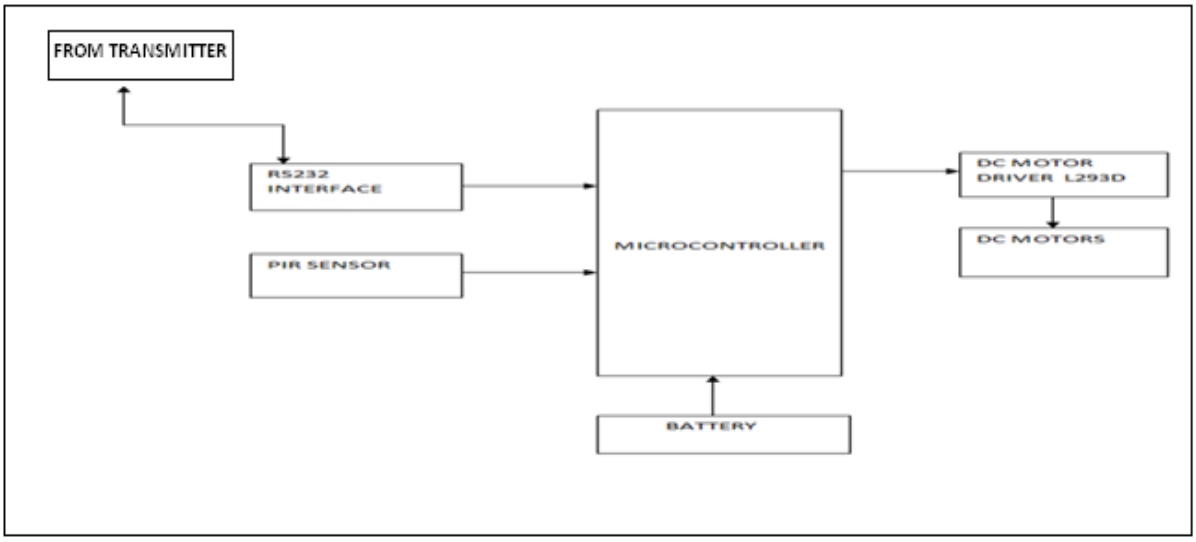


RECEIVING SECTION



IV. CONCLUSION

Our model "Brain Actuated Application for Paralyzed People" is proposed for paralysed people. The Brain Computer Interface uses brain signal for all application, since Neurosky mindwave mobile/Brain sense uses AAA- battery and electrode is just placed in the scalp, it doesn't make any harm to the brain. It can be pre-configured for every user to increase the accuracy of blink classification to use the application. It makes every paralyzed people to be independent in some applications. The Brain wave sensor can measure, track and help you improve your Attention, Focus, Meditation, Eye blink. By using the parameters by wheelchair can be controlled.

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