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Smart Wheelchair: A Review

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Abstract: Paralysis is the inability to move a portion of the body temporarily or permanently. Paralysis is caused by nerve damage in almost all instances and is not caused by injury to the impacted region. For example, a spinal cord injury in the middle or lower regions is likely to interfere with function below the injury, including the ability to move the feet or feel sensations, even though the actual structures are as healthy as ever. This results in at least one of the following symptoms in patients. Because of brain injuries, the brain cannot transmit a signal to a body region. Also known as the "direct neural interface," the brain-computer interface (BCI) can provide a direct channel of communication and interaction between the brain of the user and the computer. The concept of the brain-computer interface for wheelchairs is provided for persons with disabilities. The architecture of the proposed system relies on electroencephalographic signals (EEG) being obtained, processed and identified and then wheelchair operated. The number of experimental brain activity tests was conducted with human wheelchair control commands. The classification system based on fused neural networks (FNN) is known on the basis of the user's mental activity and the motor control commands of the wheelchair. For brain control the architecture of the FNN-based algorithm is used. Training data are used to design the system and test data are used to assess control system performance. The wheelchair control is carried out under real circumstances by means of wheelchair direction and speed control commands. The method used in the paper reduces the chance of misplacement and increases the wheelchair control performance.

Keywords: Microcontroller, Sensor, Joysticks, Bluetooth HC-05.

INTRODUCTION

Increasing the quality of life of the elderly and the disabled at the right time is one of the most important tasks for us as a responsible member of society. So it's important to build an intelligent, mobile wheelchair. In this study an effort was made to propose a brain-controlled wheelchair that uses the recorded brain signals and activates them. For the acquisition of the EEG signals that the microcontroller recorded and interpreted in motion commands, moved in turn, by the electroencephalography (EEG) method. The smart chair is displayed in Figure 1.

Figure 1: Smart Wheel Chair

The electric wheelchair is a wheelchair with an electric motor operated by a hand joystick. However certain people with extreme engine disabilities, such as paralysis and people with physical impairments and locked-in syndrome, cannot use the joystick. Several work has recently been carried out for the production of many BCI wheelchair applications. The primary function of BCI is to relay and translate human wishes for wheelchairs, robots, computers and so on into effective commands. BCI allows disabled people to improve their quality of life and communicate with their community.

In an experimental case, the comparison is the application of BCI and wheelchair regulation. The research looks at how a digital wheelchair is operated remotely before BCI is actually used. By using training and testing software, virtual reality (VR) decreases the number of dangerous situations. BCI is equipped with three possible commands to power the wheelchair: turn right, turn left and step forward. The EEG signals produced by 8 electrodes are equipped for BCI. For function extraction, Wavelet transform was used to classify the pre-defined movements using radial baseline networks.

The unidirectional robot is operated by a controller based on the brain emotional learning algorithm. Reference demonstrates the idea of a BCI humanoid robot navigation asynchronous control system using an EEG. A non-invasive brain-computer interface based on EEG is required in order to achieve safe controls of a low-speed unmanaged aerial vehicle.

OBJECTIVE OF THE SYSTEM

The main objective of this project is to create an intelligent low-cost brain and eye controlling wheel chair that has a communication interface system to allow user to interact with the control of the wheelchair by using the eye-blind detected from brain waves. Wireless networking must be used as far as possible to achieve maximum flexibility and low costs to provide a simple user. [1]

- To create EEG Based Blink Control Detection.
- To build an UI keyboard where you can pick the keys and type them with your Blink to use to communicate with your caregiver.
- To design a text-to-speech converter that can send a speaker or a SMS to the caregiver with the types of keys.
- Design and create an Omni Wheel Chair that can charge and accommodate 120 kg weight, with Brainwaves.
- To design and build a Directional Emergency Alert.
- Developing the Obstacle Prevention and Computer Vision system for smooth wheel chair navigation, based on the Lidar and camera.
- The primary goal of the project should be to test the capacity of individuals to willingly operate the wheelchair through their brain and eye activity in order to ensure that the commands are carried out properly. GPS based Path learning system based on Neural Networks. The overall goal is to build a comparatively inexpensive, easy to use smart wheel chair where users can monitor and interact with this tool. [2], [3]

DESIGN OF SYSTEM

The BCI based wheelchair regulation is demonstrated in Figure 2. This BCI system consists of a computer-linked Emotive headset. Emotional sensors provide the device with information. The computer runs signal processing and classification algorithms and is attached to a moving microcontroller. You can tilt your wheelchair in four directions. The wheelchair speed is constant and, if necessary, the wheelchair can be on and off. The BCI system uses the commands mentioned above: step forward, move backward, turn left, turn right, turn on and off switch, etc. [4]

Figure 2: Brain Controlled Wheelchair

The functions mentioned above are taken into consideration. Signal preprocessing & feature extracting blocks process the EEG signals recorded by the Emotive headset. The preprocessing signal block filters in a certain interval the sounds and scales the signals. Such signals require time to be processed for a long time. The extraction technique is therefore applied to decrease the signal size and remove more significant classification features.

The researchers used Furrier transform (FFT) rapidly in the paper to extract the features of the EEG signal data. The operations used in the feature extraction stage are shown in Figure 3. The input signal is split into windows with a time interval of 2 sec. [5]

METHODOLOGY

EEG is an electro-physiological control method for electrical brain activity recording. Normally, the electrodes on the skirt are invasive. EEG tracks brain neuron voltage shifts caused by ionic current. Brain signal categorization is based on the frequency EEG signal acquisition of a specially constructed, non-invasive bio sensor. The purchase portion shown in the figure includes the numerously mind wave, Arduino and HC-05 modules. [6]

The mind wave device is used to capture the raw signal of the brain and to communicate it to the HC-05 module via Bluetooth. With this Bluetooth module, the raw EEG information is transmitted to the Arduino board at a baud speed of 57600. The flow chart is described in Figure 3. The raw signal is listed within the Arduino board as eye twitch and attention values. The eye's blinking value continuously varies with the speed of the blinking of the eye. The distinct blink strength and attention value are transmitted at a baud rate of 57600. [7]

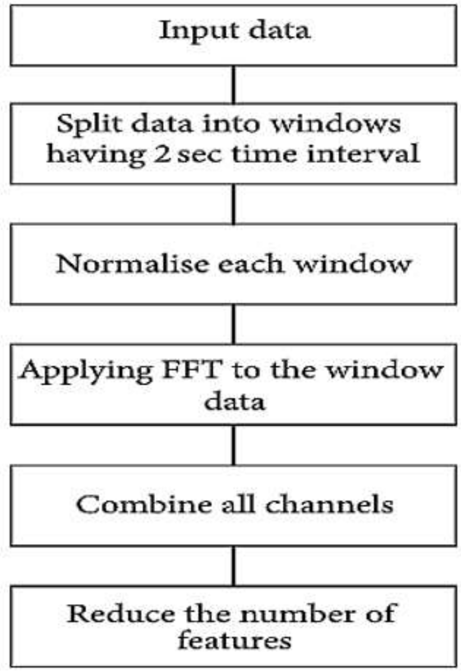

Figure 3: Flow Chart

RESULTS

For real-life implementations the BCI is simulated and used. The EEG signals are measured using the Emotive EPOC headset, which is a signal processing tool. Researcher used 14 channels to calculate EEG signals in these experiments. The EEG signals recorded have different frequency patterns. Experiments show that it is difficult to measure brain signals, so researcher tested our brain system with muscle signals. For example, the signals from five sample channels are illustrated in Figure 4. Figure 4 displayed a neutral posture, calming and doing nothing for the patient. A constructive expression is displayed in the Figure 4.

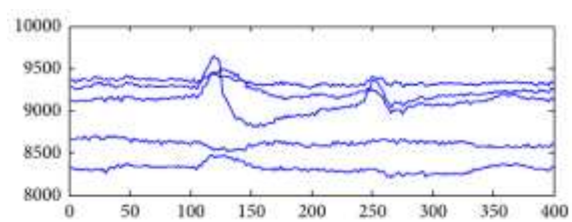

Figure 4: EEG signals for five channels: A Neutral Pose

The EEG signals change more often than a neutral position, as the Figure 5 show. The FFT is used in the paper to extract relevant signal characteristics. The key features of these signals are extracted and used to classify after the preprocessing stage, provided in Section 2. 100 was calculated for the number of extracted features. These are FNN machine inputs. Clusters are the outputs of the software FNN. In this experiment, the following clusters are used: go ahead, move back, turn left, turn right and turn on and off the switch. The machine obtained 10 seconds of data for each cluster.

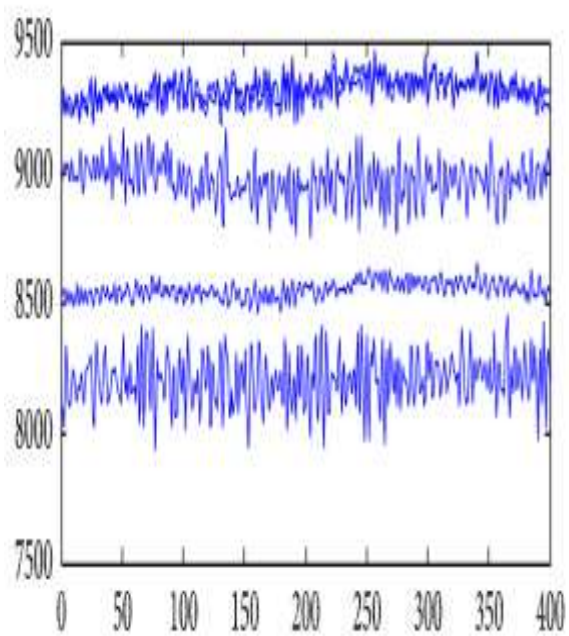

Figure 5: EEG for Five Channels: Positive Gesture Pose

CONCLUSION

The study of literature on different techniques for hardware development shows the benefits and inconveniences of earlier systems. The goal is to achieve the design goals of a moving wheelchair with a brain controlled system with the Arduino Pi Raspberry and the Mind wave headset. The main purpose of this project is to control the electric wheelchair with blind eye and EEG signals in separate directions (forwards, left and right). The article presents the BCI design for a wheelchair based on FNN. For control purposes, the user's mental and physical symptoms are assessed. BCI has been designed with six user's mental activities in mind to drive a brain-controlled wheelchair; go back, go ahead, turn left, go right, turn on, begin and stop. The FNN with 10-fold cross validation data set is used in the classification of EEG signals. Fuzzy means of classification and the gradient descent algorithm are used to design a FNN system. The 100% classification results obtained show that the techniques used are potential candidates for EEG signals classification in the design.

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