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Brain Actuated Wheelchair Using Brain Wave Sensor

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Abstract: This project discussed about a brain controlled mobile 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. The intention of the project work is to develop a mobile robot that can assist the work independent on others. 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. 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 Mat lab platform. Then the control commands will be transmitted to the robotic module to process. With this entire system, we can move a robot according to the human thoughts and it can be turned by blink muscle contraction. By using this brainwave concept executed in wheelchair the handicap will easily controls wheel chair.

Keywords: Brain computer interface, brain wave sensor, EEG, Bluetooth, mat lab

I. Introduction

The human brain is made up of billions of interconnected neurons, the patterns of interaction between these neurons are represented as thoughts and emotional states. Every interaction between neurons creates an electrical discharge, alone these charges are impossible to measure from outside the skull. However, the activity created by hundreds of thousands concurrent discharges aggregates into waves which can be measured. Different brain states are the result of different patterns of neural interaction. These patterns lead to waves characterized by different amplitudes and frequencies, for example waves between 12 and 30 hertz, Beta Waves, are associated with concentration while waves between 8 and 12 hertz, Alpha Waves, are associated with relaxation and a state of mental calm. Here a wheelchair is controlled automatically according to the brain signal. The brain signals are collected using a brain wave sensor. Using these signals wheelchair can be moved. This brain wave sensor consists of 3 main parts. They are dry electrodes, signal conditioning circuit and inbuilt RF transmitter. Dry electrodes are used to absorb the brain waves. This signal is analog in nature. For further processing these analog signals should be converted to digital form. Signal conditioning stage will do this conversion. The next part is inbuilt RF transmitter. It converts this digital signal into packet of data. This data packet is transmitted through Bluetooth transmitter. Here the received data packets are processed using mat lab tool. M script or math script is an interface program for brain wave. The mat lab output is a graph showing attention & blinking in y-axis and time in x-axis. Attention means the robot is moving forward. Blinking is used for rotation of robot. This output is given to robotic module for automatic movement of robot.

II. Literature survey

In the paper involving young children in the development of a smart pediatrics wheelchair, Independent mobility is crucial for a growing child and its loss can severely impact cognitive, emotional and social development. Unfortunately, powered wheelchair provision for young children has been difficult due to safety concerns. But powered mobility need not be unsafe. In the paper brain controlled wheelchair a robotic architecture, Independent mobility is core to being able to perform activities of daily living by oneself. However, powered wheelchairs are not an option for a large number of people who are unable to use conventional interfaces, due to severe motor disabilities. For some of these people, non-invasive brain computer interfaces (BCIs) offer a promising solution to this interaction problem and in this article we present a shared control architecture that couples the intelligence and desires of the user with the precision of a powered wheelchair. Here a master control of the wheelchair using an asynchronous motor–imagery based BCI is used.

In the paper brain controlled telepresence robot by motor disabled people, a rather complex task as the robot is continuously moving and the user must control it for a long period of time (over 6 minutes) to go along the whole path. These two users drove the telepresence robot from their clinic more than 100 km away. Remarkably, although the patients had never visited the location where the telepresence robot was operating, they achieve similar performances to a group of four healthy users who were familiar with the environment. In particular, the experimental results reported in this paper demonstrate the benefits of shared control for brain-controlled telepresence robots. It allows all subjects to complete a complex task in similar time and with similar number of commands to those required by manual control.

III. Proposed method description

The main purpose of this project is to design a wheelchair for severely disabled person move them voluntarily. Their movement of wheelchair can be controlled with their own mind waves. A Neuro sky product called brain wave sensor is used for this purpose. The brainwave sensor consists of dry electrodes which collect raw brain signals, they are analog in nature. The signal conditioning unit converts this analog signal into digital form and transmits through an inbuilt Bluetooth transmitter. A Bluetooth receiver is connected to the computer where these raw brain signals are extracted and processing using mat lab platform .M script /math script is used to interface brain wave output with mat lab and produce output waveform with respect to time. The mat lab command window shows the signal strength of attention and blink signals. The output waveform shows the attention & blink signals in x-axis and time in y-axis. Attention signal strength is high then wheelchair starts forward motion and blink signal strength is high then wheel chair rotates clockwise. These mat lab output is given to robotic module. Robotic module consists of dc motor which moves forward, left or right according to brain signals.

Figure 1: Block diagram of transmitter section

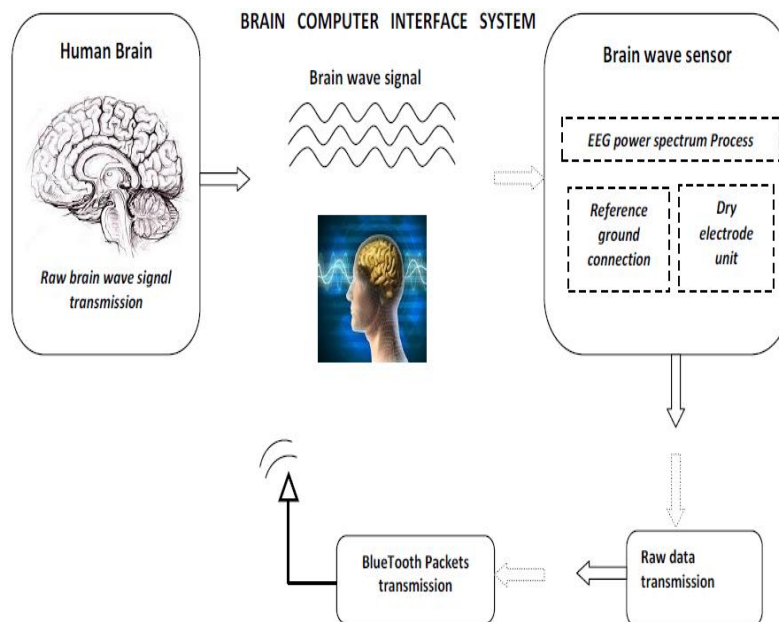


Figure 2: Block diagram of data processing unit
DATA PROCESSING UNIT

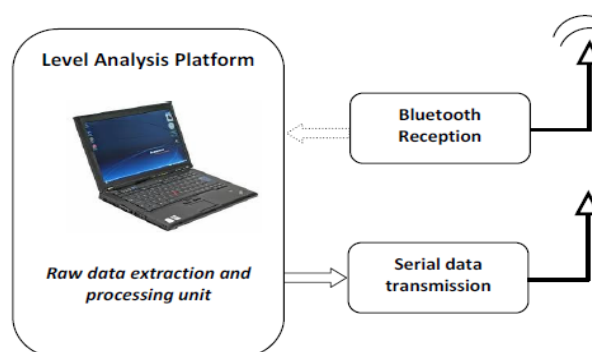
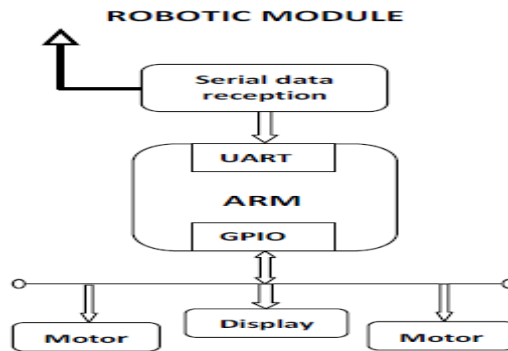


Figure 3: Block diagram of receiving section



Mat lab code

```

%function PSEMB301
%run this function to connect and plot raw EEG data
%makes sure to change portnum1 to the appropriate COM port
Clear all
Close all
Data BLINK = zeros (1,256);
Data ATTENTION = zeros (1,256);
Data MEDITATION = zeros (1,256);
% X= zeros (1,256);
portnum1 = 4; %COM Port #
comPortName1 = sprintf ('\\.\COM%d', portnum1);
%TG_BAUD_57600 = 57600;
TG_BAUD_115200 = 115200;
TG_STREAM_PACKETS = 0;
%TG_DATA_DELTA = 5;
%TG_DATA_POOR_SIGNAL = 1;
%TG_DATA_ATTENTION = 2;
%TG_DATA_BLINK_STRENGTH = 37;
%TG_DATA_BATTERY = 0;
TG_DATA_BATTERY = 0;
TG_DATA_POOR_SIGNAL = 1;
TG_DATA_ATTENTION = 2;
TG_DATA_MEDITATION = 3;
TG_DATA_RAW = 4;
TG_DATA_DELTA = 5;
TG_DATA_THETA = 6;
TG_DATA_ALPHA1 = 7;
TG_DATA_ALPHA2 = 8;
TG_DATA_BETA1 = 9;
TG_DATA_BETA2 = 10;
TG_DATA_GAMMA1 = 11;
TG_DATA_GAMMA2 = 12;
TG_DATA_BLINK_STRENGTH = 37;
TG_DATA_READYZONE = 38;
%load think gear dll
Load library ('Thinkgear.dll');
Fprintf ('Thinkgear.dll loaded\n');
%get dll version
%dllVersion = calllib ('Think gear', 'TG_GetDriverVersion');
% fprintf ('ThinkGear DLL version: %d\n', dllVersion);
%%% Get a connection ID handle to ThinkGear
connectionId1 = calllib ('Think gear', 'TG_GetNewConnectionId');
% fprintf ('Connect If (calllib ('Thinkgear', 'TG_EnableBlinkDetection', connectionId1, 1) =0)

```

```

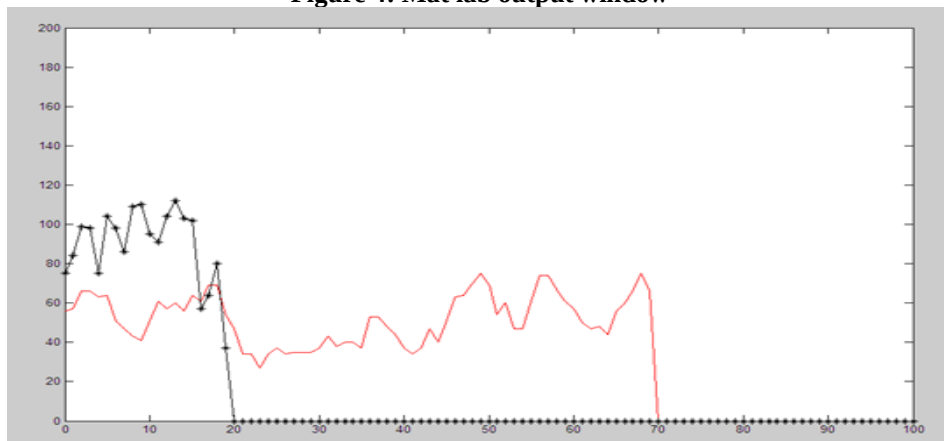
Disp ('blinkdetectenabled');
End;
%record data
Disp ('BLINK = ');
Disp (data_BLINK (j));
If (data_BLINK (j) > 40 )
%      if(data_BLINK(j) < 95)
Blink = Blink+1;
data_ATTENTION (k) = calllib ('Thinkgear','TG_GetValue', connectionId1,
TG_DATA_ATTENTION);
Disp ('ATTENTION = ');
Disp (data_ATTENTION (k));
%      plot (data_ATTENTION)
%      axis ([0 100 0 100])
%      draw now;
Blink=0;
Axis ([0 100 0 200])
Draw now;
%      end
End
End
%%end
%disconnect
Calllib ('Think gear', 'TG_FreeConnection', connectionId1);

```

IV. Simulation Analysis using matlab

A neurosky product called brain wave sensor is used for collecting brain signals. A Bluetooth receiver is connected to the computer where these raw brain signals are extracted and processing using mat lab platform. M script /math script is used to interface brain wave output with mat lab and produce output waveform with respect to time .The program is written in program window and run the program & output is taken from mat lab platform which consists of 2 signals .The mat lab command window shows the signal strength of attention and blink signals. The output waveform shows the attention & blink signals in x-axis and time in y-axis. Attention signal strength (red color) is high then wheelchair starts forward motion and blink signal strength(black cross mark) is high then wheel chair rotates clockwise.

Figure 4: Mat lab output window



V. Conclusion and future scope

From this project robotic vehicle can be controlled using brain wave sensor. I realized this project will be useful in medical field. This can be used for assisting disabled persons to move. The advantage of thought controlled wheel chairs are that they respond to commands much faster and that patients who have lost the ability to speak may utilize them. The main purpose of this project is to design a wheelchair for severely disabled person to move them voluntarily. There are different ways for operating a wheelchair for eg: voice controlled, using gestures, using eye movement or using joystick etc. But these types of wheelchair can't be used for stroke patients or paralyzed patients. Here patients can control their wheelchair using their own brain signals. For that purpose a brain wave sensor is used. Mainly brain wave sensor is used for monitoring patient health condition to find if there are any abnormalities. This system can also be used to identify the correct person with biometrics.

VI. References

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