Intelligent Wheelchair Based on Brain Wave Detection for Special Persons

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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 of others.*

I. INTRODUCTION

For most people with disabilities,travel and independent life are undoubtedly the two biggest difficulties. wheelchair is a travel tool for many disable people, which enables them to go out and participate in social activities, it has greatly improved the quality of life people with disabilities.in real life, however, most wheelchairs are still manual, for people with disabilities who lose their limbs and even lose their language function, it's still hard to do it on their own. using the brain wave detection of brain wave detection technology. In recent years, the brain computer interface (BCI)technology has become one of the hot topics in the field of computer science. In this design the use of TGAM module neuro sky neurosky limited launched.the module can output three sense parameters of neurosky ,analog to digital conversion possible .

1.1 Existing system:

The human interface for easy operation of the intelligent wheelchair is the most popular research issue. A novel method to classify human facial movement based on multichannel forehead bio signals. A novel hands-free control system for intelligent wheelchairs based on visual recognition of head gestures is used. the authors developed a voice-controlled wheelchair. The another system(the sip-and-puff (SNP)), the user either draws in air or blows air into a wand or tube. The SNP system recognizes four different commands, hard sip, soft sip, hard puff, and soft puff. the patient controls the wheelchair by tracking the eyes for blinks and estimating gaze direction through a camera placed in front of the wheelchair users. A different and newer ideal is the Tongue Drive System (TDS) is used to control the wheel chair.

1.2 Proposed system:

The proposed work is to develop a wheelchair that can assist by the disabled people in their daily life to do some work independent on others and to bring this technique into the equipment's which are used by the elders at homes. The proposed system analyze the brain wave signals, and uses only single electrode headset based on EEG sensors which will monitor the EYE BLINKS, ATTENTION MODE, and MEDITATION MODE, and not going to monitor all the rays coming from the scalp, by analyzing the frequencies ranges of the certain level.

Every human being will have different thoughts and emotions so it's enough monitor waves from forehead frontal point (FP1)alone, this mind wave headset sensor usesthe Electromyography (EMG) Technique which will detect the muscle contractions that occurs while blinking the eye(i.e. rising the eyebrows or blinking)and this contraction will generate a unique electrical signal.

II. SYSTEM DESIGN SCHEME

The Block diagram of the proposed system is shown in figure 2.1. This explains how the brain waves are processed and transmitted to the wheel chair for the specially challenged person. The system architecture which is composed of Brain Computer Interface System, Data Processing unit and the controlling unit is shown in the figure.

2.1: Overall Block Diagram:

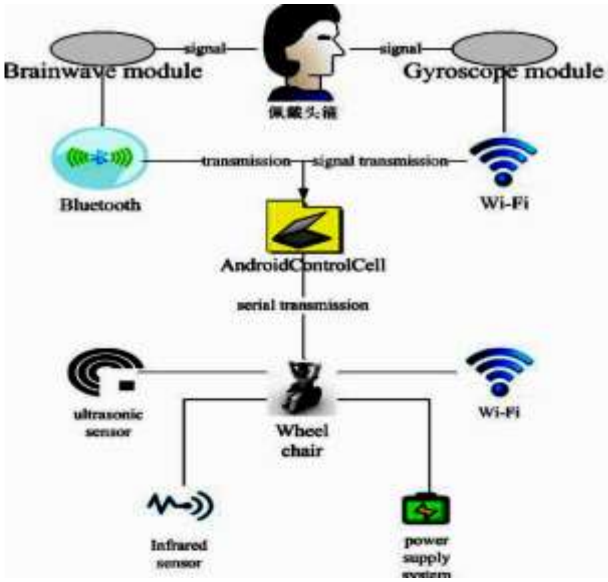

Figure 2.1: Overall Block Diagram

The design method of brainwave recognition control wheelchair system is mainly to send the EEG data to the android computing unit. After processing, the control signal is transmitted to the wheelchair terminal, so as to control the wheelchair.EEG signals are collected by head mounted equipment, and the original analog signals of EEG are processed by AD conversion, extraction and classification. Finally it will be outputted by the packet format. We added the posture sensor MPU6050 in the headset equipment for the facility of wheelchair control.

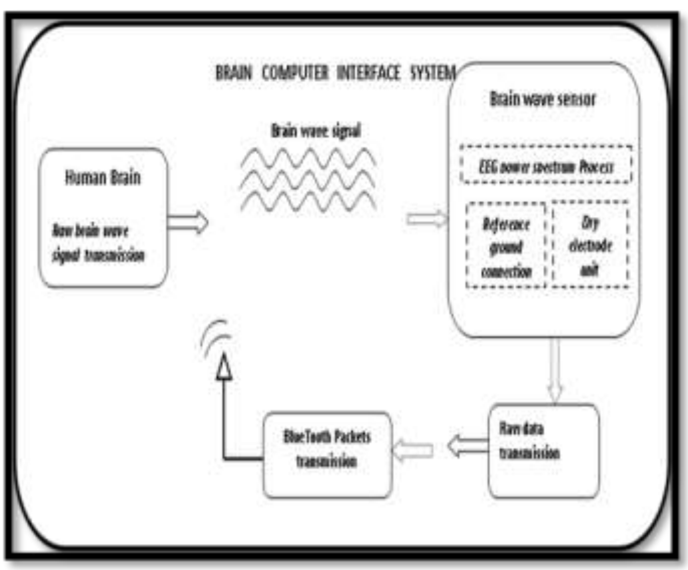

Figure 2.2: Brain Computer Interface System

The direction of the axis of rotation of a rotating object will not change when it is not affected by external forces. Based on this principle, the head deflection signals collected by gyroscopes determine the movements that the patient wants to perform.

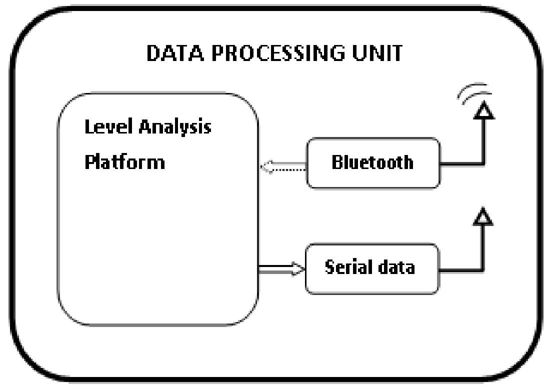

Figure 2.3: Data Processing Unit

The EEG signals and the gyro signals are sent to the android computing unit by wireless transmission, ands these signals are analyzed and processed by the ARM processor to output the control signals. The control command signals are send to the wheelchair system controlled by MCU by the serial port. After receiving the control signals ,the wheelchair will be driven to forward, backward, left turn, right turn and etc. The design diagram of the processing scheme based on android computing unit.

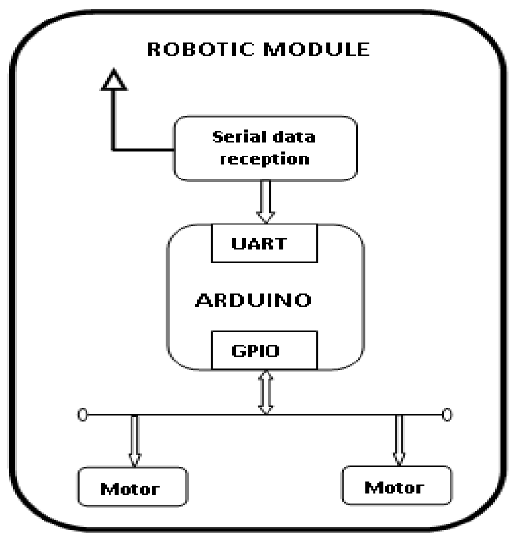

Figure 2.4 Controlling Unit

2.2 Flow Chart:

The implementation of the proposed system software is shown in the figure 2.5. We need to collect signals from headsets on EEG and gyroscope, through wireless transmission data packets signals are sent to ARM as the main control unit of the wheel chair. The main control unit extracts the useful data and analyses package of the received EEG&

gyroscope data. Then through a simple hybrid algorithm the data is process and output to control command signals.

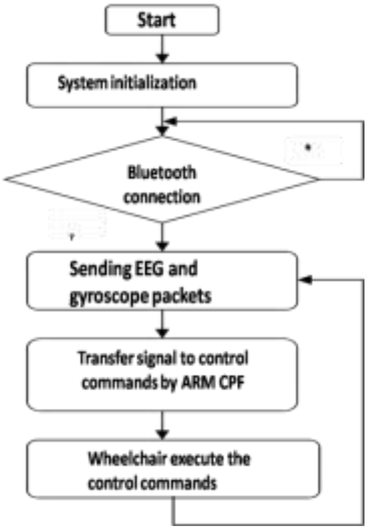

Figure 2.5 Flow Chart

After each data is processed, the control is transmitted to the motor driver so as to completethe control of the wheelchair forward and steering.

III. HARDWARE REQUIREMENTS

The hardware components used for the proposed system is shown below.

- Arduino UNO R3
- Brain wave sensor
- DC motor
- Battery
- L293D Driver

a.Arduino Microcontroller:

Arduino is an open source physical computing platform based on a simple input/output (I/O) board and a development environment that implements the Processing language. Arduino can be used to develop standalone interactive objects or can be connected to software on your computer. Arduino hardware is an open-source circuit board with a microprocessor and input/output (I/O) pins for communication and controlling physical objects (LED, servos, buttons, etc.).

Specification:

- Microcontroller: ATmega328
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6

Figure 3.2Arduino Microcontroller

- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by boot loader
- SRAM: 2 KB (ATmega328)
- EEPROM: 1 KB (ATmega328)
- Clock Speed: 16 MHz

b. Brainwave sensor:

Brain sense is a brain computer interface (BCI) device for Student, Researchers and Wellness Community. A sleek, single-channel, wireless headset that monitors your brain activity and translates EEG into meaningful data you can understand.

Figure 3.2 Brainwave sensor

c. L2932 Drivers:

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.

Figure 3.3 Hardware setup

The hardware setup for the proposed system is shown in figure 3.3.

IV. SOFTWARE REQUIREMENTS

The following software are used for the system.

- Arduino IDE
- Matlab
- Language: Embedded C

a. Using Arduino:

- Write your sketch
- Press compile button
  (to check for errors)
- Press upload button to program arduino board with your sketch. Try it out with the "blink" sketch!Load "File/Sketchbook/Examples/Digital/Blink"

b. Matlab:

Matlab → Matrix laboratory Developed by Cleve Moler in 1970s as a teaching tool High performance language for technical computing. Typical uses are, numerical computation Data analysis, plotting and visualization Graphical user interface building Algorithm development and modeling.

V. RESULTS AND DISCUSSION

The module uses PC terminal debugging software: Mind Viewer. The collected brain wave information is displayed graphically.

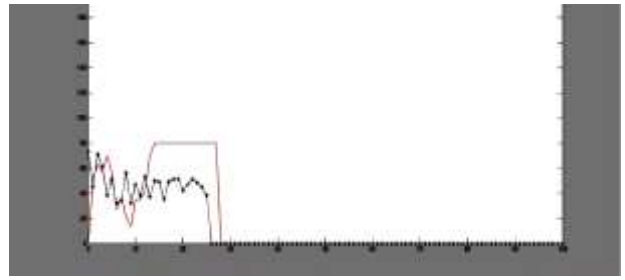

Figure 5.1 Brainwave Signals

TGAM sends packets per second. The packets is divided into small packet and big packet. Primary data raw data is composed of xxHigh and xxLow data, and the following byte xxCheckSum is checksum. So a packet contains a set of useful data called rawdata. So about 512 rawdata will be sent every second. Of course, before calculating the rawdata, we need to check the checksum. Sum = ((0x80 + 0x02 + xxHigh + xxLow) ^ 0xFFFFFFFF) & 0xFF. If the sum and xxCheckSum are equal, it means that the package is correct, and then the rawdata is calculated. Otherwise the package is ignored. Packet loss rate below 10% will not affect the final result. Finally, we need to get other signals in the brain wave, including Intensity Signal, Concentration Attention, Relaxation Meditation, and 8 EEG Power values. All of those data is in the 513rd package, and the package format is fixed. The frequency of alpha which affects rawdata fairly stable when people are not stimulated. But when the people is stimulated by the outside world, or awake and opening eyes, the frequency range will change to a low value even zero. So we can tell when the people blink his eyes though the frequency. This design uses high-precision gyroscope MPU6050. The measured amount of data is obtained through the serial port. MPU6050 output the current attitude of the module in the dynamic environment because of attitude solver is integrated into the module, and the dynamic Calman filter algorithm is used accurately. Now the attitude measurement accuracy is 0.01 degrees, and the stability is very high. The performance is even better than some professional inclinometer. Information is displayed using Matlab software. The module sent data to the host computer, which is divided into 3 data packets, respectively acceleration package, angular velocity packet and angle packet. 3 data packets are sequentially output.

VI. CONCLUSION

The system designs an intelligent wheelchair controlled by brainwave technology.Using the TGAM module of neuro sky neurosky limited launched,through smart wearable devices to extract the EEG signal and the angle signal of gyroscope. The system is fast and stable. Simple structure low cost, easy operation,strong human-computer interaction.

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