Brain Controlled Robot Car

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ABSTRACT:
Robot Car is that device that can be remotely controlled using the user’s brain signals. This system uses BCI (Brain-Computer Interface) to provide communication between our brain and the robotic car. It uses an EEG (Electroencephalogram) headset to acquire data, classifies and interprets the data set on the hardware, and achieves desired commands on the robotic car based on the provided classification. The data is transferred through a Bluetooth module, while the commands are executed by Arduino. The purpose of the robot-car is to demonstrate the feasibility of applying in BCI application, as we will be shown in this paper to controlling the robotic car.

Keywords: Mind wave sensor, Beta Wave, Neurosky, Arduino, HC-05

I. INTRODUCTION

With the world’s progress every one want to be advanced, as the automation in the field of engineering is increasing, it can be best understood by the laser operations where automation works, it has increased the success rate. For brain mapping we use a technique electroencephalogram (EEG), which works on the electric pulses generated in the brain, by extracting these nerves we can track the state of the mind, for example attention, meditation. An electroencephalogram (EEG) gives us with different frequencies which can be further decoded as the states of mind, propensity to have writing and specific sort of epilepsy. For the people with disabilities, it can be used to control a car or it can be implemented for anything which needs to be handled for movement through wheels. Products are available with which control through voice recognition or some sort of sensors. With a step ahead of them we are using brain to control the proceedings.

II. METHODOLOGY

To control the robot car, EEG signals are required. This paper explains EEG signals through Neurosky interface. In this system we have:

Signal intensity: it provides the EEG strength, which is low and given in microvolts (µV).

Signal frequency: The various types of frequencies in the brain EEG are:

Delta, Theta, Alpha, Beta and Gamma which has different frequency and these are produces in different parts of brain.

The Proposed Structure

![Figure 1 For Blue-tooth interface HC-05 with the signal processing of EEG](image-url)
EEG signal from the brain is used to generate a Brain-Computer Interface (BCI) for the important part controls robot car through Bluetooth HC-05. We use Neurosky headset provides us with signals like meditation and attention. Along with this, we extract the eye-blink signals from the headset. Now, we have attention and eye-blinking signals are received as the management signals by a Bluetooth (HC-05) interface and then after used to interface in electric robot car.

The EEG signal was extracted from EEG headset which is manufactured by Neurosky. In this system, we use the Neurosky’s mindwave mobile headset to sense an EEG signal and eye blinking signals. The recorded with the sensor to read brain waves placed on the front side arm just above the eye, as shown by the Figure , the brainwaves are transmitted by the internal Bluetooth wireless module. The output of Neurosky’s mindwave mobile headset is received by Bluetooth module HC – 05 interface organized by using of Arduino UNO and it is also connected to a personal computer with a software of Arduino IDE.

We can see the experimental system an Arduino is the hardware connecting all the links which are receiving Bluetooth, the robot car to be controlled and the computer from where the commands (programs) can be transferred to the Arduino board and at the same time that software shows us all the things happening on the serial communication port. The program in the Arduino analyzes the data received by Bluetooth and accordingly generates outputs on the terminals which are already stored in the program.

The car is run by 2 motor drives. The 8 V power produced from the source helps the acceleration and the rotation to turn to a direction.

### III. IMPLEMENTATION

Here we are work on EEG wave and the Neurosky headset is having only one sensor so it’s a difficult task to take out exactly different waves for the control of the car because at the same time. First of all we need to get the raw EEG data from the brain to the software which would then make the data in such a way that can be used according to our feasibility. The data is then to be sent over to the hardware that would be solely responsible for the movements made by the car. At starting we had connected led’s to the output ports of the Arduino, a program was run to show the attention value on the output ports in the difference of 10. This way we get to check that we are receiving raw data at real time. Now for further work we are considering the MATLAB and LABVIEW software’s to play an important role for the analysis of EEG data with their simulation parts although our main focus is on less complex and cheap arrangement of the system. This is only possible when we are eliminating the use of computer based processing because will lead to complexity and a delay in output is another demerit. For the output we need to develop a robot car, this includes four 12v dc gear motors which are driven by motor driver IC as they require handsome amount of current, which the Arduino is unable to provide. So external source is needed to supply the needed current. For making the robot car totally wireless we need to put that external source on the chassis of the car and the Arduino is to be supplied from the same supply source. There is a two type voltage supply (5V and 8V) used for Arduino and motor Drive, Arduino is drive by 5V and motor is driven by 8V. There is a requirement of motor drive IC L293D which has a dual H type bridge and it works as a current amplifier. L293D takes low current as input and gives high current for motor. It is also use for forward and reverse

<table>
<thead>
<tr>
<th>Output response</th>
<th>Brain signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take a move</td>
<td>Eye-blink</td>
</tr>
<tr>
<td>Accelerate</td>
<td>Attention</td>
</tr>
</tbody>
</table>

*Table.1 Responses of the Robot Car*
acceleration of motors. We can drive two motors in forward and reverse direction from single IC. According to shown in fig-5 In IC L293D we have 2,7,10 and15 for input and 3,6,11 and 14 are used to drive motors. For starting motor pins 1 and pin 9 is high these are ENABLE pins. Pin 4,5,12 and 13 are ground pins. +8V supply is given at pin 7 and 5V is connected at enable pin 1 and 16.

![IC Connection diagram](image)

**Figure. 5 IC Connection diagram**

Neurosky gadget senses the signals which are originated in our brain then it is sent to Hc-05 Bluetooth module. The Bluetooth device is connected to Arduino and vehicle is associated to Arduino [5].
Arduino Code

#define LED 13
#define BAUDRATE 57600
#define DEBUGOUTPUT 0
#define PORT6 6
#define PORT7 7
#define PORT8 8
#define PORT9 9
#define powercontrol 10

void blink()
{
digitalWrite(PORT6, HIGH);
digitalWrite(PORT7, HIGH);
digitalWrite(PORT8, LOW);
digitalWrite(PORT9, LOW);
delay(1500);
}

// checksum variables
byte generatedChecksum = 0;
byte checksum = 0;
int payloadLength = 0;
byte payloadData[64] = {0};
byte EYEBLINK = 0;
byte attention = 0;
byte meditation = 0;

// system variables
long lastReceivedPacket = 0;
boolean bigPacket = false;

void setup()
{
  pinMode(PORT6, OUTPUT);
  pinMode(PORT7, OUTPUT);
  pinMode(PORT8, OUTPUT);
  pinMode(PORT9, OUTPUT);
  pinMode(LED, OUTPUT);
  Serial.begin(BAUDRATE);  // USB
}

// Read data from Serial UART //
byte ReadOneByte()
while(!Serial.available());
ByteRead = Serial.read();

#if DEBUGOUTPUT
Serial.print((char)ByteRead); // echo the same byte out the USB serial (for debug purposes)
#endif

return ByteRead;
}

///////////
//MAIN LOOP/
///////////
void loop()
{

// Look for sync bytes
if(ReadOneByte() == 170)
{
  if(ReadOneByte() == 170)
  {
    payloadLength = ReadOneByte();

    if(payloadLength > 169)  //Payload length cannot be greater than 169
        return;
    generatedChecksum = 0;
    for(int i = 0; i < payloadLength; i++)
    {
      payloadData[i] = ReadOneByte();   //Read payload into memory
      generatedChecksum += payloadData[i];
    }

    checksum = ReadOneByte();        //Read checksum byte from stream
    generatedChecksum = 255 - generatedChecksum;  //Take one’s compliment of generated checksum

    if(checksum == generatedChecksum)
    {
      EYEBLINK = 200;
      attention = 0;
      meditation = 0;

      for(int i = 0; i < payloadLength; i++)
      {
        // Parse the payload
        switch (payloadData[i])
        {
        case 2:
        i++;
        EYEBLINK = payloadData[i];
        bigPacket = true;
        break;
        case 4:
        i++;
        attention = payloadData[i];
        break;
        case 5:
        i++;
        meditation = payloadData[i];
        break;
        case 0x80:
        i = i + 3;
        break;
        case 0x83:
        
    }

}
\[ i = i + 25; \]
break;
default:
break;
} // switch
} // for loop

#if !DEBUGOUTPUT
if(bigPacket)
{
    if(EYEBLINK >= 10)
    {
        digitalWrite(LED, LOW);
        void blink();
    }
else
    digitalWrite(LED, HIGH);

Serial.print("EYEBLINK: ");
Serial.print(EYEBLINK, DEC);
Serial.print(" Attention: ");
Serial.print(attention, DEC);
Serial.print(" Time since last packet: ");
Serial.print(millis() - lastReceivedPacket, DEC);
lastReceivedPacket = millis();
Serial.print("\n");

switch(attention / 10)
{
case 0:
digitalWrite(PORT6, LOW);
digitalWrite(PORT7, LOW);
digitalWrite(PORT8, LOW);
digitalWrite(PORT9, LOW);
break;
case 1:
digitalWrite(PORT6, LOW);
digitalWrite(PORT7, LOW);
digitalWrite(PORT8, LOW);
digitalWrite(PORT9, LOW);
break;
case 2:
digitalWrite(PORT6, LOW);
digitalWrite(PORT7, LOW);
digitalWrite(PORT8, LOW);
digitalWrite(PORT9, LOW);
break;
case 3:
digitalWrite(PORT6, HIGH);
digitalWrite(PORT7, LOW);
digitalWrite(PORT8, HIGH);
digitalWrite(PORT9, LOW);
delay(1500);
break;
case 4:
digitalWrite(PORT6, HIGH);
digitalWrite(PORT7, LOW);
digitalWrite(PORT8, HIGH);
digitalWrite(PORT9, LOW);
delay(1500);
brea...
case 5:
  digitalWrite(PORT6, HIGH);
  digitalWrite(PORT7, LOW);
  digitalWrite(PORT8, HIGH);
  digitalWrite(PORT9, LOW);
  delay(1500);
  break;

case 6:
  digitalWrite(PORT6, HIGH);
  digitalWrite(PORT7, LOW);
  digitalWrite(PORT8, HIGH);
  digitalWrite(PORT9, LOW);
  delay(1500);
  break;

case 7:
  digitalWrite(PORT6, HIGH);
  digitalWrite(PORT7, LOW);
  digitalWrite(PORT8, HIGH);
  digitalWrite(PORT9, LOW);
  delay(1500);
  break;

case 8:
  digitalWrite(PORT6, HIGH);
  digitalWrite(PORT7, LOW);
  digitalWrite(PORT8, HIGH);
  digitalWrite(PORT9, LOW);
  delay(1500);
  break;

case 9:
  digitalWrite(PORT6, HIGH);
  digitalWrite(PORT7, LOW);
  digitalWrite(PORT8, HIGH);
  digitalWrite(PORT9, LOW);
  delay(1500);
  break;

case 10:
  digitalWrite(PORT6, HIGH);
  digitalWrite(PORT7, LOW);
  digitalWrite(PORT8, HIGH);
  digitalWrite(PORT9, LOW);
  delay(1500);
  break;

#else
  bigPacket = false;
#else
  // Checksum Error
  // end if else for checksum
  // end if read 0xAA byte
  // end if read 0xAA byte

IV. CONCLUSION

This paper includes the use of EEG waves for controlling a robot car through BCI (Attention and Eye blink) by using medium of Arduino and Bluetooth HC-05. Further it includes the programming of Arduino and the Bluetooth, while proving the HC 05 with AT commands for the automatic pairing of the headset and the HC-05 module. It is intended that this paper explains a person about the EEG waves and how to receive them using a Bluetooth module over to the Arduino and then generating output without any other application. This paper gives future scope that the car can be
controlled more precisely using a commercial headset as it has more sensors and even by switching over to LABVIEW as a computer processing of the signals.

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REFERENCES