USING BRAIN WAVES TO PREVENT ACCIDENTS AND CALCULATE OUR STRESS LEVELS IN OUR DAY TO DAY LIFE

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Abstract— Brain Computer Interface (BCI) is the direct connection between the computers and human brain. The BCI reads the waves produced from the brain at different locations in the human head, translates these signals into actions and commands ,that can control the computers. We propose to integrate this technology with output devices. This interface system is especially useful to overcome or warn us with accidents that might happen in future due in improper working of brain. The system involves two parts: an EEG sensor circuit and a Arduino microcontroller board. The brain waves are captured using electrodes. These signals are filtered and amplified to remove noise .These analog signal is converted to digital. The digital signals are decoded and are used to control a device.

Index Terms— AgCl electrode, IC AD8232, ARDUINO NANO, Artificial Neural Network, β waves , α waves , θ waves , Δ waves , ɣ waves.

1 INTRODUCTION

Amazingly, nothing in the world can be compared with the human brain. Our Human Brain has high complex structure and is made up of about 100 billion neurons. There are many types of neurons in our brain such as motor neurons, sensory neurons and inter neurons. These neurons get fired up while generating a response for a particular stimulus and generate an electrical signal. These electrical signals are not fully transferred from one neuron to another, but some part of it escapes and reaches the scalp. These signals are captured by the electrodes and used to control the device.

Device Automation is an area where BCI can be used and our device can be controlled by our brain. BCI is a direct communication pathway between an enhanced or wired brain and an external device. Brain computer interface can be classified into three main groups-invasive, semi- invasive and non- invasive. In invasive BCI systems, the EEG sensing device are directly placed on human brain through critical surgery. In semi-invasive BCI system, the EEG sensing device is placed on our skull, directly on top of human brain. In non-invasive BCI system, the EEG sensing device are placed outside our brain and is considered by far the most practical safest BCI system.

I have proposed a method that how a device is used with BCI for some safe precautions to follow in this paper. Using this technology the life of people would be further simplified, physical efforts would be considerably reduced and it would also prove as one of the safest method to use.

2 HARDWARE DESIGN

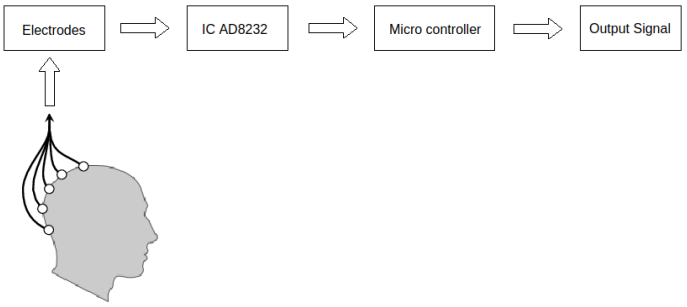

Fig -1: System Block diagram

The hardware consists of three main parts that are useful to process the signal from our brain.

2.1 Electrodes

We will be using dry non-invasive AgCl disposable clinical electrode. The AgCl is used because silver is non allergitic to skin. We are collecting data from 6 electrodes. These 6 electrodes are placed in 6 particular positions in our skull. Two are placed on forehead(which gathers signal from frontal lobe of brain) and and one each is placed on the either side of the head(which gathers signal from temporial lobe of

brain) and the last two is placed on the back side of the head(which gathers signal from occipital lobe of brain). We will obtain the electrical signals associated with those 6 positions in head.

2.2 IC AD8232

The AD8232 is an integrated signal conditioning block for ECG and other bio potential measurement applications. It is designed to extract, amplify, and filter small bio potential signals in the presence of noisy conditions. This design allows for an ultra low power analog-to-digital converter or an embedded micro controller to acquire the output signal easily. The AD8232 can implement a two-pole high-pass filter for eliminating motion artifacts and the electrode half-cell potential. This filter is tightly coupled with the instrumentation architecture of the amplifier to allow both large gain and high-pass filtering in a single stage.

2.3 Micro controller

We use ARDUINO NANO board for it's feasibility and simplicity. It employs ATMEGA328 microcontroller. It is programmed in embedded C using Arduino IDE. After the amplification and the filtering process the Arduino will process the signals and give the output according to the specific algorithm. Here i used basic ANN neural network to train the arduino from gathered signals from different persons in different situations. The Arduino will do the following operations:
1. Will take the analog signal data from the ICAD8238 and process it by ANN.
2.The ANN model recognizes the signal and analizes the output.
3. The Arduino will send the control signal to the device that is to be controlled.

3 ABOUT DIFFERENT TYPES OF BRAIN WAVES

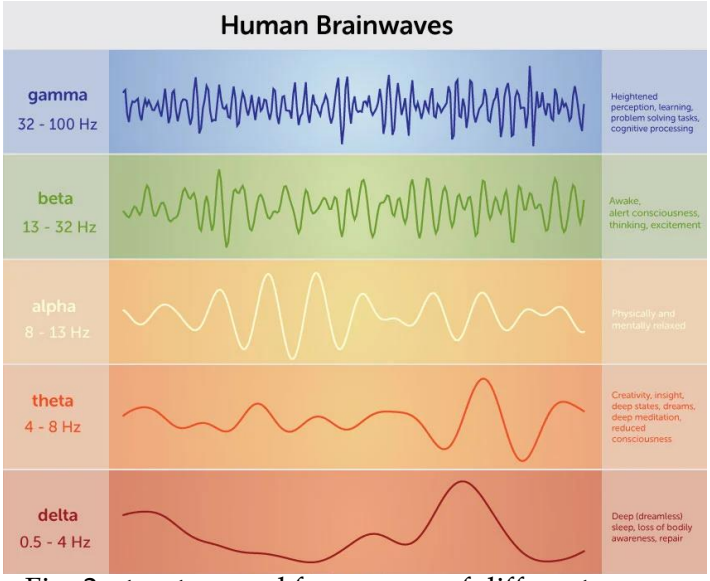

Fig -2: structure and freequency of different waves

1.Beta waves:
- Range 15 – 40 Hz
- faster waves and has low amplitude
- β waves are arousal
- β waves can be generated when a person feels anxiety, stress and can't relax situations
- it can also be generated if a person is in active conversation like a teacher.
- It is majorly found in frontal and central area(mainly in motor cortex) in brain

2.Alpha waves:
- Range 9 – 14 Hz
- Slower waves and has high amplitude
- α waves are non-arousal
- α waves can be generated when a person has a peace of mind or having a break
- It is majorly found in occipital lobes

3.Theta waves:
- Range 5 – 8 Hz
- Slow waves and has higher amplitude
- θ waves can be generated when a person is more slightly or expremely relaxed
- It is majorly found in hippocampus region in brain

4.Delta waves:
- Range 1.5 – 4 Hz
- Slowest waves and has highest amplitude
- Δ waves can be generated when a person is in deep sleep
- It is majorly found in thalamus and frontal cortical regions in brain

5.Gamma waves:
- Range greater than 35 Hz
- Fastest brain waves
- ɣ waves can be generated when a person concentrates more in a thing
- It is majorly found in premotor, parietal,temporial and frontal cortical regions in brain

4 WORKING OF HARDWARE

My BCI system captures the electrical signals from the forehead position. The electrodes will then send the signals to the amplifier and filter circuit wherein the signal is amplified and unwanted noise and signals are filtered out .The analog signals are then converted into digital signals by the inbuilt ADC of Arduino. Since the electrical signals are taken from the six positions in head, they contain
data regarding those six positions. Thus we obtain the signal data from the obtained electrical signal .The micro controller process the signals based on the following logic:

1. When the aurino starts, EEG waves will be observed right after that.
2. The aurdino observes the pattern of the signal and tries to find out the signal from a trained ANN model
3. Once it identifies the required signal it sends the respective instruction .
5. The output device responds according to that instruction

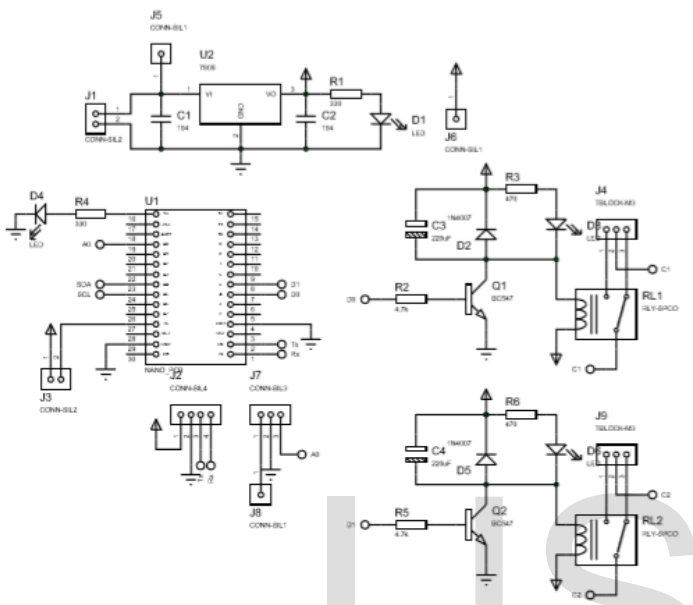

Fig -3: Circuit diagram

5 EMBEDDING THESE ON A HELMET TO HAVE MORE SAFETY

In some of the cars we have face recognition technology so that the camera detects the drowsiness of the driver and alarms him in the car but this kind of technology is not applicable for two wheelers as image recognition is not possible while wearing a helmet. So i used this technology for two wheeler riders.

I had embedded this system on helmet to make the ride more safety. The Arduino perfomes the task based on follows.

- While putting on the helmet the six electrodes attached inside the helmet records the signal in their respective positions.
- The signal records and analyzes by Arduino while the driver is riding in a motor cycle.
- If he feels any kind of drowsiness while riding the Arduino detects the θ waves
- Arduino sends the instruction and activates the vibrator which is attatched to helmet
- The vibrator vibrates the helmet and the driver looses his drowsiness and can have a safe ride

This saves the driver from risk if he feels sleepy in middle of the ride and vibrates so that the driver is steady while driving.

It can also responds if a rider met with an accident or suddenly faints. In that case the aurdino detects delta waves and sends the message to the near hospital and to his relatives with his location from his mobile.

6 OTHER AREAS WHERE THIS SYSTEM CAN BE USED

This system can be embedded in a band that can be wored in head so that if Arduino find any continuous stress (β waves) it notifies us via mobile device to get relaxed for some time (by playing favourite music) and that relax time is measured by α waves and measures time and all will be recorded in mobile so that we will be more peaceful without having stress and can observe our stress and relaxed time in mobile.

We can also use this band as a massager so that whenever we feel stress(detects β waves) continuously the band automatically massages until you feel relaxed(detects α waves).

7 CONCLUSIONS

Hence i conclude that using this kind of technology, our lives become more safe and secure and even makes our mind peaceful by taking out stress and this project stands as an affirmation to that vision. Signals from the brain can be further studied and the technology can be refined to bring about more specific results. The scope of the project was primarily to overcome accidents by studying brain waves and it has been successful in doing so but it has also laid a foundation for many applications which would greatly improve the standard of life for all.

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