



# EEG Based Attention Tracking During Distracted Driving

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### Abstract:

This project discussed about EEG-Based Drowsiness Tracking during Distracted Driving 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 signals from brain in mat lab signals spectrum analyzed and estimates driver concentration and meditation conditions.. If there is any nearest vehicles to this vehicle a voice alert given to driver for alert. And driver going to sleep gives voice alert for driver using voice chip. And give the information about traffic signal indication using RFID. 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. The nearest vehicles information is information is taken through ultrasonic sensors and gives voice alert. And traffic signals condition is detected through RF technology.

**Key words:** ARM, RF, BCI, ultrasonic sensor.

### I. INTRODUCTION

Driving is a complex task, requiring full concentration and a calm attitude. Stressed and strong emotions, whether they result from the driving task itself or unrelated matters, can affect a driver’s abilities. For example, research has shown that angry drivers are more likely to take risks such as speeding, rapidly switching lanes, tailgating and jumping red lights. EEG signal can be one of the features of BCI for detecting driver’s state of mind. The main objective of this paper is to study the different mental state recognition methods based on EEG signals. Later work can be done on analyzing different mental states of a driver in different traffic situation and based on the study, predicting whether driver is mentally fit or not. In recent past, it has been observed that drivers with mental fatigue lead to accident. In, authors have proposed a robust real-time embedded platform to monitor the loss of attention of the driver during day and night driving conditions. The alertness level can be assessed using different measures, such as electroencephalogram (EEG) signals, ocular features, blood samples, speech and others. The EEG-based method has been reported to be highly authentic for estimating the state of drowsiness. In a novel method for multifractal analysis of EEG signals named generalized Higuchi fractal dimension spectrum (GHFDS) was proposed and applied in mental arithmetic task recognition from EEG signals.

### Block Diagram:

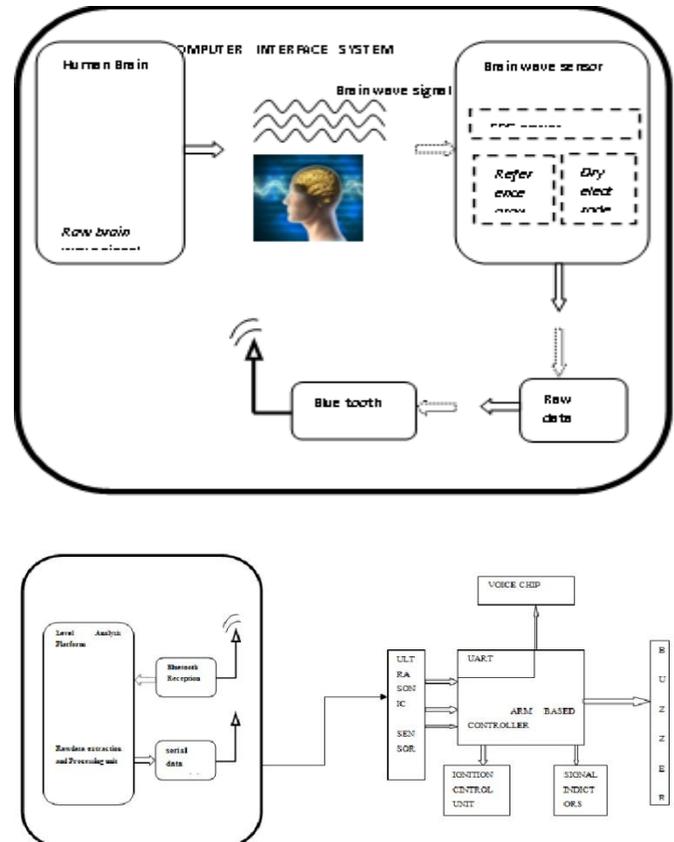


Figure.1: BCI- attention tracking

## II. Design and Implementation

Electroencephalography (EEG) is the measurement of electrical activity in the living brain. In this project we used a brainwave sensor MW001 to analyze the EEG signals. This design discusses about processing and recording the raw EEG signal from the Mind Wave sensor in the MATLAB environment and through Serial transmission control commands will be passed to the voice chip. Mind wave sensors are not used in clinical use, but are used in the Brain Control Interface (BCI) and neurons feedback (one of biofeedback types). The BCI is a direct communication pathway between the brain and an external device.

### Working Principle:

The principle of operation is quite simple. Two dry sensors are used to detect and filter the EEG signals. The sensor tip detects electrical signals from the forehead of the brain. At the same time, the sensor picks up ambient noise generated by human muscle, computers, light bulbs, electrical sockets and other electrical devices. The second sensor, ear clip, is a ground and reference, which allows thinkgear chip to filter out the electrical noise. The device measures the raw signal, power spectrum (alpha, beta, delta, gamma, theta), attention level, meditation level and blink detection. The raw EEG data received at a rate of 512 Hz. Other measured values are made every second. Therefore, raw EEG data is a main source of information on EEG signals using Mind Wave MW001.

### Design Theory:

#### A. Mat lab Platform:

The MATLAB allows including thinkgear.dll. This environment has broad support in toolbox, which makes it ideal for a scientific research. This paper presents how recording and processing the raw EEG signal in MATLAB environment using Mind Wave sensor. The Communication Protocol shows a system of digital rules for message exchange between MATLAB environment and Mind Wave MW001 device. This section also presents the main parameters of think gear library.

#### B. The Communications Protocol

The proposed communications protocol is a system of simple rules for message exchanges between MATLAB and the EEG device. It consists of 7 basic steps, which are presented in following steps.

- ❖ *Load Think Gear library into MATLAB*
- ❖ *Get a connection ID handle to Think Gear*
- ❖ *Attempt to connect the connection ID handle to serial port "COMx"*
- ❖ *Waiting to establish the connection*
- ❖ *Read packets from the connection*
- ❖ *Close the connection*
- ❖ *Unload Think Gear library*

In the first step are functions with parameters in the following order::

1. `libisloaded('Think gear')` – returns true if the Think Gear library is loaded, and false otherwise.

2. `load library('Think gear.dll','think gear.h')` – loads the functions defined in the header file and found in the library. Now, the function `calllib()` can call a function in the ThinkGear library.

3. `calllib('Thinkgear','TG_GetDriverVersion')` – returns the version of loaded library. In the next step, the function `calllib('Thinkgear', 'TG_GetNewConnectionId')` gets a new connection ID handle to ThinkGear. The value -1 is returned if too many connections have been created. In the ThinkGear library, the most important function is `TG_Connect`. This function needs 4 parameters: the connection ID, number of the serial port, Baud rate and type of data. The number of the serial port is given during the pairing of the device. The device can connect on modes 1200, 2400, 4800, 9600, 57600 and 115200 bits per second (bps). Here, we use the 9600 bps rate and stream 5V RAW mode, because these parameters have the minimum of transmission errors.

#### C. Hardware section:

We can read the value of raw EEG signal with the maximum frequency of 512 Hz. Sampling frequency is set on 512 Hz, and we control time delays in sampling. The value of the signal and time are written to the array data. The data which are stored in array will be compared with the threshold points given by the user. In this project, the Matlab section waits for three consecutive blink in order to send the hardware activation signal. Then based on the blink level signal, the cursor will be placed upon any section to get the device control. Further the person has to raise the attention to switch the device.

## III. System Hardware

### LPC2148 Processor:

LPC2148 Microcontroller Architecture. The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core.

Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue.

The key idea behind Thumb is that of a super-reduced instruction set. Essentially, the ARM7TDMI-S processor has two instruction sets:

- The standard 32-bit ARM set.
- A 16-bit Thumb set.

The Thumb set's 16-bit instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM's performance advantage over a traditional 16-bit processor using 16-bit registers. This is possible because Thumb code operates on the same 32-bit register set as ARM code. Thumb code is able to provide up to 65% of the code size of ARM, and 160% of the performance of an equivalent ARM processor connected to a 16-bit memory system

- Standard 32-bit ARMv5TE set
- 16-bit THUMB set

### Brain wave sensor

Electroencephalography (EEG) is the measurement of electrical activity in the living brain. In this project we used a brainwave sensor MW001 to analyse the EEG signals. This design discusses about processing and recording the raw EEG signal from the Mind Wave sensor in the MATLAB environment and through Serial transmission control commands will be passed to the Home section. Mind wave sensors are not used in clinical use, but are used in the Brain Control Interface (BCI) and neurofeedback (one of biofeedback types). The BCI is a direct communication pathway between the brain and an external device.

### ThinkGear ASIC Module

- Directly connects to dry electrode (as opposed to conventional medical wet sensors)
- One EEG channel with three contacts: EEG; REF; and GND
- Improper fit detected through "Poor Signal Quality" warning from ASIC to reset if off the head for four consecutive seconds, or if it is receiving a poor signal for seven consecutive seconds
- Advanced filtering technology with high noise immunity
- Low power consumption suitable for portable battery-driven applications
- Max power consumption 15mA @ 3.3 V
- Raw EEG data output at 512 bits per second

### Think Gear or TGAM Features + Technical Specifications

#### Measures

- Raw brainwave signal
- Processing and output of EEG power spectrums (Alpha, Beta, etc.)
- Processing and output of NeuroSky proprietary eSense meter for Attention, Meditation, and other future meters
- EEG/ECG signal quality analysis (can be used to detect poor contact and whether the device is off the head)
- Eyeblink detection

#### Electrodes

- Maximum surface area of ~150mm<sup>2</sup> (but less surface area is optimal)

- Ag/AgCl, Stainless Steel, Gold, or/and Silver (both solid and plated material works)
- EEG electrode located above the left or right eye on the forehead
- Ground and reference electrodes located behind the ear or at the earlobe
- Have enough pressure to prevent movement, with a minimum of 0.8 PSI

### DC motor:

DC motors are configured in many types and sizes, including brush less, servo, and gear motor types. A motor consists of a rotor and a permanent magnetic field stator. The magnetic field is maintained using either permanent magnets or electromagnetic windings. Motors are the devices that provide the actual speed and torque in a drive system. This family includes AC motor types (single and multiphase motors, universal, servo motors, induction, synchronous, and gear motor) and DC motors (brush less, servo motor, and gear motor) as well as linear, stepper and air motors, and motor contactors and starters.

### Ultra Sonic Sensor:

Ultra Sonic Sensor Our ultrasonic rangefinder is capable of allowing the user to determine his or her distance from an object or wall. When deciding on what type of project to design and construct, we decided that we wanted to create something that would have some practical use in life. Many groups in the past created video games, but we wanted to be different. We considered issues such as safety, user interface, and ease of use, and came up with the idea of making an ultrasonic rangefinder. A rangefinder can be used in various applications such as a measuring device or an obstacle detection device.

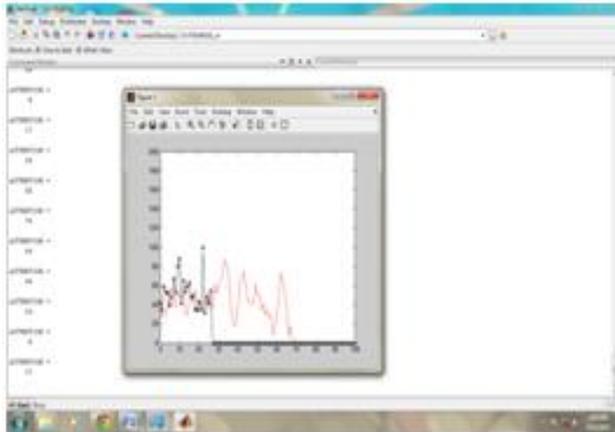
## IV. System Software

MATLAB's Graphical User Interface Development Environment (GUIDE) provides a rich set of tools for incorporating graphical user interfaces (GUIs) in M-functions. Using GUIDE, the processes of laying out a GUI (i.e., its buttons, pop-up menus, etc.) and programming the operation of the GUI are divided conveniently into two easily managed and relatively independent tasks.

### Role of Mat lab in BCI:

The MATLAB allows including thinkgear.dll. This environment has broad support in toolbox, which makes it ideal for a scientific research. This paper presents how recording and processing the raw EEG signal in MATLAB environment using Mind Wave sensor. The Communication Protocol, shows a system of digital rules for message exchange between MATLAB environment and Mind Wave MW001 device. This section also presents the main parameters of thinkgear library. The connection is established through command: calllib ('Thinkgear', 'TG\_Connect', Id, ComPortName, TG\_BAUD\_115200, TG\_STR EAM \_5VRAW). In the next step, we must attempt to read a Packet of data from the connection. We use the TG\_Read Packets () function with ID parameter and number of packet to read. The command calllib ('Thinkgear', 'TG\_ReadPackets', Id, 1)

returns false for error, and otherwise true. The function TG\_Get Value Status () checks if a value has been updated by TG\_ReadPackets(). If this function returns true, we can use TG\_GetValue() function to get the updated value of the raw EEG signal.



**Figure.2. Brian signal representation in MATLAB  
Cursor control in VB**

The above graph representation includes the attention value and blink strength. Based on this signals device control file will be opened and the device will get controlled based on the brain signals.

## V. CONCLUSION

The main goal of this paper is to design and implement a human thought controlled electrical switching system using BCI technology for the physically challenged people. Non invasive BCI method is used for capturing the brain signals with the help of brain wave sensor. Different cognitive state of the user like attention level, meditation level, eye-blink can be used to measure the human thought. The signals are classified according their respective frequencies ranging from 0.5 Hz to 30 Hz. By setting the threshold value for an event, the interrupt is generated. This Interrupt is sent to the microcontroller unit for operating the appliances.

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