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Detection of Drowsiness Using EEG

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ABSTRACT: We proposed a real-time wireless EEG-based brain–computer interface (BCI) system for drowsiness detection. The proposed BCI system consists of a wireless physiological signal-acquisition module and an embedded signal-processing module. Here, the wireless physiological signal-acquisition module is used to collect EEG signals and transmit them to the embedded signal-processing module wirelessly. The embedded signal processing supports various peripheral interfaces, is used to real-time detect drowsiness and trigger a warning tone to prevent traffic accidents when drowsy state occurs.

KEYWORDS: Drowsiness detection, electroencephalogram (EEG), brain–computer interface (BCI)

I.INTRODUCTION

Drowsiness is transition state between awaking and sleep during which a decrease of vigilance is generally observed. Drowsy driver detection system is one of the potential applications of intelligent vehicle systems. Previous approaches to drowsiness detection primarily make pre-assumptions about the relevant behaviour, focusing on blink rate, eye closure, and yawning. But all these measuring techniques will check only the physical activities of the human. In some cases, people will mentally sleep with eyes open for a few seconds. This will make very big accidents in driving. So, in our proposed Project work we are analysing the mental activities of brain using EEG signals based on Brain- Computer Interface (BCI) technology. The Brain-Computer Interface system is a type of a communication system, which helps the people in controlling the various computer based applications using the thoughts of human beings. The Electroencephalogram (EEG) helps to detect various changes occurs in the brain and sample the values in the normal state. Once the changes occur in the normal stage, then it intimates the BCI to perform the pre-processing functions and extracting the data. The accuracy level should be set during the initial stage itself. This system consists of microcontroller, sleep detection circuit, motor etc. the sleep detection circuit is used to check whether the driver is sleeping or not. If the person is sleeping, the speed of the vehicle is decreased by using PWM.

II.EXISTING SYSTEM

There are few drowsiness detections systems existing currently, which work according to physical parameter measurements mostly according to image processing techniques. The disadvantage of image processing technique is the detection possible only in eye close state. Also in existing system the lack of self-control mode if drowsiness is detected, only warning signal is given to the driver to become alert. Previous studies have proposed a number of methods to detect drowsiness. They can be categorized into two main approaches. The first approach focuses on physical changes during fatigue, such as the inclination of the driver's head, sagging posture, and decline in gripping force on the steering wheel. The second approach focuses on measuring physiological changes of drivers, such as eye activity measures, yawning etc. Previous approaches to drowsiness detection primarily make pre-assumptions about the relevant behaviour and drowsy driver detection through facial movement analysis. In other methods a drowsy driver detection system has been developed, using a non-intrusive machine vision based concepts. The system uses a small monochrome security camera that points directly towards the driver's face and monitors the driver's eyes in order to detect fatigue.

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Fig 1: Existing method

III.BLOCK DIAGRAM AND DESCRIPTION

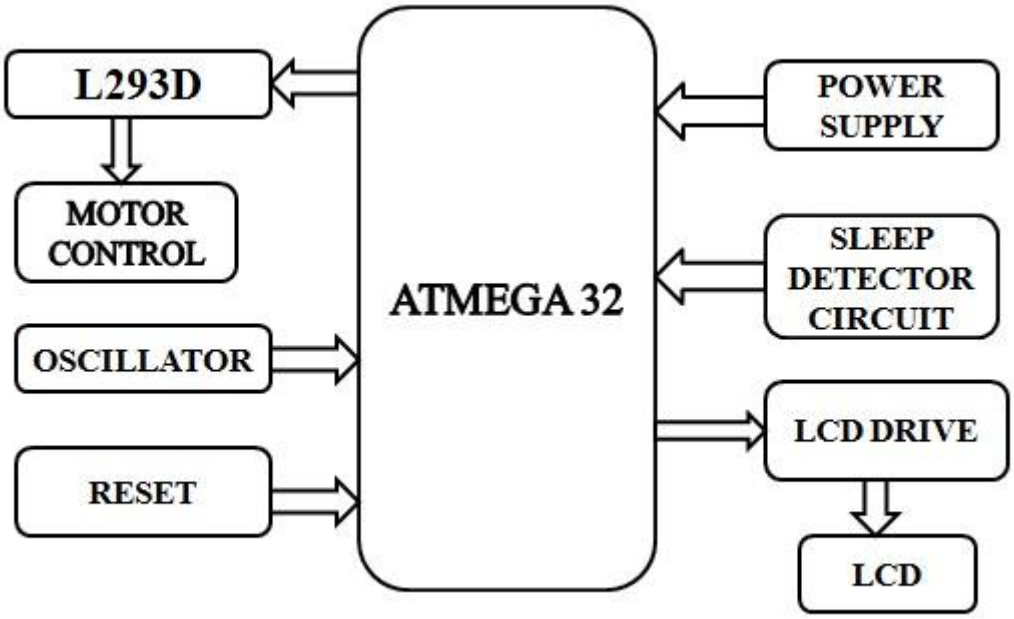

Fig 2: Block Diagram of the drowsiness detection system

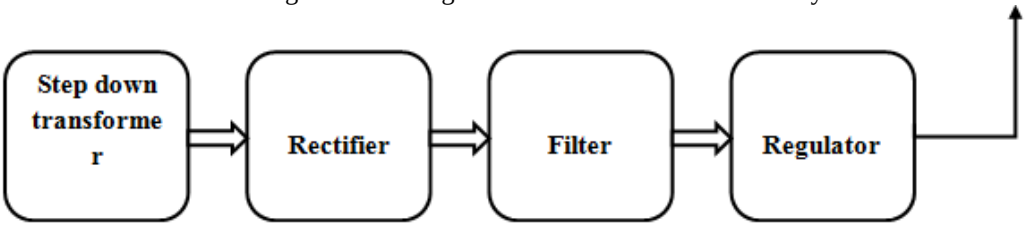

Fig 3: Regulated power supply

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BLOCK DIAGRAM DESCRIPTION

MICROCONTROLLER

The major heart of this project is microcontroller; a microcontroller (sometimes abbreviated µC, uC or MCU) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals etc. However, compare to others microcontroller is fast and very ease to program in C language because of huge support can gain from the manufacturer for programming.

LCD MODULE

A **liquid-crystal display** (**LCD**) is a flat panel display, electronic visual display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. The most common application of liquid crystal technology is in liquid crystal displays (LCDs). A liquid crystal display consists of an array of tiny segments (called pixels) that can be manipulated to present information. The LCD screen is more energy efficient and can be disposed of more safely than a CRT. Its low electrical power consumption enables it to be used in battery-powered electronic equipment.

SLEEP DETECTOR CIRCUIT

Used to detect the driver is sleeping or not.

CRYSTAL OSCILLATOR

A **crystal oscillator** is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time, to provide a stable clock signal for microcontrollers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits incorporating them became known as crystal oscillators.

RESET FUNCTION

Reset is used for putting the microcontroller into a 'known' condition. That practically means that microcontroller can behave rather inaccurately under certain undesirable conditions. In order to continue its proper functioning it has to be reset, meaning all registers would be placed in a starting position. Reset is not only used when microcontroller doesn't behave the way we want it to, but can also be used when trying out a device as an interrupt in program execution, or to get a microcontroller ready when loading a program.

POWER SUPPLY

A **power supply** is a device that supplies electric power to an electrical load. The term is most commonly applied to electric power converters that convert one form of electrical energy to another, though it may also refer to devices that convert another form of energy (mechanical, chemical, solar) to electrical energy. A regulated power supply is one that controls the output voltage or current to a specific value; the controlled value is held nearly constant despite variations in either load current or the voltage supplied by the power supply's energy source.

STEP DOWN TRANSFORMERS

Step down transformers are designed to reduce electrical voltage. Their primary voltage is greater than their secondary voltage. This kind of transformer "steps down" the voltage applied to it. Step down transformers convert electrical voltage from one level or phase configuration usually down to a lower level.

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RECTIFIER

A **rectifier** is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as **rectification**. Physically, rectifiers take a number of forms, including vacuum tube, diodes, mercury-arc valves, copper and selenium oxide rectifiers, semiconductor diodes, silicon-controlled rectifiers and other silicon-based semiconductor switches.

FILTERS

Electronic filters are analog circuits which perform signal processing functions, specifically to remove unwanted frequency components from the signal, to enhance wanted ones, or both. The most common types of electronic filters are linear filters, regardless of other aspects of their design.

REGULATOR

A **regulator** is a device which has the function of maintaining a designated characteristic. It performs the activity of managing or maintaining a range of values in a machine. The measurable property of a device is managed closely by specified conditions or an advance set value; or it can be a variable according to a predetermined arrangement scheme. We are using LM7812 & lm7805 regulators.

IV.HARDWARE IMPLEMENTATION

SYSTEM ARCHITECTURE

The hardware of this system consists mainly of two major parts: a wireless physiological signal acquisition module and an embedded signal processing module. So, in our proposed project work we are analysing the mental activities of brain using EEG signals based on Brain- Computer Interface (BCI) technology.

The key work of the project is analyzing the brain signals. Human brain consists of millions of interconnected neurons. This neuron pattern will change according to the human thoughts. At each pattern formation unique electric brain signal will form. This project work uses a brain wave sensor which can collect EEG based brain signals of different frequency and amplitude and it will convert these signals into packets and transmit and analyse the level and gives the abnormal driving alert and keeps the vehicle to be in self-controlled function until awaken state . This can save a lot of lives in road transportation.

Brain signal analysis:

Here we use brain wave stimulator which controls the vehicle by detecting the brain wave signals like alpha waves are one type of brain waves predominantly originate from the occipital lobe during wakeful relaxation with closed eyes. Alpha waves are reduced with open eyes, drowsiness and sleep. Beta wave, or beta rhythm, is the term used to designate the frequency range of human brain activity between 13 and 30 Hz (12 to 30 transitions or cycles per second). Beta waves are split into three sections: High Beta Waves (19 Hz+); Beta Waves (15–18 Hz); and Low Beta Waves (13–15 Hz). Beta states are the states associated with normal waking consciousness. A gamma wave is a pattern of neural oscillation in humans with a frequency between 25 to 100 Hz though 40 Hz is prototypical and according to the drivers brain activity we can control the vehicle. This causes a remedial change in the accident prevention system.

Brain waves have been categorized into four basic groups:

- beta (>13 Hz),
- alpha (8-13 Hz),
- theta (4-8 Hz),
- delta (0.5-4 Hz).

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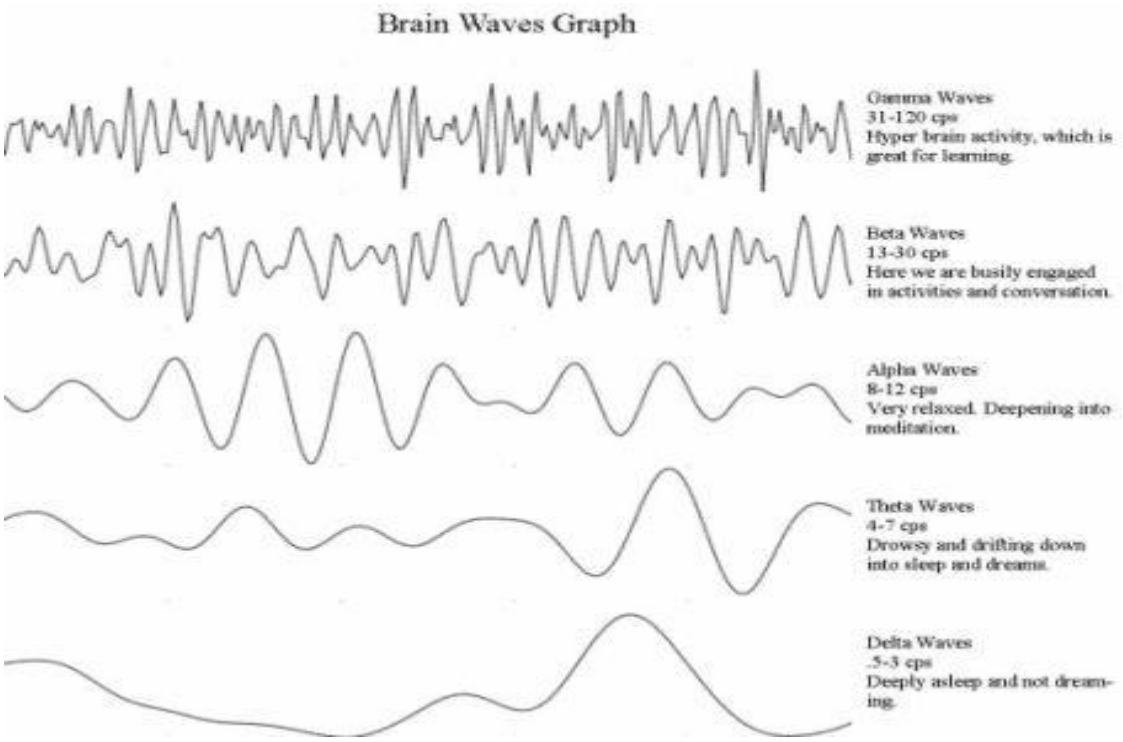

Fig 4: Brain wave signals

An EEG signal between electrodes placed on the scalp consists of many waves with different characteristics. During normal state of wakefulness with open eyes beta waves are dominant. In relaxation or drowsiness alpha activity rises and if sleep appears power of lower frequency bands increase. The last two stages correspond to deeper sleep, where slow delta waves show higher proportions with slower dominant frequencies responsiveness to stimuli decreases.

Electroencephalography:

Electroencephalography is a medical imaging is the technique that reads scalp electrical activity generated by brain structures. The electroencephalogram (EEG) is defined as electrical activity of an alternating type recorded from the scalp surface after being picked up by metal electrodes and conductive media. Due to capability to reflect both the normal and abnormal electrical activity of the brain, EEG has been found to be a very powerful tool in the field of neurology and clinical neurophysiology. In the second state of model show that the EEG distinguishes three distinct mental states ranging from alert to fatigue.

State 1: Concentration: indicates heightened alertness and is frequently present during the first few minutes of time on task.
State 2: Meditation: indicates normal alertness, often following and lasting longer than State 1.
State 3: Eye Blink: indicates fatigue, usually following State 2, but sometimes alternating with State1 and State2.

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AVR MICROCONTROLLER

Fig 5: Atmega 32

The AtmelAVRATmega32 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture with Harward architecture. That comes with some standard feature such as on chip program ROM, data RAM, data EEPROM, timers and I/O ports. Most AVR's have some additional features like ADC, PWM, and different kinds of serial interface such as USART, SPI, I2C, CAN, USB and so on.

EEG SENSOR

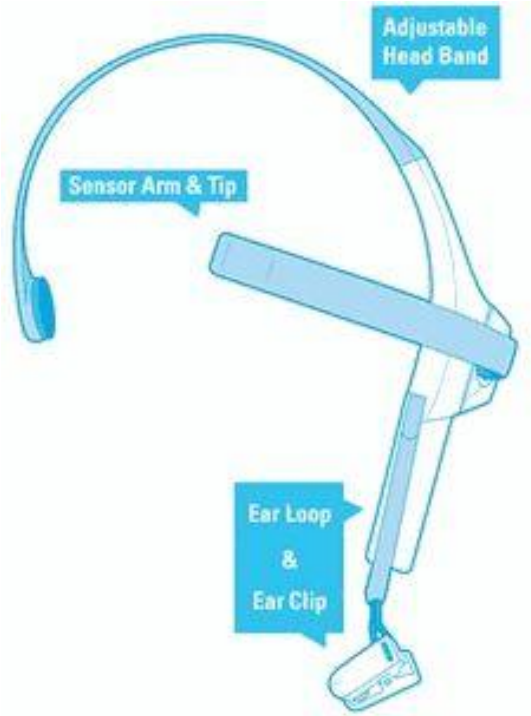

Fig 6: EEG sensor

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Fig 6: EEG sensor placed in users head

Electroencephalogram permits scientists to analyse not solely fluctuations of electroencephalogram activity as a operate of task demand or subject samples however conjointly to differentiate between practical repressive and excitant activities. Low frequencies (e.g., delta and theta) show massive synchronal amplitudes, where a selector encephalogram frequencies (e.g. beta and gamma) show tiny amplitude owing to high degree of asynchrony within the underlying somatic cell activity. In adults, the amplitude of normative electroencephalogram oscillations lies between ten and a hundred. Within the following section, a quick review of varied electroencephalogram bands and their supposed practical roles are going to be given. The review of the muscular and physiological basis underlying the generation of varied electro encephalogram oscillations

V.RESULT

Once the drowsiness is detected, then this message is displayed on the LCD

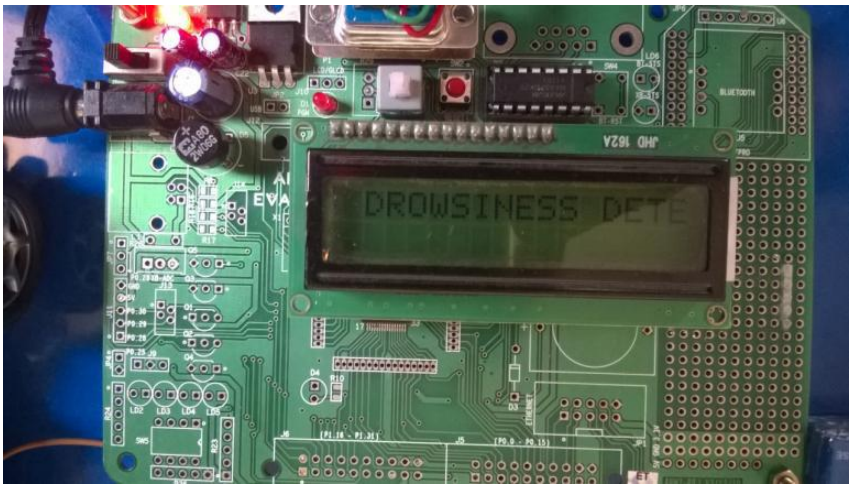

Fig 7: Display output

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VI.CONCLUSION

Many attempts were given by the people to detect the drowsiness such as Image processing technique, facial expressions all that were ineffective because of failure in giving alert to the drivers, failure in the buzzers, detecting the eye movement. Since this proposed work is based on detecting the drowsiness level at the initial stages itself by scanning the neural patterns using the Brain-Computer Interface (BCI) technique it is most successful in detecting the drowsiness even with the eyes open state. In future, the Mind wave module can be modified to increase its accuracy state and new algorithm can also be designed.

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