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Brainwave and Alcohol Sensitising Helmet for Riders Safety

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Abstract — Two wheelers are widely used than other form of vehicles due to its low cost and simplicity. Most of the time rider doesn't like to wear helmet which could be result in fatal accidents. Drunken driving and Drowsy driving are the major factors for such road accidents. Some statics shows that 35% of the accidents are caused by two wheelers and in that 60% of the two wheeler accidents are caused due to lack of consciousness, drunken driving and not wearing helmet. The primary concern of all riders is safety. A new smart helmet with Brainwave technology is introduced to avoid these kinds of accident. This helmet warns the rider if he is having distracted state of mind or drunken and it also prevent accidents and makes the rider drive safely. The breath alcohol sensitizer in the smart helmet helps to identify BAC and prevents him/her from drunken driving and thus reduces accidents. The Smart MP3 player adjusts the volume of the music automatically while rider is listening to the music as a safety precaution. The rider can use GPS technology to locate himself/herself and can navigate to the destination. In case of accidents GSM/GPRS modem send a message to a person regarding rider's location. This smart helmet mainly concerned on safety and comfortableness of rider.
Keywords — smart helmet; brainwaves; drunken driving; riders safety; accident detector;

I. INTRODUCTION

People prefer motorcycle over cars as it is much easier to drive, to repair and to park and also flexible in traffic. In India around 41 % of populations are using two wheelers than four wheelers. As the usage is high, the accident percentage is also higher than four wheelers. Accidents involving two wheelers are more dangerous than four wheelers due to the absence of protective guards like air bags, and the direct interaction of user with the environment. Recent studies show that usage of helmet can save rider from accident by 30 to 40%. Preventing the rider from accident is better than saving him from accident. In recent times many studies and statistics show that drowsiness and drunken driving are the major causes for highway accidents. These types of accidents occur due to lack of consciousness. Adopting this as a major issue, we have designed a helmet to detect driver consciousness and his drunken state every moment and guide him/her through the journey.

II. SYSTEM OVERVIEW

Many researchers have been focused on analyzing drowsy driving by measuring physiological changes such as head tilting rate, angle of head, eye blinking, movement of head and facial expression. The situation of wake or sleep could be detected by these methods, but it does not hold good while the driver was wearing glasses. Therefore by analyzing the Brainwave power spectrum, which changes according to the fluctuations in the level of alertness, the drowsiness can be measured.

Among Brainwave power spectrum, Alpha waves predominantly originate from the Occipital lobe during relaxation with closed eyes and consciousness. Alpha waves are reduced with drowsiness and sleep [1]. Beta wave or rhythm is the term used to designate the frequency range of human brain activity between 12 to 30 Hz. Beta waves are split in to three sections namely High beta waves (19 Hz +); Beta waves (15 to 18 Hz); Low beta waves (12 to 15 Hz). Beta states are the states associated with normal awareness and waking consciousness. A Gamma wave has a frequency range between 25 to 100 Hz [2]. Though 40 Hz is prototypical and according to the drivers brain activity we can sense the measure of alertness or consciousness [3][4].

Another major reason for these kinds of accidents is drunken driving. Positive in alcohol depends on the quantity of alcohol in the blood after the driver drunk. Alcohol in Blood or Blood Alcohol Content (BAC) is usually measured in mg/l.

The BAC of 0.2mg/l and above will affect the drivers behavior such as consciousness, emotional swings and anger or sadness and the rider will experience a impaired judgments coordination and sensory perception, slow time reaction, fall performance intellectual test and weakened eyesight which may lead to an accident [5].

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It is mentioned that legal limit of Blood Alcohol Concentration for driving in India is 0.03% or 30 µl alcohol in 100 ml blood. Preventing the rider from accident is better than saving him from accident. We can prevent the accidents to a certain extent. In case of accidents occurs, it is most important to save them in time. If emergency service could get information and location of

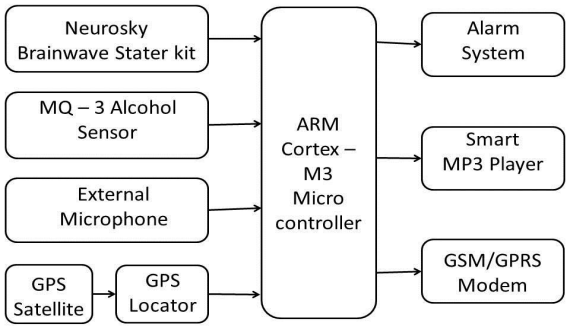

Fig.1 Block Diagram of the System

accident, many lives could have been saved. An automatic accident detection system is necessary to save precious human life by notifying the accident to the emergency service with the accident location. We can make use of Global Positioning System (GPS) technology for the same.

Now a day's GPS become an integral part of every vehicle system for tracking and navigation. We utilize the capability of GPS receiver to monitor the speed of vehicle and detect an accident basing on the monitored speed and send the location and time of the accident from the GPS data processed by a micro controller by using the Global System for Mobile Communication (GSM) network to the alert the service Centre [6]. Hence the rescue service can reach the spot and save valuable human life in time.

As mentioned above, Studies shows that usage of helmet can save rider from accident by 30 to 40 %. But the important problem with bikers is that most of the time they don't wear helmet which could be fatal when accidents happen.

Smart mp3 player is included in the helmet, in order to encourage the rider to wear helmet. The External microphone attached to the helmet, detects the traffic noise. While detecting the important traffic sounds like siren or horn, it mutes the music automatically and if there is no traffic sound the music volume will be raised gradually [7]. This system encourages the rider to wear helmet.

III. SYSTEM ARCHITECTURE

The construction of this system consists of two parts namely hardware development and software development. Hardware development involved the designing the circuit of the project while the software developments is focused on designing coding to be embedded in the hardware.

A. Hardware Developement

Brainwave and Alcohol Sensitizing Helmet includes several parts such as ARM Cortex-M3 Processor, Brainwave starter kit, Breath alcohol sensor, GPS locator, GSM/GPRS modem, microphone and Smart MP3 Player. ARM Cortex M3 microprocessor is the heart of this Smart helmet as it takes input from Neurosky headset, alcohol sensor and microphone and process the input and controls other system based on processed data.

1) Brainwave Starter Kit: Since electric signals from the brain are more complex, it can be detected using sensitive medical equipment such as EEG and MEG which are extensively large and expensive. These electric activities of a brain are known as a brainwave pattern because of its cyclic wave like nature

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Fig.2 Neurosky – Brainwave starter kit

In order to measure these Brainwave power spectrums, we use Brainwave starter kit from Neurosky which is inexpensive, commercial and entertainment-based headset shown in Fig.2. The EEG electrode is on the sensor arm, resting over frontal and occipital lobe. It measures Raw-Brainwaves and does processing and outputs the EEG power spectrums (alpha, Beta etc.).
A real-time stage 1 sleep can be detected using this system. This device issues an auditory warning at the onset of stage 1 sleep. The EEG signal is filtered into alpha and beta frequency bands which are used to analyze the onset of the sleep. When a rider moves from alert state to drowsy state, the alpha and theta band powers increase significantly [8]. These changes are more dominant in the occipital and parietal regions when compared to other regions.

2) Alcohol Sensor: The alcohol sensor circuit will detect the alcohol depends on human breath and the data will be send to ARM Cortex- M3 Processor as a controller to other circuits. The alcohol sensor MQ-3 is selected in this system due to its sensitivity in the detection of the small value of BAC. This alcohol sensor is suitable for detecting alcohol concentration on person's breath, just like a common breathalyzer.
This sensor is composed by micro Al_2O_3 ceramic tube, Tin Dioxide (SnO_2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-3 has 6 pins, 4 of them are used to fetch signals, and other 2 are used for providing heating current. Since sensitive material used is SnO_2, MQ-3 gas sensor has fast response and high sensitivity to Alcohol, and has good resistance to disturb of gasoline, smoke and vapor and provide an analog resistive output based on alcohol concentration which is given to microprocessor. The MQ3 Breath alcohol sensor is shown in Fig.3 .The sensor able to detect BAC with different concentration and classified the range of BAC detected into a few level.

3) Gps Locator: The Global Positioning System (GPS) is a popular technology which was developed by American Department of Defense (DoD) for military use. Later on it was available for civilian use. It is utilized for wide range of applications such as location, direction, speed, timing, surveying, logistics, traffic management, security, navigation etc. It can provide accurate time, location coordination and speed etc. GPS is actually a constellation of 27 Earth-orbiting satellites. GPS has a capacity to work on any weather conditions, anywhere in the world, 24 hours a day. Nowadays GPS technology has become more accurate, smaller, reliable, and economical. A very sensitive and accurate GPS signal acquiring device is required for the system. The receiver used in this system continuously tracks all satellites in view and provide accurate positioning data. The GPS locator can be used for navigation purpose and to detect the accident by monitoring speed.

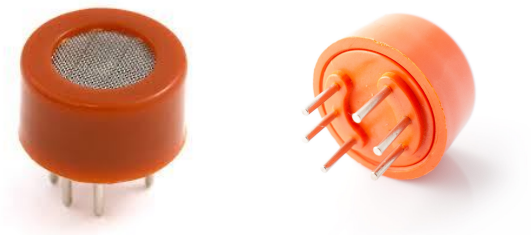

Fig. 3 MQ3 – Alcohol Sensor

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4) Gsm/Gprs Modem: Global System for Mobile communications (GSM) is a digital mobile telephony system that is widely used. Besides the voice communications it also offers Short Message Service (SMS) and General Packet Radio Service (GPRS) to transfer data. The GSM/GPRS modem can accept all kind of SIM card and utilizes the GSM network to send the location of the accident. *Modem is designed with RS232 level converter circuitry which allows to directly interfacing with PC serial port or Microprocessor and it also supports dual frequency (GSM/GPRS 900/1800MHz). It uses USART (Universal Synchronous Asynchronous Receiver and Transmitter) to interface with Microprocessor. The modem can be controlled by a microprocessor through AT command set.*

5) Arm Cortex- M3 Processor: The Cortex-M3 processor is the first ARM processor based on the ARMv7-M architecture and has hierarchical structure and has been specifically designed to achieve high system performance in power- and cost-sensitive embedded applications. It integrates the central processor core, called the CM3Core, with advanced system peripherals to enable integrated capabilities. These peripherals are highly configurable to allow the Cortex-M3 processor to address a wide range of applications and more closely aligned with the system requirements. The central cortex-M3 core is based on the Harvard architecture featuring a high level of support block integration and low power consumption

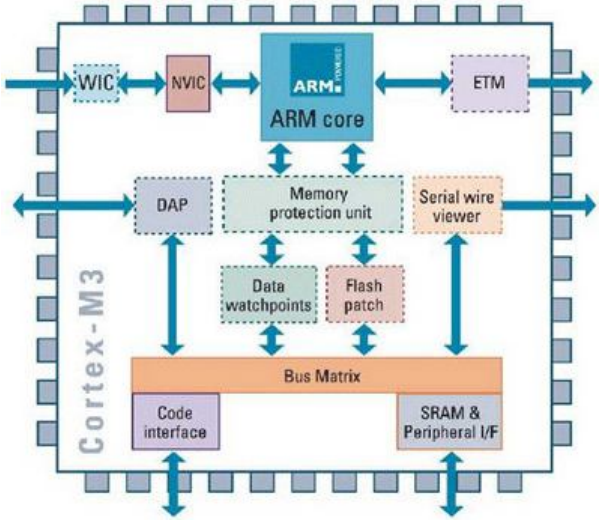

Fig.4 Overview of ARM Cortex-M3 Processor

Being able to read both instruction and data from memory at the same time, the cortex-M3 processor can perform many operations in parallel, speeding application execution. The central Cortex-M3 core, based on a 3-stage pipeline Harvard architecture, incorporates features like branch speculation, single cycle multiply and hardware divides to deliver an outstanding efficiency of 1.25 DMIPS/MHz. The Cortex-M3 processor reduces system area by implementing the smallest ARM core to date, with just 33,000 gates in the central core (0.18um G) and by efficiently incorporating tightly coupled system components in the processor

B. Software Development

Software development is to develop embedded software required to control hardware development. It is the process of coding computer program which is needed to operate hardware development. The process flow for the working of the system is given with the help of flow chart. The flow chart for the system ig shown in Fig.5

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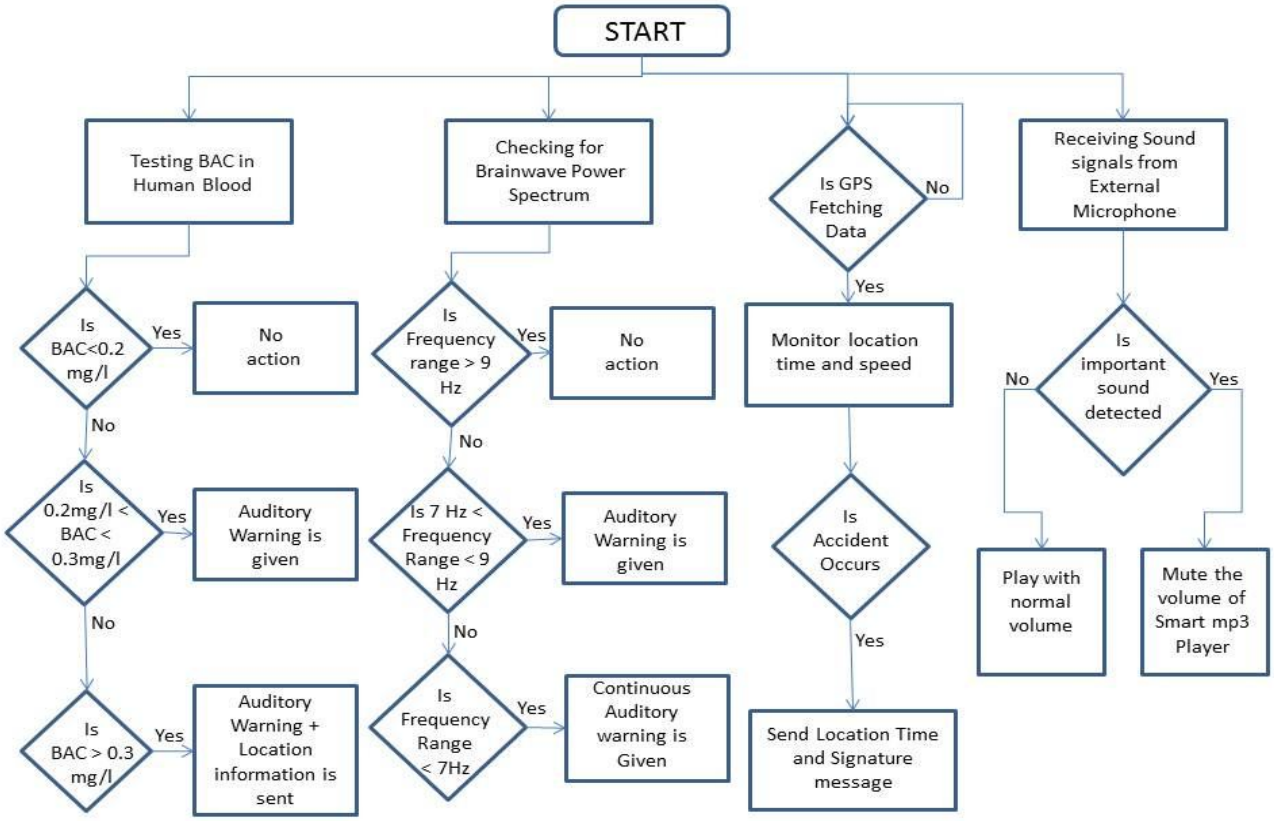

Fig.5 Flowchart of the system

IV. RESULTS

The Smart Helmet tests the driver for drunkenness alertness. The BAC is taken in account for his level of toxicity. If the rider is slightly drunk, it gives an auditory warning to the rider. If the rider is drunk heavily over the accepted level, it sends a signature message along with location to a mobile number registered previously. It also checks for his/her concentration while driving using Brainwave Starter kit inbuilt in it. If he/she lacks concentration or is in drowsy condition, it also gives an auditory warning. In case of accidents the helmet automatically sends a standard message including rider's position to a mobile number registered previously. The volume of Smart MP3 Player is adjusted automatically to the important traffic sounds. Using GPS technology the rider can navigate easily to his destination. Thus rider can drive safely and with ease

V. CONCLUSION AND DISCUSSION

Brainwave and alcohol sensitizing helmet is designed especially for two wheeler rider to safeguard him/her from accidents. It sense drowsiness and lack of consciousness using brainwave starter kit and drunkenness using alcohol sensor. This helmet can be useful to overcome the above problems discussed. It also includes Smart mp3 player in which volume is adjusted automatically. Thus it encourages the rider to wear this helmet. All units are powered by ARM Cortex M3 microcontroller which is low cost, low power and provides superior performance. Thus by this helmet, Road accidents are prevented to certain extent.

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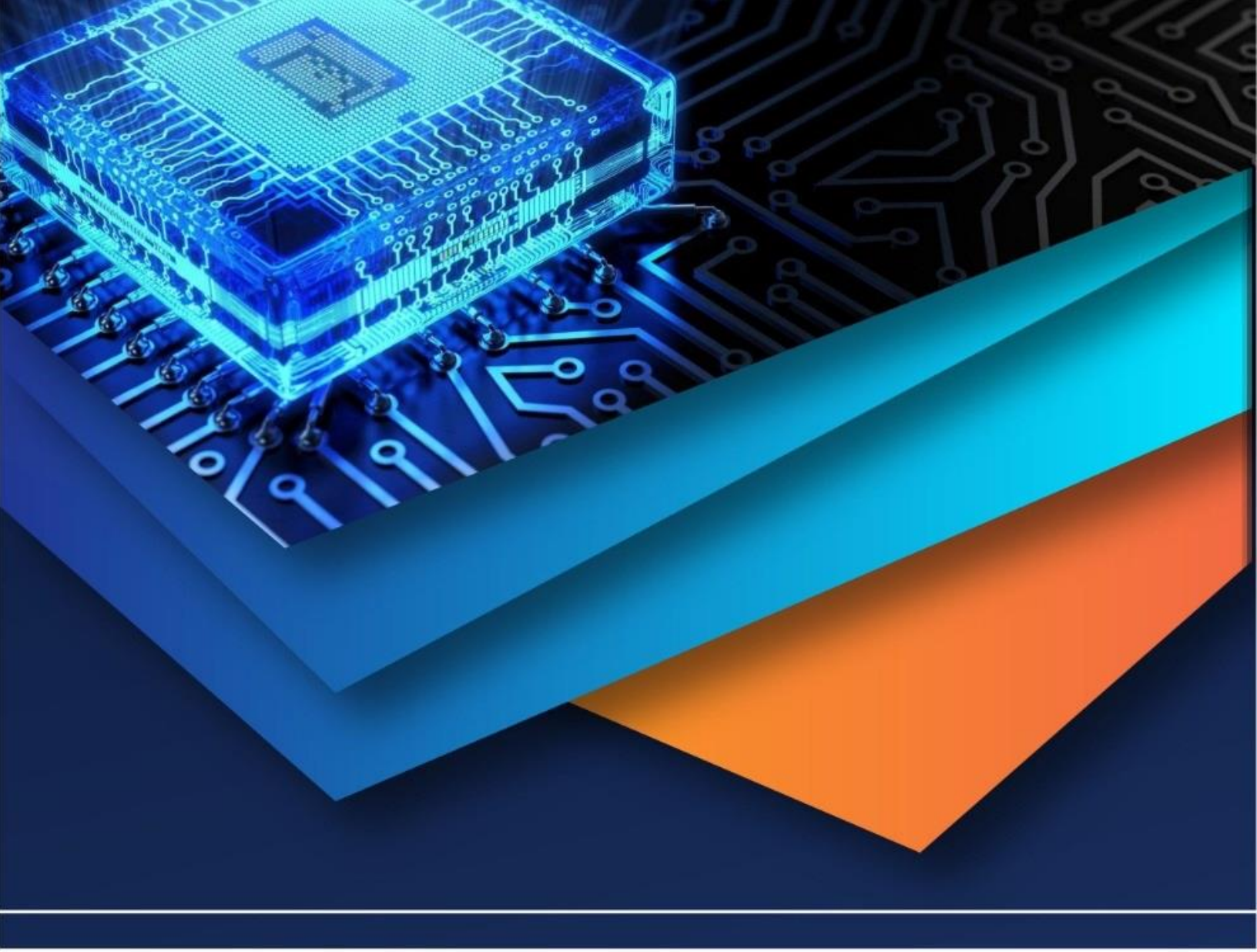

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