A smart helmet with a built-in drowsiness and alcohol detection system

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Abstract

Road accidents are increasing day by day. Many people suffer long term even injuries, permanent damages or also lose their lives. Ensuring the safety of riders has become a significant concern for these days. This project is designed to reduce the chance of happening accidents by bike riders. It detects major causes for bike accidents such as alcohol consumption and drowsiness. Whenever the system detects one of them or both, the rider will be informed using an alarm and if the bike is not moving, the ignition will be turned off and locked.

Key words: Alcohol, Bluetooth, Drowsiness, EEG, GSM, Smart Helmet

1 Introduction

Vehicle accidents are common incidents of these days. Roughly 1.35 million people are died annually due to road accidents all around the world [1]. Apart from that, nearly 20 - 50 million people suffer from non-fatal injuries and long term disabilities. Most of them are motorbike riders. The main reasons for those accidents are drinking and drowsiness.

Drinking and driving increase the possibility of an accident happening. Even a little consumption of alcohol can double the possibility of happening an accident [2]. The based on the previous studies, a risk of a death can be reduced by almost 40% by wearing a helmet [3]. However, the main purpose of the traditional helmet is to protect the head from an impact.

2 The idea behind a Smart Helmet

According to the law, bike rider should wear a helmet, and that is the rule implemented in many countries worldwide [3]. Even though regulations available, most accidents happen without helmets cause significant damages to the head and also leads to death. In this concept, the rider should wear the helmet before he can start the bike. Otherwise, the ignition of the bike will not work. At the same time, the status like whether the driver is drunk, or whether the driver is drowsy, identify by data collected from a sensor built into the helmet. Current researches have made alcohol detectors built into the helmets. They've also made systems to lock down the ignition if the rider is not wearing the helmet [4].

3 Introduction to this project

In this project, the smart helmet will be more improved by adding an EEG scanning system to capture the brainwave of the rider and verify whether he is drowsy or not. As mentioned earlier, drowsiness is another critical reason for road accidents. Detecting the drowsiness before the rider ignites his bike can save his life. Also, this system tests whether the rider has used alcohol or not. An alcohol sensor which is attached near to the mouth (built into the helmet) is used for this task.

Fig. 1 and, 2 shows the appearance of the final product at the final stage. All the sensors and electrodes are highlighted in red glow marks. The processing unit is highlighted in blue glow mark.

Fig. 1. Side View

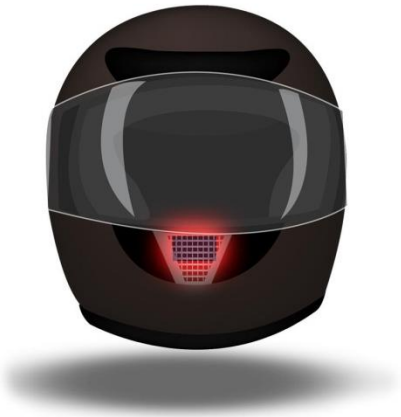

Fig. 2. Front View

4 Methodology

Drowsiness Detection

The helmet is integrated with an EEG detector. That EEG detector scans the rider's brainwaves as soon as he puts his helmet on, then the detected signal is processed, filtered and identified. This frequency is used to classify the current brainwave frequency of the rider. According to the frequency, the brainwave can be categorized into four main types [5]. They are Delta, Theta, Alpha and Beta. Frequency ranges of those waves are mentioned in Table 1.

Table 1.Brainwaves classification [5]

#	Brainwave type	Frequency range
1	Beta	> 13Hz
2	Alpha	8 Hz to 13 Hz
3	Theta	4 Hz to 8 Hz
4	Delta	Up to 4Hz

Delta and Theta waves have low frequencies than alpha waves, and they usually happen during sleep. Drowsiness is the transition stage between the state of awake and the state of sleep. During this moment, the eyes are closed due to drowsiness, and alpha waves will be generated very strongly [5]. Those brainwaves are detected by electrodes which are inbuilt to the helmet. At the same time, a signal transfer to the processing unit in the helmet.

Alcohol Detection

Fig. 3. Alcohol Sensor

On the front side of the helmet, there's an alcohol detection sensor (MQ-3) (Fig. 3) facing towards the mouth of the rider. This sensor has an alcohol detection concentration if 0.05-10mg/L, which is fairly enough range to detect emitting alcohol from a drunk person's mouth [6]. The output signal of the sensor is sent to the processing unit inside the helmet. Processing Unit is the brain of this system. It gets both signals separately from the EEG unit and Alcohol unit, and then those signals are processed individually. Whenever either of those signals is above habitable range (Either detection of strong alpha wave or detection of alcohol), the processing unit sends a lockdown command to the receiver built into the bike. When the receiver receives a lockdown command, the ignition is cut off, or the receiver unit will fire a high-frequency alarm. Then an SMS will be sent to a pre-saved number saying that this person is drunk and he is in a risky situation.

5 Product Design

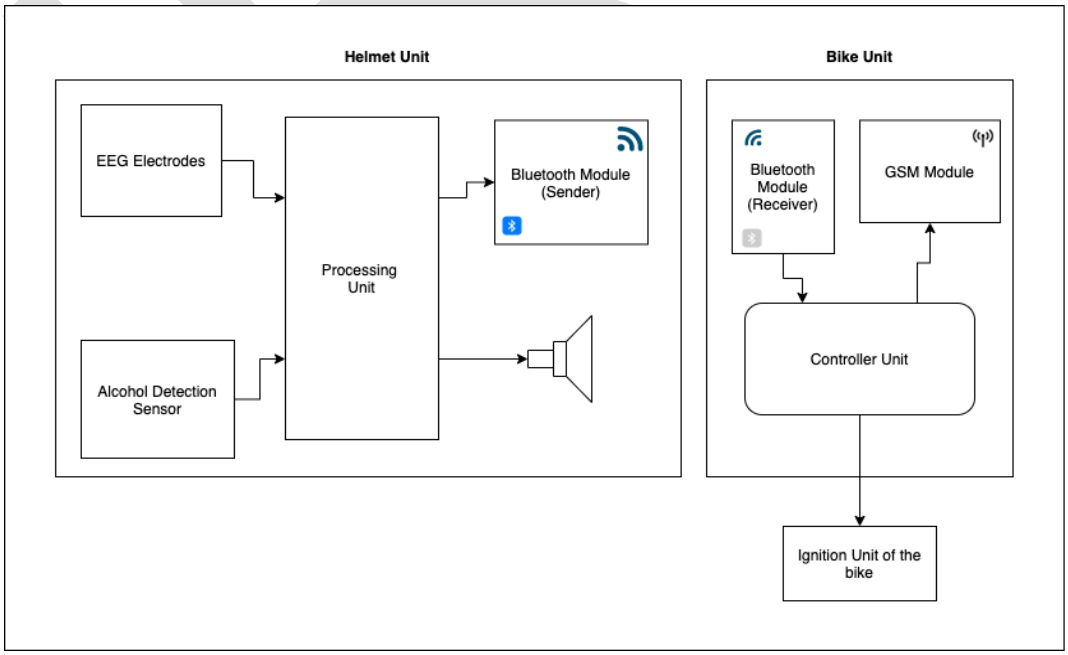

Fig. 4. Main Design

This project contains mainly two units which are given in Fig. 4. It consists of the helmet and bike unit, as well as the central sub-component systems associated with the smart helmet.

Helmet Unit

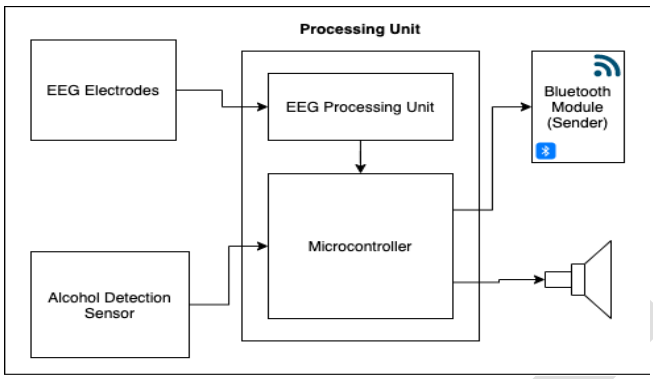

Fig. 5. Helmet Unit

Fig. 6. Components placement

The helmet unit is containing five main components, as shown in Fig. 5. Actual placements of those components are demonstrated in Fig. 6.

1. The main processing unit
2. EEG Processing unit (Contains Electrodes)
3. Alcohol sensor
4. Bluetooth Module (Sender)
5. Speaker

The main processing (1) unit is the brain of this product. Inside it, there are two components. They are the EEG signal processor and the Arduino microcontroller. This microcontroller gets the signals from the alcohol sensor (3) and EEG signal processor (2). Those signals are analyzed inside the microcontroller by a custom-written algorithm. Whenever either signal identifies a danger situation, the controller will inform the rider with a alarm (5)and send a lockdown command to the bike unit using the Bluetooth module (Sender) (4).

Bike Unit

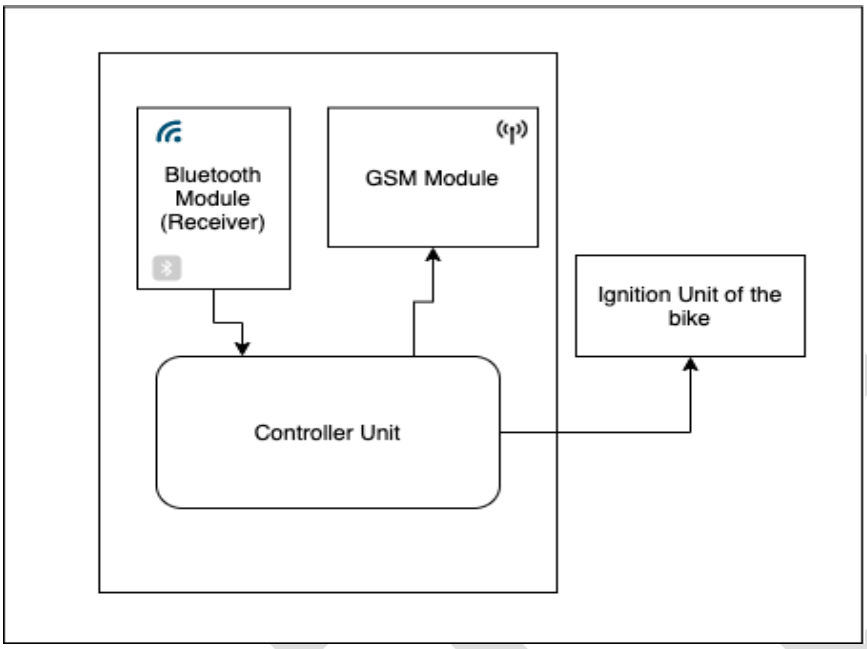

Fig. 7.Bike Unit

The bike unit has 3 main components as show in Fig. 7,

1. The controller unit
2. GSM module
3. Bluetooth module (Receiver)

Whenever the controller unit receives a lockdown command through the Bluetooth module (Receiver), it will check whether the bike is running or not. If the bike is not running, the controller unit will cut off the power to the ignition unit. If the bike is running, a high-frequency alarm will be fired to indicate the danger to the rider. If he is drowsy, this high-frequency sound will wake him up. For both running and non-running situations; an SMS will be sent to a pre-saved number using the GSM module, to inform that this person is in some kind of danger. There were products to detect alcohol of bike riders and detect drowsiness other vehicle drivers. But the uniqueness of this product is this can detect both alcohol (Using a sensor) and drowsiness (Using EEG) individually and lockdown or raise the alarm according to the situation. This is specifically designed for bike riders.

6 Conclusion

The safety of bike riders can be increased using this helmet by detecting some of the major causes of accidents such as alcohol consumption and drowsiness. Above mentioned situations will identify by the system and will inform the driver by an alarm. At the same time, the ignition system will not function if the rider has not started the bike yet. If the system detects either of those causes while the bike is moving, the rider will receive the warning message using a high-frequency alarm, and he will be commanded to stop the bike immediately.

7 References

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