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A Smart Helmet Using GSM and GPS Technology

Pankaj Mahoorkar[1], Deepali Vanke[2], Gouri Joshi[3], Haripriya Kulkarni[4], Krupa Kulkarni[5*]
[1]Assistant Professor, Department of Electronics and Communication Engineering, P.D.A. College of Engineering, Kalaburagi, India
[2,3,4,5]Student, Department of Electronics and Communication Engineering, P.D.A. College of Engineering, Kalaburagi, India

***Abstract*: The usage of a smart helmet, a sort of protective headgear, increases the rider's level of safety when operating a motorcycle. India, the world's second-most populous nation, has a sizable young population. Today's youth like riding bikes, and due to fashion, they often choose not to wear helmets. Due to them, the number of fatal bike accidents is rising daily. Head injuries are a major cause of fatalities and can be avoided by using a helmet. More incidents of drunk driving are occurring, which leads to accidents and death by negligence when an accident happens. These occurrences inspired us to create a smart helmet using the internet of things that has the following features: the bike only starts if the rider is wearing a helmet, and the ignition will immediately shut off if the rider is too inebriated. If an accident happens, a GSM modem will use a sim card to send a message to the registered contact number. When a rider gets sleepy, the bike slows down and signals the rider.**

***Keywords*: Smart helmet, GSM, GPS.**

1. Introduction

The word "technology" is used frequently throughout the world, particularly in the domains of education, product manufacture, transportation, communication, and health. The transportation sector's industry has always been a crucial component of the economy and a tool for the government. While there are many methods to get around the world, motorcycles are the craziest kind of transportation for both the young generation and the entire planet. Motorcycle riders have a unique relationship to motorcycles, therefore motorcycle safety is specifically tied to several elements of the vehicle, such as equipment model, vehicle design, and operator skill. They are, nevertheless, the most dangerous road users since, in the absence of a protective body, even the slightest carelessness can result in serious injuries or even the rider's death. In addition to carelessness, other factors that contribute to fatalities include excessive speeding, reckless driving, excessive alcohol usage, and breaking traffic laws. But the lack of a helmet on the victim was the primary cause of brain damage, which results in instant death. Eighty percent of brain injuries can be prevented if the cyclist wears a helmet, and accidents can be prevented altogether. Using cutting-edge technologies like IoT, hazardous traffic situations won't happen. To well as equipping bikes with sensors, an alarm system that sends messages to the rider and their surroundings, and laws requiring helmet use while riding. According to a recent analysis, 4 people die in car accidents every hour, and 70% of those deaths are related to not wearing a helmet. Using data from statistics around the world, tightening safety rules, and cutting-edge technology being developed to prevent such occurrences and guarantee passengers' safety.

In recent years, every State has made wearing a helmet a requirement. India has seen an annual increase in traffic accidents. According to Section 129 of the Motor Vehicles Act of 1988, everyone operating a two-wheeled vehicle must wear protective headgear that complies with BIS standards (Bureau of Indian Standards). The Motor Vehicle Act of 1939 makes driving under the influence of alcohol a crime in India. This declares that the bicycle rider will be disciplined. A bike rider can currently easily elude the law. These three key concerns are what drives us to create this project. Identifying whether or not to wear a helmet is the first step. If a helmet is on, the ignition will turn on; if not, it will stay off until a helmet is removed. Alcohol detection is done in the next stage. Alcohol sensors are used as breath analyzers to check for alcohol in the rider's breath. If the level is higher than what is allowed, the ignition will not turn on. The message will be delivered to the registered phone. These make use of the MQ-3 sensor. The ignition will start whenever these two requirements are met. Accidents and delayed medical care make up the third major problem. When a rider is in an accident, he may not be able to get help right away, which is a major cause of fatalities. About one death due to delayed medical attention or an unattended accident occurs every second. We attach an accelerometer to the bike unit for fall detection. This technique allows us to determine whether an accident actually happens. The project's sleepiness detection is its fourth main moto. The eyeblink sensor does it. The goal of this project is to create a helmet protection system for improved bike rider safety. In this project, two separate microcontrollers are utilised. We have used different microcontrollers for each unit; the bike unit uses an Arduino Uno, while the helmet unit uses an Arduino Nano. RF technology is used for signal transfer between the bike unit and helmet unit.

*Corresponding author: kulkarnikrupa21@gmail.com

2. Literature Review

A. Previous Investigation

The following are a few of the earlier studies that were done on this subject.

Divyasudha N. et al., "Analysis of Smart helmets and Designing an IoT based smart helmet" discusses how one of the most important and extremely crucial areas that need attention is the safety and security component of our life. Accidents on the roadways have resulted in a significant number of human fatalities and injuries. Many fatalities are being linked to either those who are inebriated or who are not wearing a helmet. This raises the possibility that a collision or accident will result in the death of every person involved. Therefore, the researchers have suggested in this research article that an effective technique be developed that can ensure that the rider is wearing a helmet and is not intoxicated.

V. Jayashree and M. N. Kumari, "IoT Based Smart Helmet for Construction Workers" explains the idea of the rising death rate among construction workers in more detail. One of the worst locations for workers has been the dangerous environment of a construction site. To protect the safety of the workers on the construction site, numerous safety procedures are being implemented. However, there have been instances where personnel have caused mishaps by forgetting to use the safety equipment. As a result, a smart helmet has been developed that makes use of the Internet of Things platform to accomplish the objectives of monitoring the worker's physical status, including fall detection and distraction.

A. Jesudoss, R. Vybhavi and B. Anusha, "Design of Smart Helmet for Accident Avoidance" explains the widespread wrongful death that takes place every day in the world. This has been one of the most serious incidents that have occurred as a result of user irresponsibility and distraction from tiresome labour, both of which can be quite harmful. Accidents are happening more often, and many of them—especially those involving cyclists—have been quite fatal. As a result, the authors suggested an IoT strategy that makes use of an infrared sensor, a load sensor, a gas sensor, and MEMS. These sensors are intended to make riding smart and safe, which is essential for the rider's survival in the event of an accident or other calamity. Additionally, it has the ability to detect alcohol levels, which will decrease the likelihood of

N. Nataraja, K. S. Mamatha, Keshavamurthy and Shivashankar, "Smart Helmet" educates the reader to the risks to their safety that a rider of a two-wheeler faces on the roads. Biking is a delightful pastime, but because it is so risky and dangerous, it is frequently disregarded. The fact that bikes are still popular among users is attributable to their many advantages over automobiles, including their ability to park easily, ease of use, low cost, and usefulness in congested areas. As a result, a software that can produce the desired results was created using structured modelling. It can be utilised as a Real-life solution with only a few modifications. The system is simplified and more cost-effective because the majority of the components, together with the microcontroller, may be built on a single chip.

M. S. Gour, Shikha Gupta et al., "Arduino based smart and intelligent helmet system for two-wheelers" what causes that the death rate for riders of two-wheelers is greater, per our country's crash data. Smart helmets have become necessary as a result of how well they work at preventing fatalities. However, a smart helmet should also work to avert the calamity in the first place. It may provide the essential support. The recommended system's capabilities can be increased to allow for direct contact with paramedics or healthcare facilities that have professional assistance. With the correct assistance from the government, many individuals could actually afford the smart helmet. The government might be able to help make this kind of helmet mandatory given the smart helmet's importance.

3. Objectives of the Study

A real-time safety system can be employed with a smart helmet. Later, we can integrate the entire circuit into a compact module. It is a safety system that uses less power.

A. Proposed System

In order for a biker to start his or her bike, according to our work, the rider must be wearing a helmet. Additionally, it provides information about the area in case the biker is involved in an accident. A GSM module sends an SMS containing the accident's location to the registered mobile numbers' cell phones. Before the accident's location is known and can be determined using GPS technology, the rider cannot be helped by just sending an SMS about it. One of the main factors in accidents where people unwittingly nod off while riding a bike is drowsiness warning. Because of this we have introduced eye blink sensor in this project so the bike gets slowed down when a person does not blink his eye or about to fall asleep.

B. Existing System

All the features of a smart helmet are not present in the current system. At the moment, people tend to disregard safety regulations rather than care about wearing helmets. It makes traffic police work unsettling. Numerous incidents that do not contain accident location monitoring are occurring as a result of helmet avoidance.

4. Design Methodology

The system has two sections,

- Helmet section
- Bike section

A. Helmet Section

An alcohol sensor, switch, accelerometer, microcontroller, and RF transmitter are included in this part. The switch determines whether the rider is wearing a helmet or not, and an alcohol sensor determines whether or not the rider is intoxicated. The alcohol sensor sends a signal to the bike section through an RF transmitter. The eyeblink sensor detects drowsiness and slows the bike down.

B. Bike Section

This portion includes a relay, dc motor, LCD, GSM modem,

and decoder in addition to an RF receiver, microcontroller, ignition key, and GPS. The RF receiver receives the signal from the helmet portion and uses a decoder to decode the signal. The relay will automatically shut off the ignition if the person is too inebriated. The message will be delivered via a GSM modem and the location of the accident is sent to the registered mobile number via GPS technology if the accelerometer detects any tilt in the helmet or if a person has an accident. If the eyeblink sensor in the helmet part detects that the rider is dozing off, signals are sent to the bike component's receiver, and the bike slows down.

C. Block Diagram

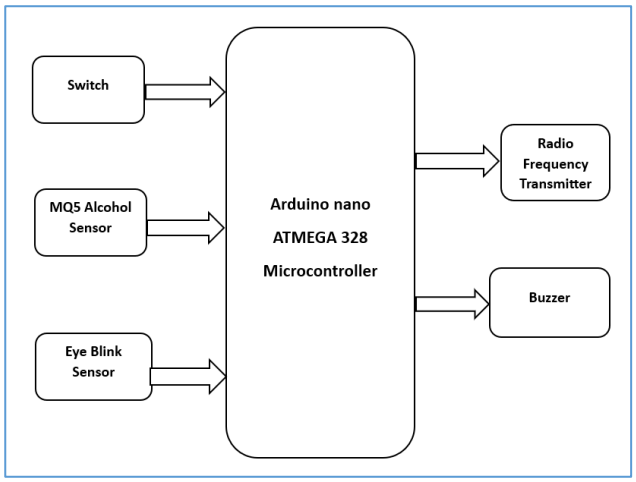

Fig. 1. Block diagram (Helmet part)

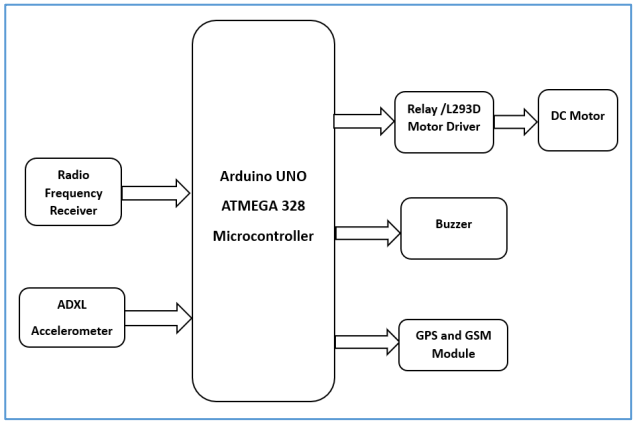

Fig. 2. Block diagram (Bike part)

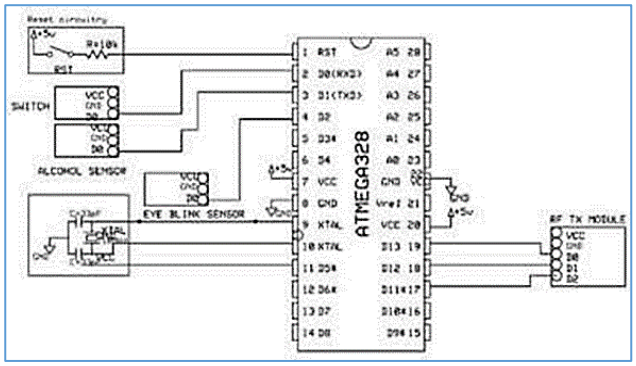

Fig. 3. Circuit diagram (Helmet part)

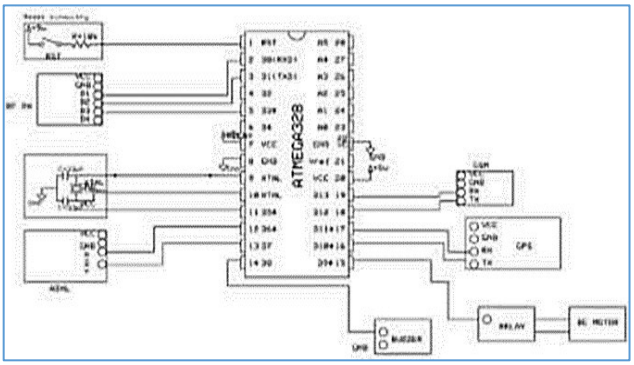

Fig. 4. Circuit diagram (Bike part)

D. Software Development

1) Software Installation

Installing ARDUINO IDE:

To install the Arduino IDE for Windows, follow these instructions:

1. Download .exe file from website. http://arduino.cc/en/Main/Software/
2. Once the download is complete, double-click the file, and extract it. (Usually, the file is downloaded in .zip format).
3. The extracted "Arduino" named folder is to be copy and paste it into C-Drive, and Open the folder, if you wish create the shortcut of Arduino.exe file on your desktop.

Installing DRIVERS:

The next task is to install the drivers for your Arduino board's USB interface.

1. Connect your Arduino to your PC with the USB cable. After a few moments an error message will be displayed, which will say something like "Device driver software not successfully installed." Just close that dialog or balloon.
2. Navigate to the Windows Control Panel. Open the Device Manager and scroll down until you see the ports or Arduino.
3. Right-click Arduino Uno under Other Devices and select Update Driver Software. Then, select browse option and update the drivers.

Taking a look Around the IDE:

Fig. 5. Arduino IDE

The IDE is divided into three main areas: the command area, the text area, and the message window area.

The Command Area:

The command area includes the title bar, menu items, and icons. The title bar displays the sketch's filename. Below this is a series of menu items (File, Edit, Sketch, Tools, and Help) and icons.

The Icons:

Below the menu toolbar are six icons. Mouse over each icon to display its name. The icons, from left to right, are as follows:

1. *Verify:* Click this to check that the Arduino sketch is valid and doesn't contain any programming mistakes.
2. *Upload:* Click this to verify and then upload your sketch to the Arduino board.
3. *New:* Click this to open a new blank sketch in a new window.
4. *Open:* Click this to open a saved sketch. Save Click this to save the open sketch.
5. *Serial Monitor:* Click this to open a new window for use in sending and receiving data between your Arduino and the IDE.

The Text Area:

The actual code is written in this block.

The Message Window Area:

On the bottom side, the message window area is visible. In the black section, messages from the IDE are displayed. Messages concerning confirming sketches, status updates, and other topics may be among the messages you view.

E. Advantages and Disadvantages

1) Advantages

- All components are easily available.
- No manual attention is needed.
- Flexible and reliable.
- This project can be implemented for security purpose.
- Can protect you against injuries for face, teeth and head.
- GPS navigation.

2) Disadvantages

- In this project usage of relays leads to consume high power.
- One time investment cost.

5. Results and Analysis

The result and analysis section is where we finally display the project's goal.

Following our project's demonstration, we obtained the result as shown in the figures.

This figure displaying MQ5 Alcohol sensor which analyzes the breath of a person and gives the result on the basis whether the person is drunk or not. If he is drunk then bike won't start.

This project part is a complete bike part which displays Arduino uno, L293D Motor driver / relay, ADXL accelerometer, 12V battery supply, DC motor, RF Receiver, GPS and GSM module. All the conditions from the helmet part are transmitted to the receiver via RF transmission and here the analysis of all the conditions takes place. Accelerometer is used to measure the rash driving of a person. If a person drives rashly or tilts the bike greater than the threshold value then the DC motor stops.

If a person meets an accident, then the coordinates of a person are sent to the registered mobile number through GPS and GSM technology respectively. This ensures a complete safety to the driver and can reduce the risk of accidents.

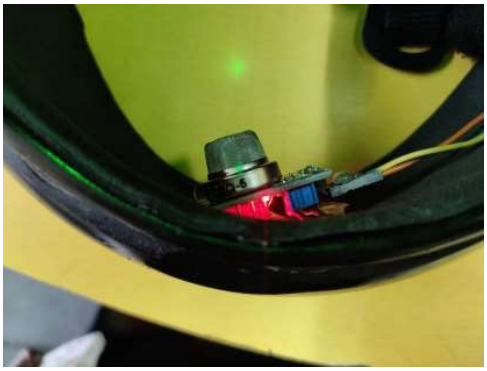

Fig. 6. Project model displaying MQ5 alcohol sensor

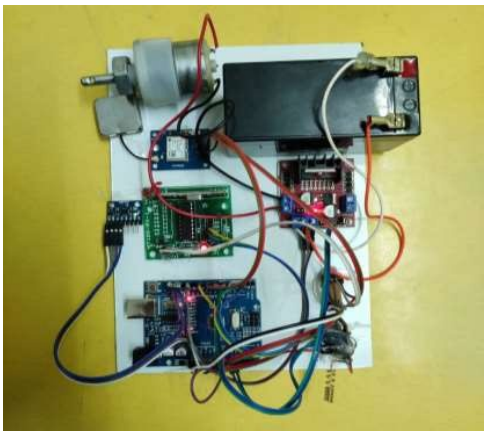

Fig. 7. Project model displaying bike part

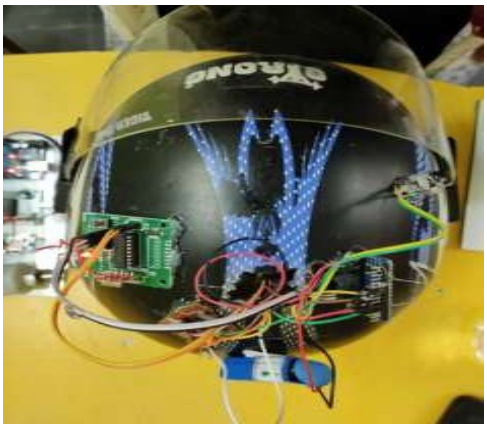

Fig. 8. Top view of helmet

This is the top view of the helmet part which consists of RF transmitter, 9v battery supply, Arduino nano and buzzer.

Here the transmitter encodes the values of alcohol sensor (MQ5), eyeblink sensor, and switch and sends the results to the RF receiver fitted in the Bike part.

Fig. 9. Bottom view of helmet part displaying alcohol sensor, switch, eye blink sensor

This is the bottom view of the helmet part which consists of alcohol sensor, eyeblink sensor, and switch. When switch is pressed only then the helmet is detected and the motor turns on by the wireless communication taking place between RF transmitter in helmet part and RF receiver in Bike part. If the person is feeling sleepy then the eyeblink sensor senses the blinks of a person's eye and slows down the bike. If a person is detected from alcohol in the alcohol sensor, then also the bike turns off. In order to start the bike a person must always wear helmet, must not be drunk and if he is drowsy then the bikes stop.

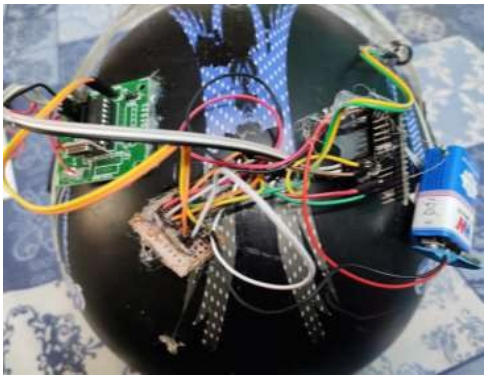

Fig. 10. Project model displaying helmet

A clear view of the top side of the project displaying all the components which works accordingly and helps in ensuring safety to a person.

```
Sending SMS...
IR detected ignition switched off
000
Acceleration X: -0.81, Y: -0.23, Z: 17.68 m/s^2
Rotation X: 0.01, Y: 0.00, Z: -0.01 rad/s
Temperature: 34.65 degC

helmate not detected motor off
000
Acceleration X: -0.80, Y: -0.23, Z: 17.70 m/s^2
Rotation X: 0.01, Y: 0.00, Z: -0.01 rad/s
Temperature: 34.62 degC

helmate not detected motor off
000
Acceleration X: -0.82, Y: -0.20, Z: 17.71 m/s^2
Rotation X: 0.01, Y: 0.00, Z: -0.01 rad/s
Temperature: 34.63 degC

helmate detected motor on
001
Acceleration X: -0.76, Y: -0.21, Z: 17.63 m/s^2
Rotation X: 0.01, Y: 0.00, Z: -0.01 rad/s
Temperature: 33.68 degC

helmate not detected motor off
011
Acceleration X: -0.77, Y: -0.20, Z: 17.71 m/s^2
Rotation X: 0.01, Y: -0.00, Z: -0.01 rad/s
Temperature: 33.65 degC

Sending SMS...
helmate detected motor on
001
Acceleration X: 2.26, Y: 0.33, Z: 18.34 m/s^2
Rotation X: 0.02, Y: 0.29, Z: 0.05 rad/s
Temperature: 33.92 degC

helmate detected motor on
001
Acceleration X: 5.90, Y: -0.50, Z: 15.16 m/s^2
Rotation X: -0.24, Y: 0.26, Z: -0.05 rad/s
Temperature: 33.91 degC

ADXL Values crossed the max limit
000
Acceleration X: 0.61, Y: 0.93, Z: 17.77 m/s^2
Rotation X: 0.54, Y: 2.17, Z: 0.65 rad/s
Temperature: 33.93 degC

helmate not detected motor off
000
Acceleration X: -0.77, Y: -0.20, Z: 17.71 m/s^2
Rotation X: 0.01, Y: 0.00, Z: -0.01 rad/s
Temperature: 33.92 degC

ADXL Values crossed the max limit
001
Acceleration X: 3.99, Y: -1.11, Z: 16.45 m/s^2
Rotation X: 0.03, Y: 0.11, Z: -0.06 rad/s
Temperature: 32.76 degC

ADXL Values crossed the max limit
001
Acceleration X: -4.76, Y: -2.33, Z: 19.21 m/s^2
Rotation X: 1.55, Y: -0.19, Z: 0.13 rad/s
Temperature: 32.78 degC
```

Fig. 11. Results from Arduino IDE

6. Applications

- Automotive and transport vehicles.
- If the biker had consumed the alcohol, the alcohol sensor placed near the front end of the helmet senses the alcohol and don't allow the biker to start the bike.
- Security, Remote monitoring and transportation and logistics.
- The second purpose is when the biker meets with an accident then message and the location of accident is sent to the family members.
- The bike won't activate until the helmet is worn when RF decoder sends information to the microcontroller which allows the biker to start the bike.
- It notifies the biker about drowsiness by making the bike slower.

7. Future Scope

- The design of smart helmet can show satisfactory result by further modification according to standard ergonomics and can work well by harvesting solar energy.
- In future the helmet can be enhanced by applying augmented realty (AR) technology to provide onscreen navigation
- We can use small camera for the recording the driver's activity.
- An emergency and accident alert system can be added to combat the worst situations.
- In future the helmet can be enhanced by adding some other features like rider's fatigue detection system, cooling mechanism, emergency alert system that are lacked in the conventional helmets to provide a better safety and security to the rider.

8. Conclusion

The developed design for the helmet reduces difficulties in people's life and intends people to use this helmet for safety driving. It will minimize the accident ratio of distracted and rash driving by making all mobile functionalities available to the user. By using the helmet, the riders will be conscious since they are giving all the safety functionalities to the helmet. The product developed is feasible in many aspects like economic, technical since its components are open source, easily available, hassle free to configure and low cost and easily operated by any person. The idea behind our project is to ensure the "Safety on Two Wheels" for a safe journey.

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