

Smart Helmet System for Real-Time Occupational Health Monitoring and Injury Prevention Using Embedded IoT Sensors

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ABSTRACT

Helmets are said to be the first line of defense against injuries created by road accidents for motorists. About 70-85% motorists deaths happen in India because of not wearing a helmet. It is not possible to control the occurrences of accidents, but by taking precautions life-threatening injuries can be avoided. Thus, using a different perspective, this project provides safety with luxurious and intelligent features using a smart helmet. Two modules, one on the helmet and bike each will work in synchronization, to ensure that the biker is wearing the helmet. A Zig-bee module is responsible for the wireless communication between the helmet and the bike circuit. An alcohol sensor is used to prevent drink and drive scenarios. Accelerometer detects accidents, and this is extended by employing GSM and GPS module in our circuit. The former is used to automatically send a message to one personal contact and one concerned authority that the person has met with an accident and the later detects the location of the accident site along with the message. A fog sensor is also employed for increasing visibility in case of fog or smog. The whole system operates using Arduino microcontrollers.

KEYWORDS: Zig-Bee module; accelerometer; MQ-3; Arduino; GSM; GPS

1. INTRODUCTION

In India, about 78% of vehicles on the road are two-wheelers and they constitute for about 29% of road accidents, a statistic that has risen steadily over the years. Various reasons for accidents which leads to death includes not having adequate ability to drive, defective two wheelers, rash driving, "drinking and driving", etc. But the main reason is the absence of helmet on that person, which leads to immediate death due to brain damage. Wearing a good helmet and tying it properly is viable to prevent loss of lives in about 90% of the accident cases. It is found that people in India do not wear helmets due to their compromising attitude; They prefer Comfort over Safety. Therefore this stubborn attitude of people must be tackled. Hence a solution for this problem is proposed by letting the vehicle start and run only if the rider has worn the helmet. And in order to tackle the problem of drinking and driving, this paper has introduced an alcohol sensor to the helmet module, to detect alcohol consumption. In this condition too, the bike will be in halt condition.

Another reason which increases the severity of accident is lack of proper medical attention within short time. Thus here included a system in which, when the rider crashes and the helmet hit the ground, these sensors sense and provide it to the microcontroller board, then the board extracts GPS data using the GPS module which is integrated to it. When the data exceeds the limit then GSM module automatically sends alerting message to one personal contact and one concerned authority. In order to increase the usefulness of the helmet, an automatic lighting system is included which increases the visibility in case of fog.

The basic idea for the development of this project "Smart Helmet" is taken from [1] [2]. And detail functionality of each of hardware and software components used are is taken from [3] and [4]. The main component used is Arduino UNO. The principles of operation of the system is taken from references [5]. Therefore, all references have contributed to the development of the project.

2. MATERIALS AND METHODS

The proposed system comprises of two unit which are described below:

(A) HELMET UNIT

The helmet unit comprises of an alcohol sensor, helmet on detection circuit, ARDUINO UNO and ZIGBEE module. The MQ3 sensor module installed in the helmet provide both analog and digital output. This output is fed to ARDUINO UNO board. The output signal from the sensor module is compared with the reference value. The helmet on detection circuit consists of the helmet strap switch and a push switch at the top. The

helmet on detection circuit is checked using ARDUINO. The sensor output as well as the helmet detection circuit output are compared and is transmitted to the bike section for further processing via ZIGBEE transmitter module. The ZIGBEE transmitter module can have a communication throughout the range of 100 m and above.

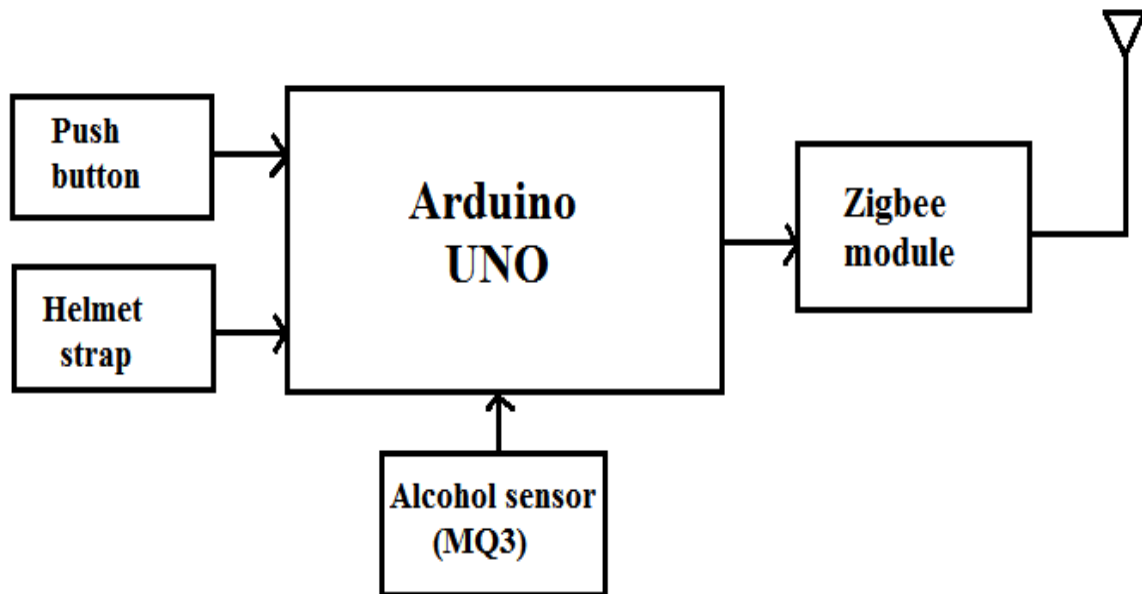


Fig 1: Block diagram of Helmet unit

(B)BIKE UNIT

The bike unit comprises of ZIGBEE module, ARDUINO UNO,LDR,ACCELEROMETER,GPS,GSM,LCD displays and relays. The bike section receives the preprocessed values from the helmet section via ZIGBEE module. ARDUINO UNO acts as the central processing unit of the system to which all the other components are interfaced. If the sensor detects that the rider is wearing the helmet, then the engine is turned on and also if the MQ3 sensor detects alcohol, the module installed on the bike turns off the engine to avoid any accidents so that the drunken person takes appropriate measures to reach his destination. This is employed using relays and bike ignition system. Another feature uses an LDR in order to avoid incidents due to low visibility in fog. Fog sensing unit consists of an LDR. That is; Light Dependent Register which detects the light coming from external environment. If the presence of fog inhibits the light to reach the LDR, the relay turns on the lighting system to improve the visibility of rider.

Accident detection circuitry is made up of an accelerometer and some resistors. The accelerometer checks the tilt of the helmet to determine the occurrence of an accident. The location where the accident took place is taken by using the GPS. If the tilt of the helmet is more than a preset value, which is set in accordance with the case of an accident, free-fall sensing concludes that the rider has met with an accident. During an accident the accelerometer discharges a voltage which is read by the ARDUINO UNO and it sends message to one personal contact and one concerned authority that an accident has occurred. GSM modem communicates with microcontroller through USART(Universal Synchronous Asynchronous Receiver Transmitter) and microcontroller gives command to GSM modem known as AT(Attention) commandsto send message to one personal contact and one concerned authority.

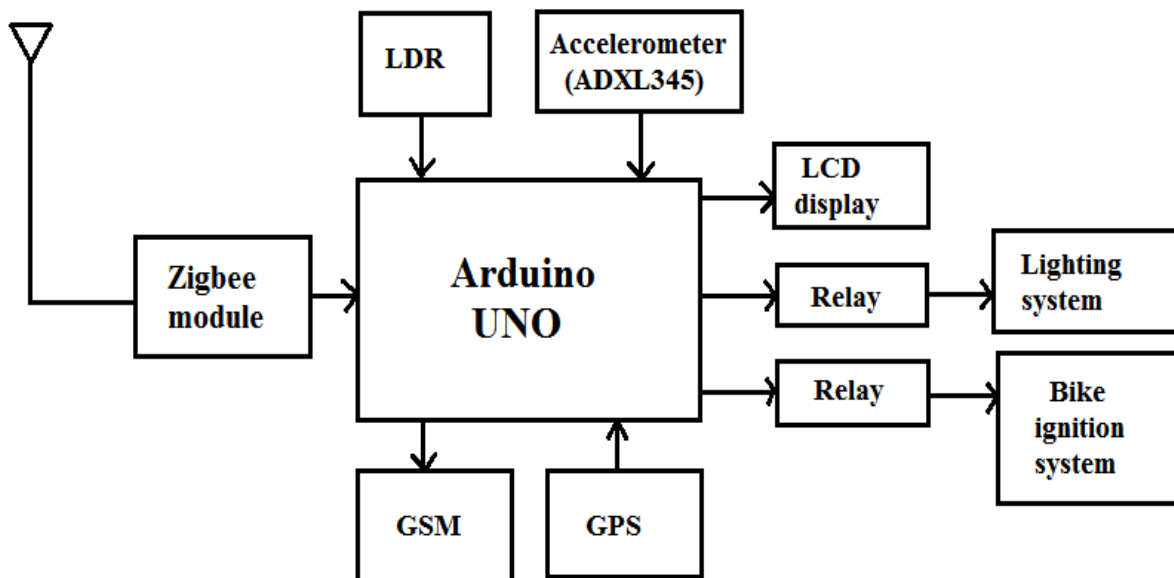
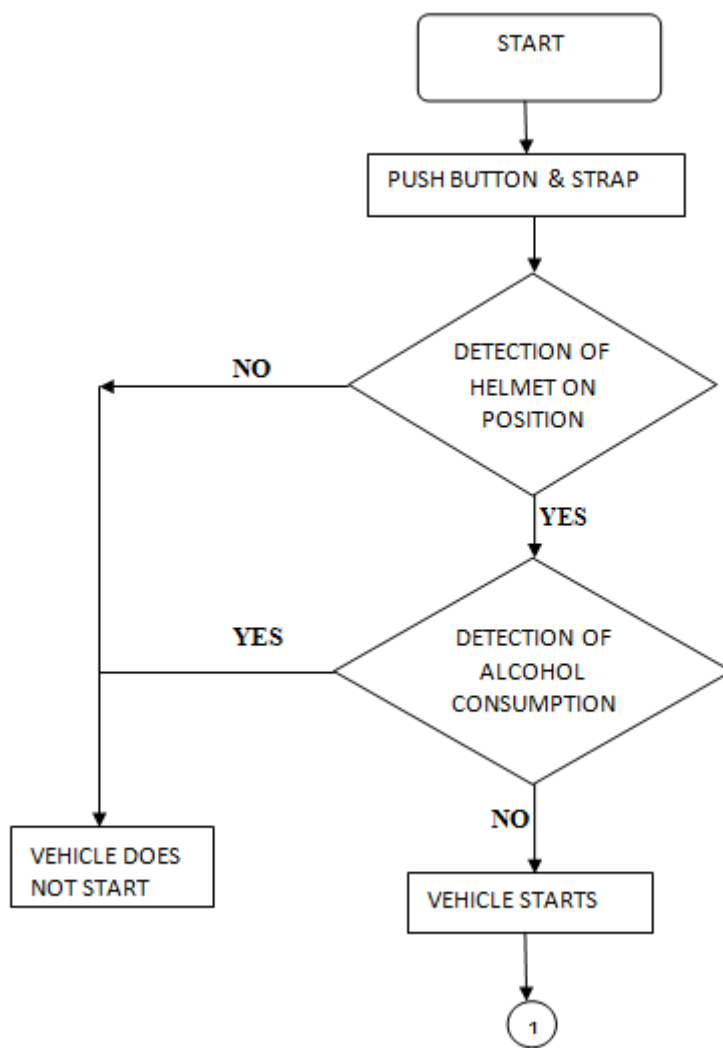


Fig 2 :Block diagram of Bike unit



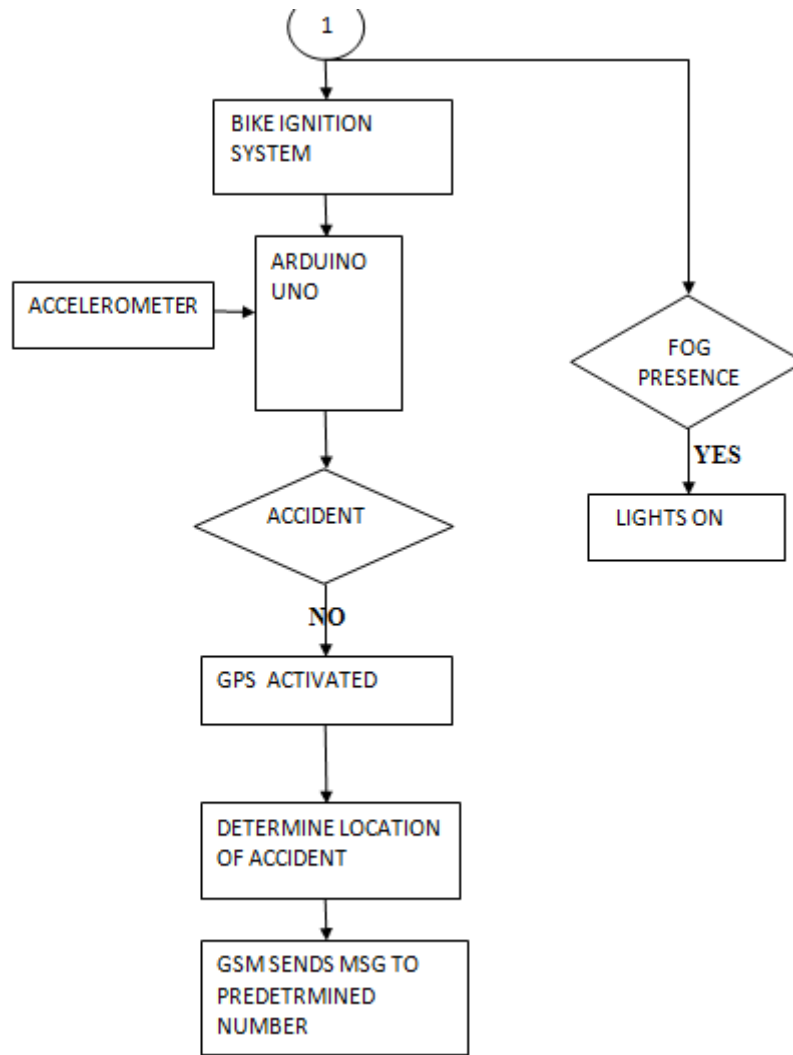


Fig 3: System flowchart

3. RESULTS AND DISCUSSION

All the components are assembled and tested successfully. The circuit is designed in such a manner that the bike does not start until and unless rider wears the helmet. Also the bike won't start if the rider is drunk. If an accident occurs, the GSM module and GPS module comes in action when the accelerometer reports an emergency situation and reports accidents through messaging system, to relatives and nearby police personnel. This can be achieved by encoding GSM, GPS modules to transmit the exact GPS coordinates of the accident to the responsible authorities making them aware of the dire situation for quick action which may help in saving lives. The lighting system automatically turns on if fog is detected. Thus, the experimental phase was completed. Thus, the project was successfully completed and all the features were implemented accordingly.

Tables:

Table 1: Components required for smart helmet

SL.NO	Components	Name

1	Arduino	Arduinouno
2	Alcohol Sensor	MQ3
3	Accelerometer	Triple Axis accelerometer ADLX345
4	Transmitter, Receiver	Zigbee module
5	Fog sensor	LDR
6	LCD display	RG1602A
7	GSM	SIM800
8	GPS	Neo 6M
9	Relay	

4. CONCLUSION

Smart helmet is an innovative solution to many problems. Wearing the smart helmet and being sober are necessary conditions for the bike to start, which reduces the possibilities of accidents. Even if a person takes caution sometimes accidents do occur. Here the ignition cut off feature reduces the chances of fatalities significantly. Zig-bee Module transmits signal from helmet to the motorcycle with improved capability and precision of transmission compared to conventional RF module.

This helmet makes the person to ride in a way that even if the person met with an accident his life could be saved through GPS data send to the receiver contact using GSM. Though this helmet has lots of restrictions it should be noted that these restrictions are the only way to prevent accidents to be occurring

5. ACKNOWLEDGEMENTS

It gives us great pleasure in acknowledging the support and help of our principal Dr. Jaya V L and Head of Department Dr. C Gopakumar, and other faculties of the department of Electronics and Communication, who helped us directly or indirectly with the works of our project and gave us a chance to portray our skills and dedication through this project.

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