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IoT-Based Smart Helmet

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Abstract: *As accidents are increasing day by day, hence many laws and regulations are posed by the government to avoid these accidents. Accidents can be defined as unplanned events or mistakes that may occur resulting in injury and sometimes it also leads to death. The accidents in case other two-wheelers compared to other vehicles. This may be avoided by wearing helmets and riding vehicles without consuming alcohol. A helmet is a form of protective gear worn to keep safe the head from injuries. More specifically, the helmet aids the skull in protecting the brain. A smart helmet can detect the accident's locations also save lives and makes two-wheeler driving safer than previously. This survey is on the smart helmet for accidence avoidance and also examines various related techniques. This research also helps to understand IoT technology which is being emerged nowadays. Smart helmet system helps to provide safety and security to two-wheeler riders.*

Keywords: Accidents, Smart helmet, Internet of Things (IoT), Laws and Regulation, GPS and GSM technology, Accident Detection, Bike Rider's Safety

I. INTRODUCTION

IoT-based Smart Helmet is a safety helmet for drivers embedded with a smart electronic system. This smart helmet consists of two sub-systems that aim to reduce the accident rate. The helmet is completely portable, battery-based, and lightweight. This smart helmet system is also connected to one more system via an RF link (wireless) which is used to control the ignition of the vehicle. The primary application of this helmet system is to detect events like accident or collision and sends alert notification/SMS to a person (family member, friend, etc.), and turn off the ignition system of the vehicle. It also notifies about the event's location (accident/collision location). To send alert notifications/SMS this helmet system requires a sim card that can be inserted into a sim slot/socket in the helmet system. The notification SMS consists of a URL to the location of the accident so one can open it in google maps to track that location. For location tracking/identification this helmet consists of GPS S which enables this smart helmet to track the live location of the driver (whoever wearing this helmet) in rehearsal timesat a frequency of up to 2Hz. To detect accident or sudden collision events it consists of an accelerometer sensor that gives continuous 3D coordinates data of acceleration to detect sudden collisions, falls, side-falls, etc. The helmet is connected to the ignition system wirelessly which automatically controls the ignition of the vehicle.

The secondary application of this smart helmet is to detect alcohol levels to control the ignition of the vehicle. This secondary system also aims to reduce the risk of accidents as it is directly controlling the ignition of the vehicle in case if consumption of alcohol is getting detected. To detect the level of alcohol consumed by the driver (one who wears a helmet) the helmet system consists of an alcohol gas sensor. This alcohol gas sensor senses alcohol gas in the air near the mouth of the driver and gives a reading based on the amount of alcohol consumed. Once enough amount of alcohol gas is getting detected (based on the sensitivity parameter of the sensor) the smart helmet system sends data to the wirelessly connected vehicle ignition control system which then disables/turn-off the ignition of the vehicle (if already off then remains off). The complete smart helmet and ignition control system is based on an 8-bit low-power, low-cost 8051/52/MCS51/52-based microcontroller (AT89C51/52 from Atmel). This microcontroller is programmed in Embedded-C with lightweight firmware, performance-efficient drivers, and algorithms.

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II. LITERATURE REVIEW

In this survey, various smart helmets with various approaches and methodologies are given:

Kimaya Bholaram Street. al proposed a system that consists of a helmet module and a bike module. It consists of IR sensors, an MQS alcohol sensor, a vibration sensor, a GSM module, a GPS module, Arduino, Intercom system. The workflow of the system is as follows when the bike starts if the rider has consumed the alcohol and if it is greater than the threshold then the bike won't start else the bike will start and if the vibration sensor limit is greater than the threshold message is sent to the registered number about the accident. This system is cost-effective and provides better security to the biker.

Jesudoos A et. al proposed a mechanism, where sensors such as IR sensors, vibration sensors, and gas sensors, mems are used. The gas sensor is used to detect the amount of liquor he had consumed by checking the breath of a person wearing the helmet. The bar control of the vehicle is handled by MEMS. The accident is detected by a vibration sensor. The load of the vehicle is recognized by the load checker. The Sensors are interfaced with the PIC microcontroller. The gas sensor will detect if a user consumed alcohol and display it on the LED display. If an accident occurs the vibration sensor, senses the accident and sends information through GPS to the hospital. If there is any rash driving done by the rider the MEME sensor detects the amount of the person from his bank account. To check whether the rider is wearing the helmet or not IR sensor is used. In this system exactness and accuracy are high and the ambulance is booked automatically based on ten locations.

S. R. Kurkute, N. R. Ahirrao, R. G. Ankad, V.B Khatal "IOT based smart system for the Helmet detection" SUSCOM-2019. Kabilan M, Monish S, Dr S. Siamala Devi "Accident detection system based on IOT-Smart Helmet" IJARIIT 2019S.R.Kurkuteet.al proposed a system consisting Raspberry pi module, a Pi camera, pressured sensor, inbuilt wifi, and a GPS. Image processing algorithms are used to capture the face of the biker. It can be applied in real-time and it is cost-efficient and effective and also used in any type of vehicle.

Kabilan M et. al proposed a system using vibration sensors. When the rider wears the helmet consisting of a vibrator sensor with a frequency if the frequency crosses the threshold, the message is sent to the emergency responses using the GPS module. This system helps to detect and report accidents and can save the life.

Dr. D. Vivekananda Reddy et.al proposed a system consisting of two sections i.e a helmet section and a bike section. In the helmet section, there is an alcohol gas sensor to check if a person is drunk and it also contains an IR sensor, Alcohol sensor, and LCD to display the information. In the Bike section, there is a vibration sensor that senses the accident and sends the information using the GSM network and GPS module.

III. PROPOSED SYSTEM

A smart helmet is developed using the Internet of things (IoT) technology which ensures the safety of the bike rider by avoiding road accidents of bikers by,

- The system detects whether the rider is wearing a helmet or not if he wears then only the vehicle will start.
- It detects the amount of alcohol consumed by the rider, if the rider has over-drunk, the bike engine will not start.
- When the bike rider meets with an accident it detects it and gives the notification to the registered contact with a location.

For the safety of the bike rider, the latest technology of IoT is used. This technology provides advanced techniques for alerting the rider and ensures that the rider follows the rules and regulations. For two-wheeler riders, a Helmet is the most basic protection device and it is necessary for every bicycle or motorbike rider. But it does not ensure the safety of the rider and the rider won't follow the traffic rules. Most people use ordinary helmets just to avoid giving challan to the traffic police, these helmets do not ensure the safety of the driver. So, to overcome these problems Smart helmets are necessary.

The IoT-based Smart Helmet is a microcontroller-based electronics system embedded inside a normal helmet, makings it smart and intelligent. This IoT-enabled Smart Helmet consists of two separate systems which are used to perform specific/dedicated work intelligently without any human intervention. These systems are based on a base-line 8-bit low-cost, low-power, MCS51/52 core based 8051/52 microcontroller (AT89C51/52). Apart from microcontrollers these

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systems also consist of various I/O devices, sensors, and electronic passive/active components. There are two circuits designed one is for IoT-enabled Smart Helmet and another one is for Vehicle Ignition Control System.

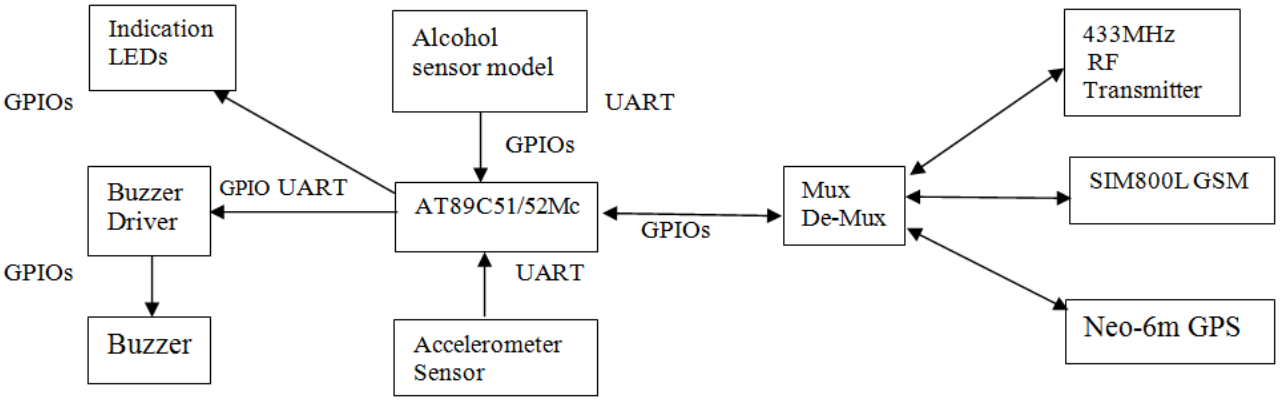

Figure (a): Smart Helmet System

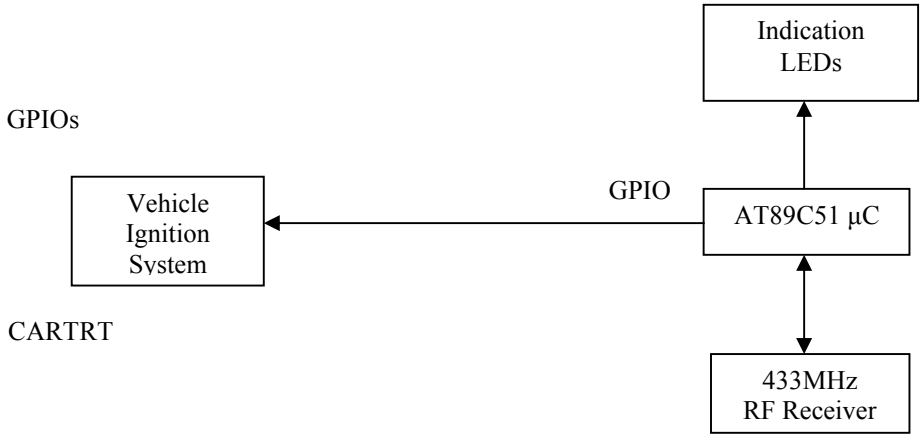

Figure (b): Vehicle Ignition Control System

As shown in the Helmet System circuit diagram it consists of various I/O devices and passive/active electronic/electrical components such as Integrated Circuits (ICs), BJT Transistor, Quartz Crystal, Resistors, Capacitors [Ceramic and Electrolytic], Diodes, LEDs, Buzzer, Connectors, etc. The microcontroller used in this system is AT89C51/52 which is an 8051/52 core-based microcontroller. This microcontroller is the backbone of the complete system. Almost all I/O devices are connected to this microcontroller to perform dedicated tasks/work based on input/incoming signals/data from various input devices/sensors. This complete circuit is divided into seven parts as marked in the circuit diagram. The power supply unit/circuit is used to regulate two DC sources of 5v and 3.3v to complete the system. This power supply circuit consists of two voltage regulator ICs as IC 7805 which regulates 5v and LD1117S33 which regulates 3.3v. The system is operated on a 9v-12v DC source (battery) which is connected to this power-supply circuit at Vin of IC 7805. The input power source from the battery is connected in parallel with one 100uF electrolytic capacitor which is used to reduce/minimize fluctuations/jitters in the power supply. Similarly, a few more capacitors [C2, C6, C7, C8] are used after each power stage to minimize fluctuations in the power line (3.3v and 5v both). For 3.3v regulation, an LD1117S33 IC is used which is getting an input source of 5v from a 5v power rail to convert it into 3.3v with minimum voltage drop (efficiently). For system indication purposes two LEDs are used as shown in the Indication LEDs section in the circuit diagram. These LEDs are system signal LEDs (Green/Blue Colour) and system alert LEDs (Red/Orange Colour). The system signal LED is a heartbeat of the system which indicates either the system is running or it is hanged. This signal LED blinks for a few milliseconds after every few seconds like a strobe/signaling light. For alert indication, an alert LED is used which continuously flashes in case of alerts like accident events or alcohol detection. In the system's ideal sta, te this alert indication LED remains off. Both LEDs are connected and controlled by two GPIO pins of the microcontroller. Apart from LED indication, there is one more

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alerting/indication device i.e., a buzzer. In case of alert events (accident or alcohol detection), this buzzer beeps several times. The buzzer is driven through a buzzer driver circuit as shown in the circuit diagram. This buzzer driver circuit consists of one NPN-type BJT transistor (BC547) which is configured in CE mode for switching purposes. As the output of the microcontroller is not enough to drive the buzzer directly this driver circuit aims to boost the current required to drive/turn on the buzzer with the help of a weak signal (from uC) applied to the base terminal of the transistor. The buzzer is 5v operated so the power supply through the driver circuit is tied to 5v.

3.1 System Design

The system has two sections

- Helmet section
- Bike section

A. Helmet Section

This section comprises an alcohol sensor, switch, accelerometer, microcontroller, er, and RF transmitter. The switch examines whether the rider is wearing a helmet or not an the alcohol sensor senses whether the rider is intoxicated or not and transmits the signal through h RF transmitter to the bike section.

(a) Alcohol sensor:

An alcohol sensor detects the attentiveness of ethanol in the air when the drunk person breathes near this sensor, it discloses the alcohol gas in his breath and obtains the output based on alcohol concentration. It is placed in the helmet t such a way that it can easily sense the breath of the person.

(b) Accelerometer:

It is an electromechanical device thatch used to measure acceleration forces and the forces will be static or dynamic forces. An accelerometer will measure the vibration of the material and it is employed tocontinuously monitor the head inclination of the rider and the d position of the helmet t and helps calculate the likelihood of accidents.

(c) RF transmitter:

RF modules are 434 MHz transmitter and receiver components. RF transmitter is a wireless data transmitting device. It transmits serial data to the receiver through an antenna which is connected to the 4th pin of the transmitter. It transmits the helmet data to the bike receiver through the radio frequency sign nails and the microconprocesses will process the received data.

(d) Switch:

A switch is an electric mechanism for ON/OFF the device, it is used to regulate the flow of electricity by interrupting or diverting the current from one conductor to another. This switch is placed inside on top of the helmet and it is pressed when the rider wears this helmet and is released when the helmet takes off. Based on the switch condition the bike ignition key will be ON/OFF.

(e) Arduino:

Arduino is an open-source platform used for building electronic projects. It const ists of both hardware circuits and software tools and this software is used to write the coded upload into the physical board through the cable. Arduino IDE uses the simplified version of C++, but this is one of the easiest to write the code. Arduino can interact with sense ors, motors, the internet, smartphone, and TV. Arduino has varieties of boards but the UNO is one popularthe most popular boards in the Arduino family.

B. Bike Section

This section can comprisean RF receiver, Microcontroller, Ignition key, GPS LCD, GSM modem, and decoder. The RF receiver gets the signal from the helmet section and the decodes signal l using decoder if the person is over drunken then the ignition will be automatically offed by the relay and if any accidents occur message will be sent using the GSM modem

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Main components description

(a) GPS Tracker

GPS stands for Global positioning system. GPS tracker is a navigation device, used for tracking the location of people vehicles, and animals. The information that is collected from the device is stored on the device inside and then transmitted through a wireless network or cellular network. The information reported from the vehicle is the real-time location and is displayed on a map in near real-time. The software for tracking the vehicle will be available on all smartphones.

(b) GSM modem:

A sim has to be inserted into the sim card port in modem and can be operated using a mobile device, it can send and receive messages from registered numbers.

(c) Microcontroller

A microcontroller is a solid integrated circuit; on a single chip, it includes many devices. It is similar to the central processing unit that has decision-making capabilities. It consists of 64KB Flash and 1024 bytes RAM. The mic is a microcontroller used in products such as engines, medical devices, appliances, and in embedded systems.

(d) LCD

LCD stands for liquid cry play it uses liquid crystals for operation. It is very popular and broadly used in electronic projects as they are used for displaying info sensors like sensor data from the project, and common smartphones smart-phones, televisions, computers, monitors, and instrument panels.

(e) RFA Receiver

Radio-frequency receiver is an electronic device, used to communicate between two electronic devices which are connected wirelessly. The transmission takes place through radio waves which are in the form of electromagnetic radiation. The helmet module(transmitter) output data will be received by the vehicle module(receiver) and the process will be via a lakeplaced by wireless technology.

IV. HARDWARE AND SOFTWARE REQUIREMENT

4.1 Hardware Requirement

1. AT89C51/52 Microcontroller
2. 40-Pin IC Base
3. ADLX335 Accelerometer
4. MQ-3 Alcohol Sensor
5. IC LM358N Dual Op-Amp
6. SIM800L GSM Module
7. Neo-6m GPS Module
8. IC CD4051 MUX/DEMUX
9. LEDs: (RED, GREEN, BLUE)
10. Small 5v Buzzer
11. BC547 Transistor
12. 433MHz RF Trans-Receiver
13. IC LM7805 5v Voltage Regulator
14. IC AMS1117 3.3v Voltage Regulator
15. Capacitors
16. Resistors
17. 9v Battery
18. 9v Battery Cap
19. Small Copper Clad PCB

4.2 Software Requirement

1. Keil µVision IDE (v5): For AT89C5x microcontroller programming.
2. Proteus ISIS & ARES (v8): For circuit & PCB design.

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3. AT89Cxx HV Prog (v1): For uploading binaries into the microcontroller.
4. Pulse View (v4): For digital signal analysis

V. ADVANTAGES

1. IoT offered simplicity in managing a virtual network device that is used in the feature so that it can work properly as it should. This is advantageous in data processing so that it produces nearly-perfect accuracy of its result.
2. IoT which is designed for the smart helmet is safe for the rider and the pillion by diminishing the probability of the causes of an accident on the road. It works by the feature that is well equipped in the helmet and detects the function of the smart helmet itself since it's worn by the driver by noticing if it's properly worn or not.
3. IoT in Smart Helmet changing people's minds if wearing a helmet is important and makes them comfortable and safe although there are many features attached to it.
4. IoT in smart helmets also develops technology in a good venture. It shows real-time data in predicting where an accident might take place.
5. IoT in smart helmets leads to a market perspective, a massive demand in a visionary way leading to a significant net profit.

VI. OBJECTIVE

1. Objective of this project is to build a smart helmet system that can detect collisions/accidents with sensory data to notify alert messages whenever events like accidents and collisions occur.
2. Along with the alert message this system will also send a location coordinate URL with which one can track the location of the person.
3. It also consists of an alcohol sensor that can sense alcohol levels to control the ignition of the vehicle.
4. For system status indication few LEDs and buzzer are also used which indicates various signals such as system heartbeat (either system is running or not), vehicle ignition status, accident/collision status, etc.

VII. CONCLUSION

The survey demonstrates a Smart helmet for accident avoidance. The helmet should be designed to reduce the number of accidents in two-wheelers this can be done by designing the device using IoT technology. Some sensors like IR sensors, alcohol sensors, GPS modules, etc. can be used to design a cost-effective and user-friendly smart helmet. The result should be accurate and should be useful to the government and society. This smart helmet can also be changed to a seat belt system in the case of four-wheelers and can be implemented in the future.

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