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SMART VEHICLE SAFETY SYSTEM

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Abstract: A smart vehicle safety system is a combination of a smart helmet and a vehicle unit. The motive of this system is to ensure all the motorcycle riders should compulsorily wear helmet and obey traffic rule. A smart helmet is a type of protective headgear comprising of some technology used by the rider which makes bike driving safer than before. The main purpose of this helmet is to provide safety to the rider. This can be implemented by using advanced features like alcohol detection, helmet detection, location tracking and regular system data reports. This makes it not only a smart helmet but also a feature of a smart bike. It is compulsory to wear the helmet, without which the ignition switch cannot turn ON. An RF Module with an encoder and decoder unit can be used as a wireless link for communication between transmitter and receiver. If the rider is drunk the ignition gets automatically locked, and sends a message to the registered number with his current location. Similarly, if the rider is not wearing a helmet, then the ignition switch cannot turn on and again a message is sent to the registered number with the system location. Thus the distinctive feature of this system is that it ensures that the vehicle is being driven after taking all the necessary precautions.

Keywords: smart vehicle, safety, location tracking, alcohol detection, helmet detection.

INTRODUCTION

Two-wheelers serve an important role as a form of transportation in emerging countries like India. Almost every family possesses a two-wheeler, which is used for both transportation and business purposes. Two-wheelers play a big role in our day-to-day life. Road accidents take place in big cities almost every day. Sometimes, these accidents prove to be fatal. One of the important problems with bike riders is that most of the time they don't bother to wear helmet which could be fatal when accidents happen. Studies show that serious head injuries can happen even at low speeds. Also, reckless drivers are in the habit of drinking. Under the influence of alcohol, they indulge in rash driving. Due to drinking and driving two-wheeler riders often get into accidents. Therefore, it becomes necessary to implement such a technique which is not easy to bypass the basic rule of wearing helmet and to avoid drunken driving.

A smart vehicle safety system is a unique idea which automatically checks whether the person is wearing the helmet and has non-alcoholic breath while driving. Our system includes an alcohol sensor and a helmet sensor which will sense if the rider of two-wheeler is wearing a helmet or not and if the rider is drunk or not. The vehicle will start depending on the sensor state, and the system will continually monitor the rider's state and position. These will gradually remove the problem of two-wheeler riders not wearing helmets, as well as minimise the number of drunken drivers on two-wheelers. The device will also assist in keeping track of riders who are attempting to drive while inebriated or without a helmet.

PROPOSED METHODOLOGY

The proposed Smart Vehicle Safety System has following features:

1. Checking helmet status i.e., whether the rider is wearing the helmet or not.
2. Checking whether the rider is under the influence of alcohol by analyzing his/her breath.
3. Collecting GPS data of the vehicle.
4. Transmitting the system status via text messages with the help of the GSM unit.

Our proposed system has two main units:

1. The Helmet Unit
2. The Vehicle Unit

The two sections will interact with each other and share data with the help of a RF transmitter and receiver pair. The above-mentioned units are explained in detail as follows:

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THE HELMET UNIT: The helmet unit comprises of an Arduino Nano based circuit with an alcohol detection sensor, an infrared detector and an LCD display, all mounted appropriately on a regular helmet. The Arduino NANO based circuit consists of a GSM module, a GPS module and an RF transmitter connected through an encoder. The IR sensor is placed in the inside region of the helmet-bottom, near chin-guard of the helmet. When the helmet is properly worn by the driver the IR sensor will sense it and notify the processor that the helmet has been properly worn. The alcohol detection sensor is placed at the mouth-piece of the helmet, where it will be able to detect the breath of the driver as soon as the helmet is worn, and will not require the operator to follow any other specific guidelines for the same. The alcohol sensor will sense the breath for alcohol and transmit the collected data to the processor unit.
The Arduino NANO will act as the authority for the system. It is the integral part of the helmet unit and is connected with both the sensors. The microcontroller will collect the data from each of the sensors and, depending upon the specific commands given to it, will take decisions regarding whether the vehicle is safe to be driven.

- It will check whether the helmet is worn properly by observing the IR sensor data.
- It will check whether the driver's breath has traces of alcohol.
- It will also collect the GPS data so that the location of the vehicle is logged.
- It will also send the text messages through GSM unit.
- The microcontroller is also connected to an RF transmitter circuit through an encoder (HT12E) which makes a wireless connection between the vehicle and helmet unit.

The GPS unit does its normal job of keeping track of the vehicle and log its location at regular intervals of time. The GSM unit will be used to transmit all the collected sensor data of the system to a pre-defined device in the form of text messages so that the data is logged properly and is available to be viewed whenever required. The RF transmitter is basically used to make a wireless connection with the vehicle unit. It works at the frequency of 433MHz. It is connected through an encoder having the signal to be transmitted received from the microcontroller. It also has a serial sequence which helps it to connect to a particular RF receiver having a decoder of same serial sequence. The LCD display is provided on the helmet which will display the current status of the system. It will inform the rider about various data collected from the sensors in real time. It will also warn the rider if the required conditions are not met. The co-ordinates generated by GPS unit and microprocessor will also be displayed on the screen.

THE VEHICLE UNIT: The vehicle unit, as the name suggests, is the part of the system which will be mounted on the vehicle. It consists of an RF receiver circuit, a decoder (HT12D) and LEDs (representing the ignition control of the vehicle). The RF receiver will receive RF signal transmitted by the helmet unit. The decoder circuit will decode the information and depending upon the data will take the appropriate action. If the data received shows that the rider has not passed the required safety checks then the ignition of the vehicle will be locked and the rider will not be able to drive the vehicle. If all the safety checks are passed then the ignition control will be released and the vehicle will be ready to be driven. For our purpose of demonstration of this unit's working, the ignition control unit is replaced by a set of LEDs.

HARDWARE IMPLIMENTATION

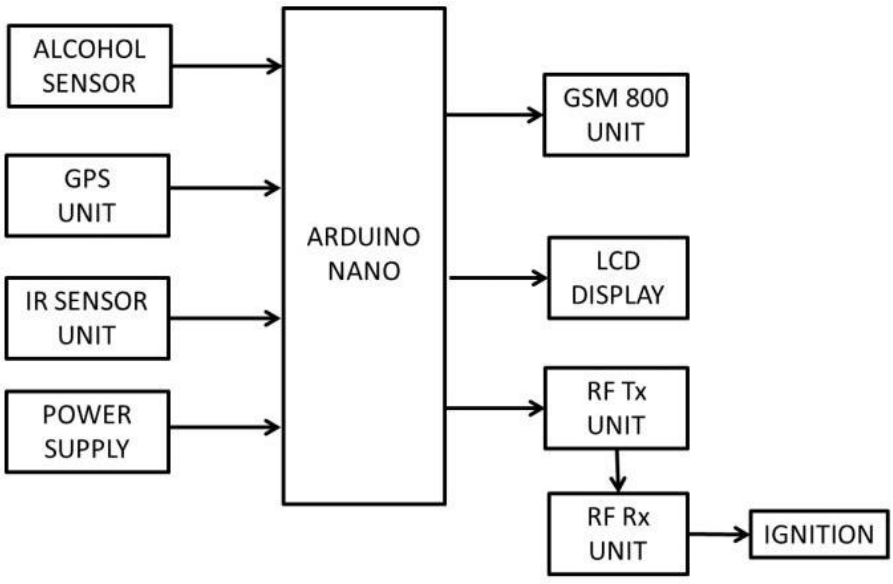

Fig. 1 Block Diagram of the System

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COMPONENT USED

1. ARDUINO NANO(ATMEGA328P): Arduino NANO is a microcontroller board based on ATmega328p. It contains 14 digital pins, 8 analog Pins, 2 Reset Pins & 6 Power Pins. Each of these Digital & Analog Pins are assigned with multiple functions but their main function is to be configured as input or output. They act as input pins when they are interfaced with sensors and as output pins while driving load. Functions like pinMode() and digitalWrite() are used to control the operations of digital pins while analogRead() is used to control analog pins. Arduino NANO has mini-USB support. Atmega328p has flash memory of 32KB, SRAM of 2KB and EEPROM of 1KB. Flash memory is used for storing code. The 0.5KB of memory out of total flash memory is used for a bootloader. ATMEGA328p operates at a voltage of 5V with input voltage ranging from 6 to 20V. Arduino has a crystal oscillator of 16 MHz.

2. GSM MODULE (SIM800L): SIM800L is a miniature cellular module which allows for GPRS transmission, sending and receiving SMS and making and receiving voice calls. Low cost and small footprint and quad band frequency makes it suitable for long range connectivity. The operating voltage of the chip is from 3.4V to 4.4V and maximum current of 2A. The module supports baud rate from 1200 bps to 115200 bps with Auto-Baud detection. A 2G micro-SIM card has to be inserted into the SIM slot of SIM800L. The LED on module will blink at various rate depending upon stage: Blink every 1s: The module is running but connection to cellular network has not been set.
Blink every 2s: The GPRS data connection is active.
Blink every 3s: The module is contacting the cellular network and can send/receive SMS.

3. GPS MODULE(GY-NEO6MV2): The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. GPS is also called as Navigation System with Time and Ranging (NAVSTAR) GPS. GPS module provides latitude and longitude location of the user.

4. ALCOHOL SENSOR (MQ3): MQ3 is a heater-driven sensor used for alcohol detection with an anti-explosive network. It is a Metal Oxide Semiconductor (MOS) type of sensor. Metal oxide sensors are also known as Chemi-resistors, because of sensing based on the change of resistance of the sensing material when exposed to alcohol. MQ3 provides binary indication of the presence of alcohol and analog representation to its concentration in air. Analog output voltage provided by the sensor (at A0 pin) varies in proportion to the alcohol concentration. The higher the alcohol concentration in the air, the higher the output voltage, whereas lower concentration gives lowers output voltage. The module has a built-in potentiometer for adjusting the sensitivity of the digital output (D0). We can also set a threshold. When the alcohol concentration exceeds the threshold value, the module will give output LOW; otherwise, HIGH. The module has two LEDs: power LED will light up when the module is powered and status LED will light up when the digital output goes LOW.

5. IR OBSTACLE SENSOR: The IR obstacle sensor works in the range of infrared frequency (300 GHz - 430THz). IR light is not invisible to us as its wavelength is higher than the visible light range. IR LED transmitter emits light of wavelength (700nm – 1mm). IR LEDs have light emitting angles of approx. 20- 60 degrees depending upon the type of IR transmitter. IR LED used is white or transparent in colour because it gives out an amount of maximum light. Photodiode acts as the IR receiver as it conducts when light falls on it. Photodiode is a pn junction diode operating in reverse bias. The amount of current flowing is proportional to the amount of light. Photodiode has a black colour coating on its outer side as black colour absorbs the highest amount of light. LM358 is an Operational Amplifier (Op-Amp) used as voltage comparator in the IR sensor. The comparator will compare the threshold voltage set using the pre-set (Pin2) and the photodiode's series resistor voltage (Pin3).

6. LCD DISPLAY(LM016L): Liquid crystal display (LCD) is a flat panel display. LCD is an electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in colour or monochrome. 16*2 LCD display modules are preferred over seven segments and other multi segment LEDs. The reason being: LCDs are economical; easily programmable; have no limitation of displaying special and even custom characters (unlike in 7 segments).

7. RF TRANSMITTER SECTION [HT12E + TWS434]: HT12E is a 212 series encoder IC manufactured by HOLTEK. HT12E receives parallel data in the form of address bits and control bits. The control signals from remote switches along with 8 address bits constitute a set of 12 parallel signals. The encoder HT12E encodes these parallel signals into serial bits. Transmission is enabled by providing ground to pin14 which is active LOW. The control signals are given at pins 10-13 of HT12E. The serial data is fed to the RF transmitter through pin17 of HT12E. The heart of the

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TWS434 is the SAW resonator which is tuned to 433.92 MHz operation. When a logic HIGH is applied to the DATA input, the oscillator runs producing a constant RF output carrier wave at 433.92 MHz and when the DATA input is taken to logic LOW, the oscillator stops. TWS434 works on amplitude shift keying (ASK).

8. RF RECEIVER SECTION [HT12D + RWS434]: HT12D is a 212 series decoder IC manufactured by HOLTEK. HT12D converts the serial input into parallel outputs. It decodes the serial addresses and data received by a RF receiver, into parallel data and sends them to output data pins. The serial input data is compared with the local addresses three times continuously. The input data code is decoded when no error or unmatched codes are found. A valid transmission is indicated by a high signal at VT pin and then relay goes on. A string of address and data bit is used to prevent false triggering. It consists of a RF tuned circuit and a couple of OP Amps to amplify the received carrier wave from the transmitter. The amplified signal is further fed to a PLL which enables the decoder to "lock" onto a stream of digital bits which gives better decoded output and noise immunity.4

Result

As soon as the power supply is provided to the vehicle unit and the helmet unit, a message "Welcome" is displayed on the LCD display as shown in the figure below.

Fig.2 LCD display when System is started

After 9 seconds the helmet section turns to the idle mode and a message is displayed on the LCD display as shown in figure below.

Fig.3 LCD display at Idle Condition

After the GPS unit locates the system, the respective coordinates are displayed on the LCD display as shown below.

Fig.3 LCD displaying GPS coordinates

The respective location of the coordinates as shown on Google Maps.

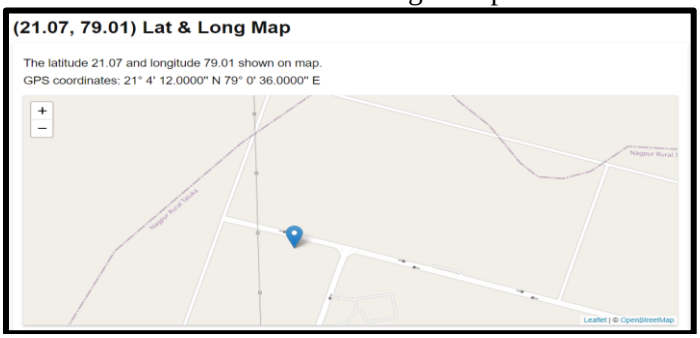

Fig.4 GPS coordinates on Map

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When the helmet is worn by the rider, a message is displayed on the LCD display as shown in the figure below.

Fig.5 LCD display when helmet is detected

Also a text message with the current coordinates of the system is transmitted to a mobile number which is embedded in the microcontroller. The text message is displayed as shown in figure below.

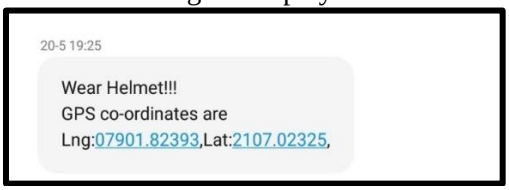

Fig.6 Text message when helmet is detected

When the helmet is removed by the rider, a message “HELMET REMOVED” is displayed on the LCD display as shown in the figure below.

Fig.7 LCD display when helmet is removed

Also a text message with the current coordinates of the system is transmitted to a mobile number which is embedded in the microcontroller. The text message is displayed as shown in figure below.

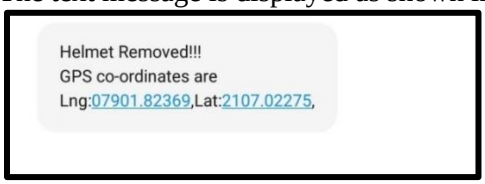

Fig.8 Text message when helmet is removed

When Alcohol is detected by the alcohol sensor a message is displayed on the LCD display as shown in the figure below.

Fig.9 LCD display when alcohol is detected

Also a text message with the current coordinates of the system is transmitted to a mobile number which is embedded in the microcontroller. The text message is displayed as shown in figure below.

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Fig.10 Text message when alcohol is detected

The removal of the helmet or the detection of alcohol in the rider's breath will also cause the ignition to turn off, represented here by the turning off of the LED.

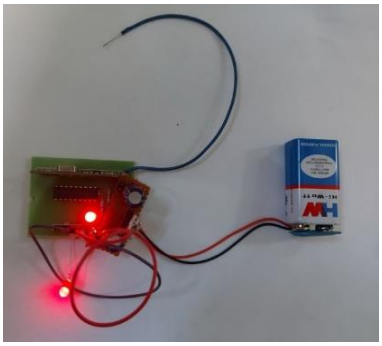

Fig.11 Ignition LED at ideal condition

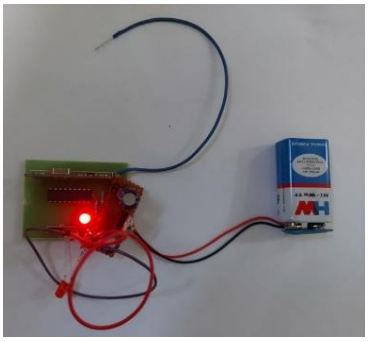

Fig.12 Ignition LED when necessary condition are not met

Final images of the Smart vehicle Safety system are shown below.

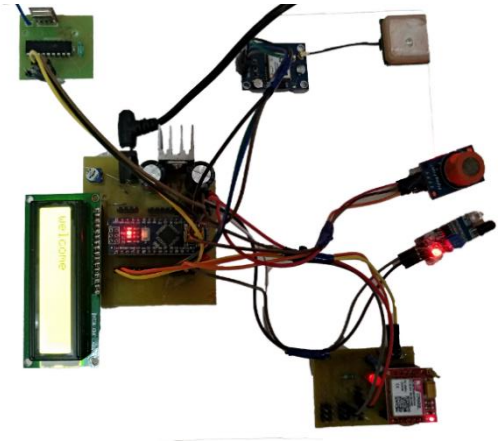

Fig.13: Helmet Unit

Fig. 14: Helmet unit mounted on Helmet

Fig.15 : Alcohol sensor and Helmet sensor mounted on Helmet

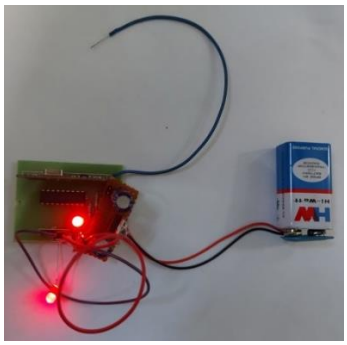

Fig.16 : Vehicle Unit

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APPLICATIONS

- This system could be very useful to the food delivery and e-commerce businesses, where the company can monitor their delivery personnel to make sure they are not violating any safety precautions while delivering goods to their customers.
- This system can also be implemented in emergency vambulances and police vehicles to ensure that they are driving safely and not putting any life in danger

CONCLUSION

The designed System ensures the safety of the rider by making it necessary to wear a helmet, and also ensures that the rider hasn't consumed alcohol more than the permissible limit. If any of these prime safety rules are violated, the proposed system will prevent the biker from starting the bike. The system also helps in efficient handling of all the data by sending all system data to the concerned authority, in real-time. This ensures that the driver is constantly under a kind of surveillance which will make them take all the proper precautions. It will also ensure the safety of the rider from head injury, if the vehicle does have an accident, by making sure that the rider is wearing a helmet. Thus, this system will become a kind of a line of defence for the rider in case of an accident to prevent fatal injuries.

REFERENCES

[1]A. Jesudoss, R. Vybhavi, and B. Anusha, "Design of smart helmet for accident avoidance," in 2019 International Conference on Communication and Signal Processing (ICCSP), 2019, pp. 0774–0778.

[2]Divyasudha, Arulmozhivarman, and Rajkumar, "Analysis of Smart helmets and Designing an IoT based smart helmet: A cost effective solution for Riders," in 2019 1st International Conference on Innovations in Information and Communication Technology (ICIICT), 2019, pp. 1–4.

[3]M. K. A. Mohd Rasli, N. K. Madzhi, and J. Johari, "Smart helmet with sensors for accident prevention," in 2013 International Conference on Electrical, Electronics and System Engineering (ICEESE), 2013, pp. 21–26.

[4]M. Uniyal, H. Rawat, M. Srivastava, and V. K. Srivastava, "IOT based smart helmet system with data log system," in 2018 International Conference on Advances in Computing, Communication Control and Networking (ICACCCN), 2018, pp. 28–31