Tara - An Accident and Alcohol Detecting Bluetooth Enabled Smart Helmet

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Abstract - *With the growing number of 2-wheel motor vehicles, frequency of accidents is on the rise. A major portion of the fatalities occur because the person was either not wearing a helmet, or his accident was not reported in time, and he could not be saved because of the delayed admittance to a hospital, or because he was riding while drunk. We propose mechanisms that can detect if one is wearing the helmet, detect accidents, and detect whether the person has over-consumed alcohol. For this purpose, we use on board sensors – touch sensor, alcohol sensor (MQ-135), MEMS sensor and breath-analyser (MQ6). The MEMS sensor measures the change in tilt, in X Y and Z axes respectively, and sends the alert message to the pre-set contacts. The breath analyser senses the breath of a person wearing the helmet and confirms the presence of a human in the helmet. The moisture sensor clears the windscreen during fog and rain making riding comfortable. This can help optimize accident detection in the future when enough data is gathered to provide reliable accuracy. The helmet can connect to any smartphone via Bluetooth, to communicate with the online API, using the internet connection of the smartphone. This will ensure the holistic safety of the rider at all times.*

Keywords: *Internet of Things, Smart Helmet, Rain Detection, Accident detection, Alcohol detection*

I. INTRODUCTION

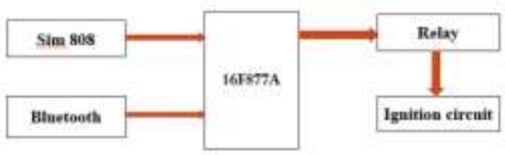
Motorcycles and bikes form an integral part of personalized transportation in India. However, unfortunately, it also involves innumerable accidents and subsequent loss of lives. Every year, about 300,000 teenagers go to the emergency department because of bike injuries, and at least 10,000 teenagers have injuries that require a few days in the hospital. Statistics say, motorcycle deaths accounted for 15 % of all motor vehicle crash deaths in 2015 and were more than double the number of motorcyclist deaths in 1997. Through an ONEISS survey conducted by the Department of Health, it was found that 90% of the motorcycles rider killed in accidents were not wearing a helmet at the time of impact. This, along with drunken driving are a major reason of accidents. We aim to mitigate these problems and hence the associated casualties by ensuring that the rider will wear the helmet all the time during his/her ride, thus ensuring safety. The helmet can understand if the person is wearing the helmet, using the pressure sensors, fitted inside the padding foam. The helmet can detect a possible accident, using the on board accelerometer and pressure sensor. If the values detected exceed a threshold, it is reported as an accident. Emergency contacts, specified by the rider during app setup, are informed about the possible accident, via a system generated email and text message, containing the address and GPS coordinates where the accident had been detected. An on board alcohol sensor also analyses the breath of the rider to detect if the current intoxication level is above the legal threshold. If he rides it anyway, his emergency contacts are informed, so that they may handle the situation. The helmet can connect to any smartphone via Bluetooth so that it can communicate with the server using the smartphone's internet access.

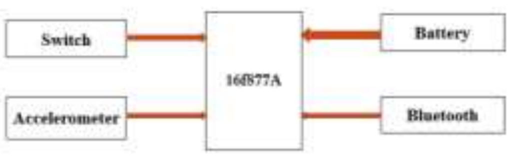
1.1 Methodology

TTP223 Sensor are mainly used for "touch sensitive" application. It is also used for detecting physical pressure, squeezing and weight. Here we use TTP223 Sensor because of simple of use and low cost. It has 2 pins in it. It changes its resistive value on pressing hence more the one presses its resistance go down. It is placed inside the helmet above the position of head. An alcohol sensor is suitable to check whether the driver is drunk or not, hence it is placed in the helmet which covers the jaw region of the rider so that it placed right in front of rider's mouth. As per the section 185 of the Motor Vehicle Act, the blood alcohol content (BAC) legal limit is 30mg alcohol in 100ml blood. Here for demonstration purpose we program the limit as 350mg/L. Since it is highly sensitive to alcohol vapour and less sensitive to benzene it is used to check the alcohol consumed by the driver and its sensitivity can be adjusted by using the potentiometer. It consists of 5 pins. Hence wearing the helmet is confirmed using TTP223 sensor and breathe analyzer. It detects the alcohol within the breath and sends the signal to the controller. The rain sensor is used to detect the presence of moisture on the windshield of the helmet and initiate the controller to turn on the wiper to wash away the presence of moisture at the earliest to make riding two wheelers during rain easier. The MEMS sensor is used to detect the shock if any in the helmet in case of a sudden tilt towards either of the directions of the helmet. The MEMS sensor intimates to the controller to send a message to the pre-set contacts via the SIM 800C GSM Module. The emergency message will contain the location of the unusual tilt in the helmet. The location is retrieved using the NEO 6M GPS module. The ignition in the vehicle is allowed only if the human is detected by the helmet. The ignition is not allowed if the alcohol is detected by the alcohol sensor. A BLE HM-10 bluetooth module is used to check the health of the individual components of the device. An LCD display is attached to the device which constantly keeps updating us of the status of the functioning of individual components of the device. The monitor readings would consist of readings like left emergency and right emergency from the MEMS sensor, motor running speed from the controller. The device can be paired with any mobile using the bluetooth module. Through this the device and the components can be controlled using the mobile phone.

1.2 Block diagram

Receiver Unit





Transmitter Unit

2. RELATED WORKS

In the literature, we found several smart helmet system but with different approach and proposed solution.

Wilhelm Von Rosenberg et al [1] has proposed a smart helmet with embedded sensors for cycling and Moto racing to monitor both vital signs and the electroencephalogram (EEG) simultaneously. They have embedded multiple electrode within a standard helmet and a respiration belt around the thorax for validation and a reference ECG from the chest. Also a multivariate R-peak detection algorithm has been applied to get data from real life noisy environment.

Sreenithy Chandranet al [2] monitored the value received from accelerometer embedded in helmet and detects an accident by analysing those values and sends an emergency notification to contacts with Global positioning system location.

C. J. Behr et al [3] has developed a smart helmet for the mines industry keeping focus air quality, helmet removal and collision. It detects the presence of hazardous gases like CO, SO2, NO2 and detects the helmet removal using an off-the shelf IR sensor. An accelerometer is implemented to detect accident by calculating the dangle of the helmet and shock detection by software using those reading.

Sudhir Rao Rupanagudi et al [4] has made a helmet which monitors the real life traffic scenario behind the motorcycle rider and a intimation system to inform him / her. A MATLAB based algorithm is implemented to perform the task along with a cost effective setup and priority has been given to some special cases such as turning and all.

A. Ajay et al [5] has proposed a smart helmet with 4 different functionality : accident identification and alert system, voice based navigation system using map, a bluetooth device based voice call which uses voice recognition to attend cellular call and a solar panel for external power source. A GSM module attached arduino board is used for accident alert system and a smart mobile phone is interfaced with the helmet to serve the navigation process.

Mohd Khairul Afiq Mohd Rasli et al [6] has designed a PIC16F84a microcontroller controlled smart helmet with force Sensing Resistor (FSR) to detect rider's head and a BLDC Fan for speed detection. Helmet starts it's alarm system whenever the speed crosses a certain limit and motorcycle's engine will start only after the rider buckles the helmet.

Muthiah M et al [7] proposed an helmet which contains a automatic safety headlight that reacts according to rider's facial movement with the help of accelerometer and other sensors and motors.

3. MATERIALS AND METHODS

3.1 Hardware Components

Table 1. List of Hardware

COMPONENTS	SPECIFICATIONS
Microprocessor	PIC 16F877A
Alcohol Sensor	MQ 135

Breath Sensor	MQ 6
Accelerometer	MEMS Sensor
Bluetooth	BLE HM-10
Rain Sensor	Rain Sensor Module
Touch Sensor	TTP223 Module
GSM	SIM 800C GSM Module
GPS	NEO 6M GPS Module
Motors	100 RPM and 10 RPM Motors

3.1.1 Microcontroller (PIC 16F877A)

PIC 16F877A is the core of the device. It is one of the most renowned microcontrollers in the industry. This microcontroller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it uses FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output.

Fig 1. PIC16F877A

When the device is started for the first time, the application prompts to calibrate the helmet. Upon calibrating, the calibrated values of the accelerometer are stored in the microcontroller's ROM. This is used to calculate the 'tilt' of the helmet while riding the motorbike.

3.1.2 Alcohol Sensor (MQ 135)

This module uses an Alcohol Gas sensor MQ 135. It is a low cost semiconductor sensor and can detect the presence of alcohol gases at concentrations from 0.05 mg/L to 10 mg/L. The sensitive material used in this sensor is SnO_2, whose conductivity is lower in clean air. Its conductivity increases as the concentration of alcohol gases increases. It has high sensitivity to alcohol and has a good resistance to disturbances due to smoke, vapour, and gasoline. This module provides both digital and analog outputs. MQ 135 alcohol sensor module can be easily interfaced with microcontrollers.

Fig 2. MQ 135 Alcohol Sensor

3.1.3 Breath Analyzer (MQ 6)

The MQ-6 module is used in gas leakage detecting equipment in family and industry. This module has high sensitivity to LPG, iso-butane, propane and LNG. It can also be used to detect the presence of alcohol, cooking fumes, and cigarette smoke. The module gives out the concentration of the gases as a analog voltage equivalent to the concentration of the gases. The module also has an on board comparator for comparing against an adjustable pre-set value and giving out a digital high or low. This sensor also detects the presence of CO_2 gas in the exhaled air. Thus it can also be used as breath analyser. It functions as a human detector which confirms the presence of human within the helmet thereby allowing the controller to ignite the vehicle.

Fig 3. MQ 6 Breath analyzer

3.1.4. Accelerometer (MEMS Sensor)

The accelerometer we use is a 3-axis accelerometer that measures tilt of the device with respect to the earth, in 3 axes X, Y and Z. Since it measures the tilt with respect to the earth, we need to store the corresponding values when the helmet it normally worn. This is the calibration we require. The values are stored in the ROM, and the difference of current readings and the stored readings are used to detect a possible accident.

Fig 4. MEMS Sensor

3.1.5 Bluetooth (BLE HM-10)

The HM-10 is a Bluetooth 4.0 Low Energy module containing the TI produced CC2540 or CC2541.It provides reliable and low power consuming Bluetooth connectivity. We use it for the communication between the device and the smartphone, and thus it is our medium of data communication. Another important reason why we use this particular Bluetooth module is that it is power efficient and low on cost.

3.1.6 Rain Sensor Module

A rain sensor or *rain switch* is a switching device activated by rainfall. There are two main applications for rain sensors. The first is a water conservation device connected to an automatic irrigation system that causes the system to shut down in the event of rainfall. The second is a device used to protect the interior of an automobile from rain and to support the automatic mode of windscreen wipers. An additional application in professional satellite communications antennas is to trigger a rain blower on the aperture of the antenna feed, to remove water droplets from the mylar cover that keeps pressurized and dry air inside the wave-guides.

Fig 5. Rain Sensor

3.1.7 Touch Sensor (TTP223 Sensor)

Touch Sensors are the electronic sensors that can detect touch. They operate as a switch when touched. These sensors are used in lamps, touch screens of the mobile, etc… Touch sensors offer an intuitive user interface. Touch sensors are also known as Tactile sensors. These are simple to design, low cost and are produced in large scale. With the advance in technology, these sensors are rapidly replacing the mechanical switches. Based on their functions there are two types of touch sensors- Capacitive sensor and Resistive sensor.

Fig 6. TTP223 Touch Sensor

3.1.8 GSM (SIM 880C)

SIM 800C Module is a complete Quad-band GSM/GPRS solution in a SMT type, which can be embedded in the customer applications. These modules are sub-system of the Internet-of-everything hardware. SIM800C supports Quad-band 850/900/1800/1900MHz, it can transmit Voice, SMS and data information with low power consumption. With tiny size of 17.6*15.7*2.3mm, it can smoothly fit into slim and compact demands of customer design.

Fig 7. GSM SIM 800C Module

3.1.9 GPS (NEO 6M)

GPS receiver module gives output in standard (National Marine Electronics Association) NMEA string format. It provides output serially on TX pin with default 9600 Baud rate. This NMEA string output from GPS receiver contains different parameters separated by commas like longitude, latitude, altitude, time etc. Each string starts with '$' and ends with carriage return/line feed sequence.

Fig 8. NEO 6M GPS Module

3.1.9 Motors (100 RPM and 10 RPM Motors)

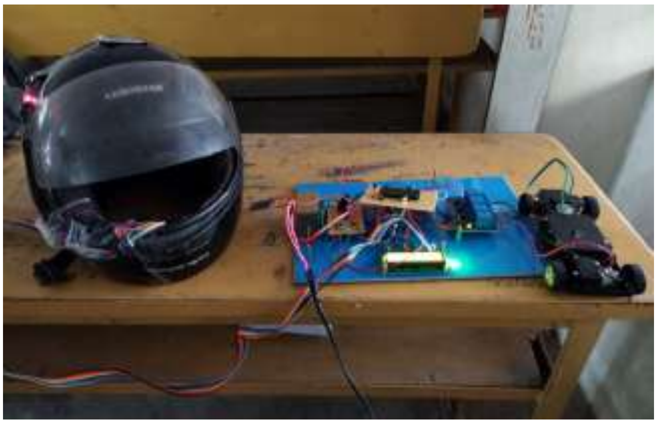
A DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

Fig 9. 100 RPM Motor Fig 10. 10 RPM Motor

4. RESULT

The prototype was checked completely to the extremes and it was found that the ignition was allowed only after the satisfaction of the three main conditions. The device detects the human, alcohol and accident. The wiper of the vehicle functions well immediately at the point of detection of water droplets. The Bluetooth module helps in checking and maintenance of the health of individual components of the device and the device as a whole.

Smart helmet



Location Retrieved

5. CONCLUSIONS

The prototype developed yielded satisfactory results. The accuracy and precision are high, which shows that our proposed mechanism is accurate in detecting an accident, a human and high alcohol consumption.

However, during accident detection, there have been many cases, where the alarm has been rung. The comparison of the parameters for accident detection, with and without the use of the alarm, shows how important the use of an alarm is, to report false accident detection. However, repeated unwanted need to respond to the alarm while driving can cause discomfort and distraction.

6. REFERENCES

[1] Saha, Himadri Nath, Abhilasha Mandal, and Abhirup Sinha. "Recent trends in the Internet of Things." Computing and Communication Workshop and Conference (CCWC), 2017 IEEE 7th Annual. IEEE, 2017.

[2] Wilhelm Von Rosenberg, Theerasak Chanwimalueang, Valentin Goverdovsky, David Looney, David Sharp, Danilo P. Mandic,Smart Helmet: Wearable Multichannel ECG and EEG, IEEE Journal of Translational Engineering in Health and Medicine.

[3] Sreenithy Chandran ; Sneha Chandrasekar ; N Edna Elizabeth, Konnect: An Internet of Things(IoT) based smart helmet for accident detection and notification, India Conference (INDICON), 2016 IEEE Annual

[4] C. J. Behr; A. Kumar; G. P. Hancke , A smart helmet for air quality and hazardous event detection for the mining industry, 2016 IEEE International Conference on Industrial Technology (ICIT)

[5] Sudhir Rao Rupanagudi ; Sumukha Bharadwaj ; Varsha G. Bhat ; S. Eshwari ; S.Shreyas; B. S. Aparna ; Anirudh Venkatesan, Amrit Shandilya, Vikram Subrahmanya, Fathima Jabeen A novel video processing based smart helmet for rear vehicle intimation & collision avoidance, 2015 International Conference on Computing and Network Communications (CoCoNet)

[6] G.Vishnu; V. Kishoreswaminathan; V.Vishwanth ;K. Srinivasan ;S. Jeevanantham, Accidental identification and navigation system in helmet, 2017 International Conference on Nextgen Electronic Technologies: Silicon to Software (ICNETS2)

[7] Mohd Khairul Afiq Mohd Rasli ; Nina Korlina Madzhi ; Juliana Johari, Smart helmet with sensors for accident prevention, 2013 International Conference on Electrical, Electronics and System Engineering (ICEESE)

[8] Muthiah M ; Aswin Natesh V ; Sathiendran R K, Smart helmets for automatic control of headlamps, International Conference on Smart Sensors and Systems (IC-SSS)