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AN APPROACH TO MAXIMIZE THE INTEGRATED SAFETY SYSTEM FOR TWO WHEELERS

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Abstract-*With the rapid urbanization and staggering growth of transport networks like two-wheeler vehicles, safety on the roads has emerged as an inescapable priority for us. It has expanded the rate of accident which lead to several damages with loss of lives. Causes of accident includes drunk driving, less usage of safety gears etc. There is also problem for quick detection of accident which causes latency in emergency medical treatment that makes the accident more fatal. Wearing a helmet can reduce shock from the impact and reduce injuries. This proposed study is a contextual method for detecting that rider is wearing helmet and not under influence of alcohol throughout the ride. It communicates with a unit on the vehicle to control the ignition system of bike. This vehicle unit also checks and determines accident which leads to send geometric coordinates of specific location via SMS. By using geometric coordinates, location of the injured rider can be generated using simple GPS tracking application. Also, this system provide theft protection as helmet is also essential along with key to start bike.*

Keywords: Road Safety, GPS,

1. INTRODUCTION

Motorbike has become a leading mode of transport especially in Asian countries and people are becoming more interested in motorcycle as an alternative to car travel and public transport for its easy accessibility to reach any destination. In our country, road accidents specially, motorbike accident has become one of the important issues recently. According to a study conducted by the Accident Research Institute (ARI) of BUET, road accident caused average 12000 lives annually and about 35000 injuries. [1] As the total prevention of accidents is not possible this project focuses on the factors that we can avoid and in case of accident, ensuring minimum causalities. Average scenario of any accident site is that late rescuing which leads the causality at worse. Many people ignore the victims got by accident as there are problem of police enquiry. Some lives can be saved if there is on time emergency services. This time gap between the occurrence and reaching the scene is not totally the authorities fault. It's happening because of the lack of knowledge and application of technology. This project will provide an optimum solution to this draw back. An automatic detection and notification to proper personnel for vehicle accidents will be provided with this project. This design of system has accuracy which can detect accidents in significantly less time and sends the location information to concerning people in less time with geographical co-ordinates of accident took place, which will help in saving the valuable lives. Here the GPS co-ordinates are sent to a server which is later shown in a web app for responsible authority.

2. PREVIOUS WORK

Road traffic crashes in Bangladesh result in an unacceptably high socio-economic toll that has been increasing due to rapidly growing motorization combined with inadequate attention and under-investment in safety. According to World Health Organization (WHO), more than 20,000 deaths from road traffic crashes are estimated to occur annually in Bangladesh, while around 4000 deaths are officially reported. Nearly 70 percent of road traffic fatalities are attributed to Vulnerable Road Users (VRUs) - pedestrians, bicyclists, motorcyclists and users of informal and unsafe motorized and non-motorized transport.[3] Various papers implemented different technologies though concentrating safety and quick medical help in case of accident. In this technical paper smart helmet explains how to establish a safe and secured society. This smart helmet has various application like useful for students, useful for bike and scooters, help to protect life in accident case, number of cases of violated traffic rules can be reduced. In Bangladesh, around 300 new motorized vehicles are coming on to road every day. The number of registered motorized vehicle grew from 552,003 in 1999 to 2,055,990 in 2013. There is an enormous change in the number of registered motor vehicles over the years with nearly over 1.1 million motorcycles in 2013.

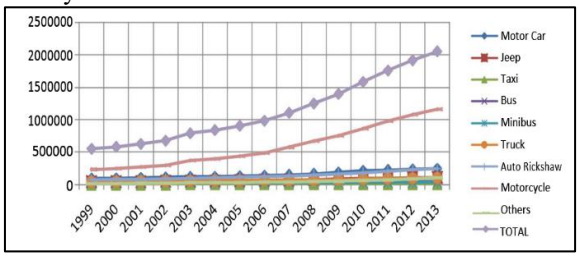


Figure 1: Registered Motor Vehicles by Types in Bangladesh (BRTA, 2013)

Trends of motor vehicle growth are shown in Figure 1 illustrating a drastic increase in the share of motorcycles from 42% in 1999 to 57% in 5 2013. The number of motorcycles grew from 215,670 in 1998 to 1,164,374 in 2013, an astonishing increase of around 440% with fleet growing at a faster rate than other vehicles.[4]

Different types of approach towards solving this problem was taken. A system having IR sensors for detecting helmet position. PIR sensors and accelerometer for accident detection purpose, GSM and GPS system sends message in emergency basis. Here, PIR sensor is used without having any special necessity. [5] Another step had taken by using pressure sensor, ultrasonic sensor and alcohol sensor with RF communication. It also contains several gas sensors for percentage of pollutant gas in that area. This is quite out of the study area. This project doesn't have any idea about accident prevention.[6] To reduce quick response time, people or vehicle alert system was developed which blocks passing a message, to help the victim using security code only authorized person unlock it. To reach from the accident place to the hospital, the system can reduce the time required at emergency basis [7]. GPS is a system for perfect detection of a location throughout the world by satellite system. A FSR sensor-based system can detect helmet position over the head and MQ3 sensor to detect the alcoholic drivers. A messaging system by GPS and GSM is also suggested at the time of accident.[8]A simple telemetry system, which is activated by means of a pressure that is applied to the helmet's interior when the rider wears it. It is based on force resistive technique. Once activated the transmitter sends a control signal to the receiver circuit and activates the relay which is connected to the bike's ignition circuit's power supply. But there isn't significant system for alcoholic drivers.[9] Even though there has been continuous awareness and several acts with punishment from the government authorities regarding helmets, a number of riders neglects them. In order to put an end to this two-sided tie, the smart helmet for motorcycle is introduced which, blocks starting of vehicles without wearing helmet by controlling ignition parameters. This smart bike helmet system has two modules, one on the helmet and another on the bike. These two modules communicated wirelessly using RF transmitter and receiver with encoder and decoder, AT89S52 is used as CPU. RF transmitter transmits the analog signal wirelessly and RF receiver receives the analog signal. In case of no signal in receiver, the bike won't start. ASK (Amplitude Shift Keying) based Tx/Rx (Transmitter/Receiver) pair at 433 MHz to use directly with microcontroller or as a remote control via encoder/decoder IC.[10] An accident avoidance system which gives a safety mechanism for the rider. Motorcyclist will be alarmed when he enters Accident/Danger zones. This is found to be useful at night or when the rider is drowsy or tired, by this accident can be reduced. Whenever any accident occurs MEMS sensor detects and sends mechanical force to ARM7, Also GSM technology is used to inform the family members in case of accident. By using GPS, the exact location can be found where accident occured, and then GSM sends message to ambulance and family members. [11] An IoT product called Smart helmet is introduced which comprises of two units, motor unit and helmet unit, Helmet unit consists of the alcohol and Eye blink sensor, Alcohol Sensor will not allow rider to take on bike after drinking alcohol and eye blink sensor raises the alarm in sleeping conditions. Motor unit is able to communicate with the care takers with messages and GPS helps the system to track the location of the bike in case of the accidents, also this system act as accident prevention and detection system.[12]

3. METHODOLOGY

Total work can be divided into three units. They are bike unit, helmet unit and central monitoring unit. While Helmet unit and the bike unit constantly communicates with each other and handle small scale risk detection and locally alarming the driver, the central monitoring unit is only alarmed when the risks are severe. A flow diagram of the system is given below.

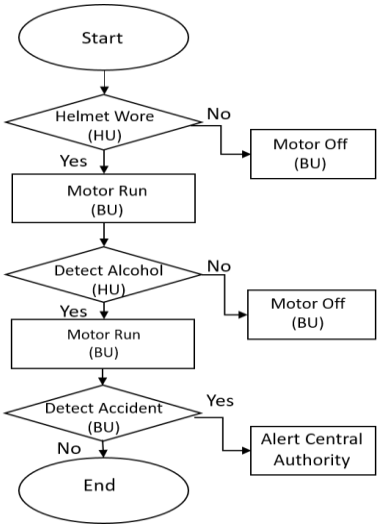


Figure 2: Flow Diagram of the Process

The system can be discussed based on the following criterion:
a) Based on circuit and parts
b) Based on Functionality
Under parts there are two units as previously mentioned Bike Unit and Helmet Unit. As for Functionality there are local control and central monitoring unit

3.1 Bike Unit

The bike unit controls the motor of the bike. The bike unit is fairly simple. It consists of:

1. Atmega 328p
1. RF receiver
2. Relay Switch

If it receives the signal from run motor only then it turns on the motor. A schematic diagram of the bike unit is given below.

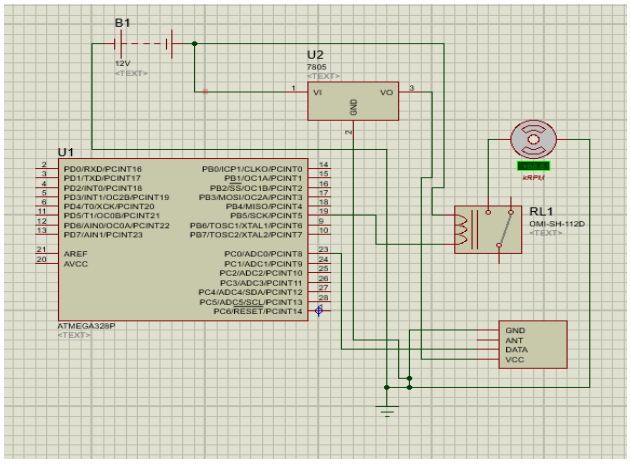


Figure 3: Circuit Diagram of bike unit

3.2 Helmet Unit

Helmet unit is the main unit in our system. It consists of:

1. Arduino
2. GPS module
3. RF Transmitter
4. Wi-Fi Module
5. Proximity Sensor
6. MQ-03 Gas Sensor
7. Battery

The control system of this is simple and straight-forward. It receives signal from gas sensor and proximity sensor and communicates via RF module to alarm locally. However, its circuit diagram of the helmet unit is given below.

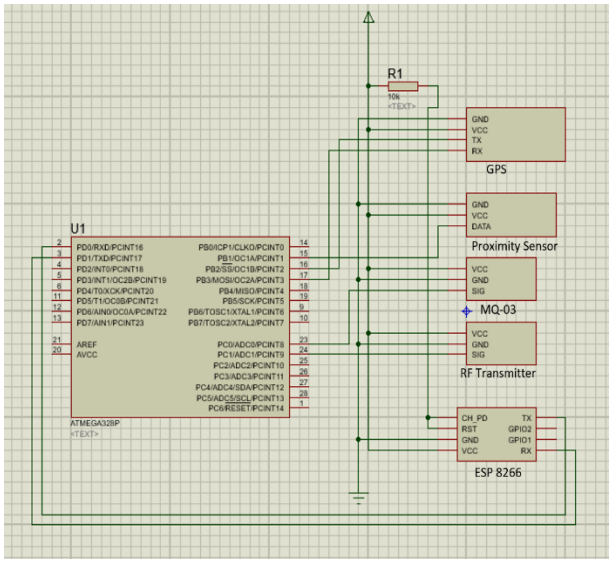


Figure 4: Circuit diagram of Helmet Unit

The functionality of the helmet unit can be divided into two parts-Local control and Central control

3.3 Local Control

Local control is quite simple and is mostly related to the bike unit. As previously mentioned, when the risk factors of the driver increase the relay will automatically activate the relay circuit and hence it will stop the motor. There is also a buzzer attached to our original circuit and it will notify the driver.

3.4 Central Monitoring Unit

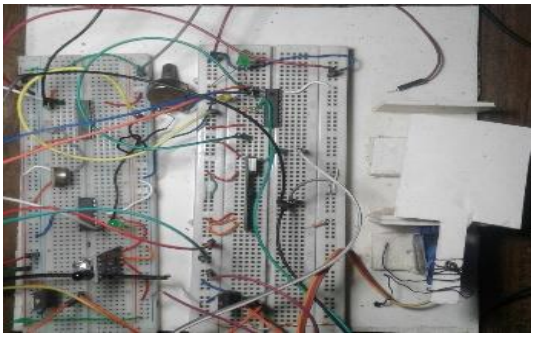
Central monitoring unit is a completely software-based solution. As previously mentioned, that esp8266 Wi-Fi module will send the data to firebase server. In this section we will retrieve the data from the firebase and display using a web framework. Here we used React JS to show the data in a web app. We also added a Based on the values used of mq-03 sensor data and previous records of the driver we assigned them a value. Then to find the risk predictability we used the following equation.

Risk Predictability= (Alcohol Intensity.4+previous records*.6) *100%*

More inputs can be added later to get even better result. The output of the monitoring system is shown in Figure 6.

4. RESULTS AND DISCUSSION

The system outcomes is tested based on few parameters. The threshold value for MQ3 sensor is 0.04mg/L and it gives output according to the set value. For accelerometer, the threshold value of the angle for rollover of the vehicle is taken 20°. When the angle between the surface and vehicle is more than 20^0 the system sets off an alarm and detects it as an accident. The actual photo of the circuit diagram is shown in the Figure 5. For testing purpose, the circuits is put in a cooking box and added it to the helmet with duct tape. The practical circuit diagram performed perfectly in every case and notified the driver.



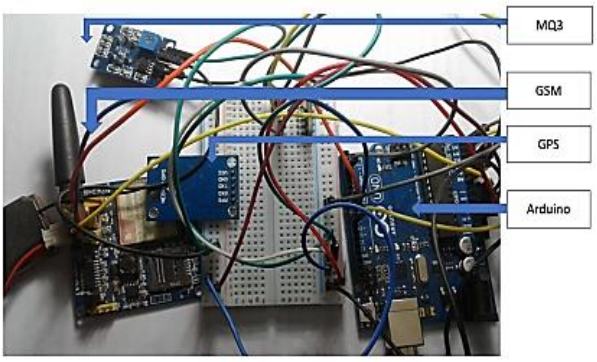


Figure 5: Actual Circuit Diagram

As previously mentioned, the central monitoring unit is completely software-based solution. The output UI of the software is shown in Figure 6. The firebase backend with esp 8266 worked perfectly and data was updated in real-time according to the tests.

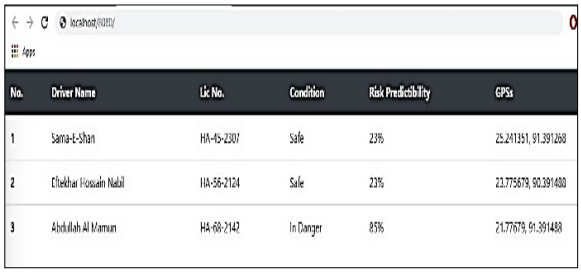


Figure 6: The user interface for central monitoring unit

5. CONCLUSION

As ride sharing services and use of two-wheeler constantly increasing, the safety measures should be a very important issue. As mentioned in our results area our implemented methods worked perfectly in local alarm and control as well as in central monitoring system. But the circuit is not compact and hence cannot be used. So, to get it in product level the circuit needs to be integrated and more compact. Again, more inputs should be added to measure risk predictability. And to finally get the system up and running there should be collaboration between the respective authorities. It is not possible to completely stop accident, but it is possible to reduce the loss tenfold. And any centralized system such as this can certainly contribute a lot to this effort.

6. REFERENCES

[1] K. M. Maniruzzaman and R. Mitra, "Road Accidents in Bangladesh," IATSS Res., Vol-29; no. 2; 2005; Pages 71

[2] https://en.wikipedia.org/wiki/Accident#cite_ref-Robertson2015_1-0, Accessed March,2018.

[3] I. Ahmed and B. Ahmed, "Urban Road Accidents in Dhaka, Bangladesh," no. May, 2013

[4] M. S. Hossain, M. A. Rahman, and S. M. A. B. A. Islam, "Safer Motorcycling and Safer Road," 2013..

[5] M, Jadhawar, G. Kandepalli, A. Kohade, R. Komati, "Smart Helmet Safety System Using Atmega32". International Journal of Research in Engineering and Technology eISSN: 2319-1163|pISSN: 2321-7308; Vol-05; Issue: 05; May-2016, Pages 287-289

[6] Karthik A, Karan GB, Kiran Pai, Srinivas A, "Smart Helmet", National Conference on Product Design (NCPD 2016), July 2016.

[7] S. Sonika, Dr. K. Sathiyasekar, S. Jaishree, "Intelligent accident identification system using GPS, GSM modem", International Journal of Advanced Research in Computer and Communication Engineering Vol-3; Issue-2; 2014; Pages 254-257

[8] S. Vijayan, V. T Govind, M. Mathews, S.Surendran, M. Sabah, "Alcohol Detection Using Smart Helmet System", International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE) ISSN: 0976-1353 Vol-8; Issue-1; 2014; Pages 545-547

[9] A.Das, P. Das, S. Goswami ,"Brainwave and Alcohol Sensitizing Helmet for Riders Safety", Proceedings of Eleventh IRF International Conference, Vol- 2, Issue-4, Oct.-2014; Pages 54-56

[9] S. Nayaka, R. Thakur, H.Thakkar, "Implementation of Smart Helmet Model Using Embedded System And RF433 Module", Indian journal of Scientific Research., ISSN: 2250-0138; Vol-14;Issue-2; 2017; Pages 348-351

[10] S. Nayaka, R. Thakur, H.Thakkar, "Implementation of Smart Helmet Model Using Embedded System And RF433 Module", Indian journal of Scientific Research., ISSN: 2250-0138; Vol-14; Issue-2; 2017; Pages 348-351

[11] Lakshmi Devi P, Bindushree R, Deekshitha N M, Jeevan M, Likhith M P, "Helmet Using GSM and GPS Technology for Accident Detection and Reporting System", International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169; Vol-4; Issue-5; 2014; Pages 18 – 21.

[12] Deekshitha K J , Pushpalatha S. "Implementation Of Smart Helmet". International Journal of Research in Engineering and Technology e-ISSN: 2395 p-ISSN:0056; Vol-4; Issue-7; 2017; Pages 3039-3042

8. NOMENCLATURE

Symbol	Meaning	Unit
IoT	Internet of Things	
GPS	Global Positioning System	
MEMS	Microelectromechanical systems	