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### RESEARCH ARTICLE

#### SMART SOLUTIONS FOR ENHANCING ROAD SAFETY AND BETTER RIDING EXPERIENCE USING IOT

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#### Abstract

This paper aims at providing solutions that would improve safety and riding experience. To ensure that the rider uses a helmet, the bike won't start unless the rider is wearing the helmet. The paper also proposes a solution to get the live location of the rider as well as using this location to disable the horn in no honking zones. With the help of different sensors mounted on the bike and helmet, the proposed system can detect an accident and inform emergency contact numbers. To further improve the efficiency of the entire system, solar power can be used.

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#### Introduction:-

The main intention behind this work is to improve safety and overall riding experience of two-wheeler riders. Only in Pune city, every year, among approximately 35 lakh two-wheeler riders, 500 to 600 face accidents out of which 300 to 400 are life threatening [6]. Due to their economic viability, agility and ease of use two wheelers are preferred by most of the Indians. We are trying to improve the driving experience of riders as well as making their experience much safer.

By integrating a key in the helmet, it is compulsory for the rider to wear a helmet in order to start the bike. The wearing condition would be checked using the load sensors which would be placed inside the helmet.

This paper also proposes an accident detection system. In an accident the rider may lose consciousness so the helmet will send an alert to the emergency contacts pre fed to the system. This system will make use of a tri axis accelerometer coupled with sensors on the bike to identify accidents.

The microcontroller along with GPS and GSM module mounted on helmet will help to know the rider's real-time location which can be seen on the created application. Furthermore, the location data will be used to check for no honk zones and horn will be disabled till the rider crosses the zone.

Making use of these sensors and microcontroller requires a constant power supply. Despite the technological advance's battery life is a problem. Comparing different energy harvesting methods making use of solar energy is the best solution. Using photovoltaic cells, we plan to charge our power source.

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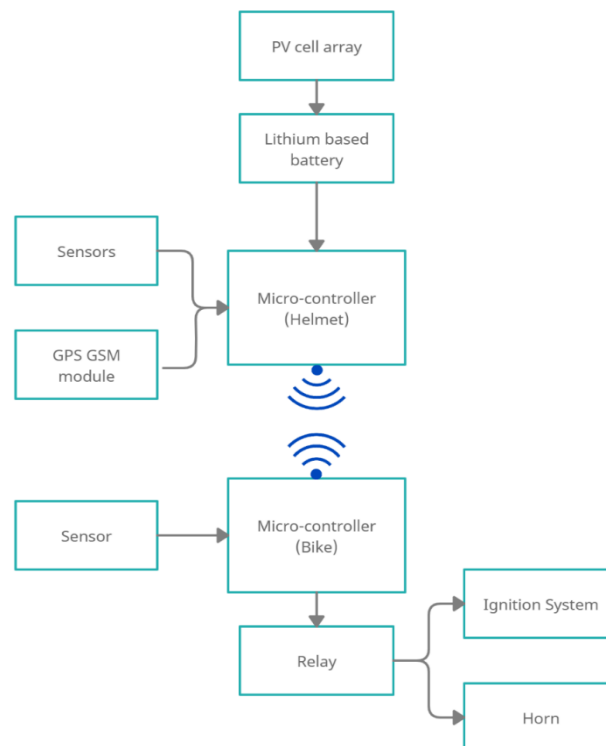
**Related Work:**

In case of GSM, it is used effectively in [4]. Although, use of them is restricted to reporting the place of accident and helping the medical help to reach on time. The present work aims to use the same sensors but for a wider range of application. Using the GSM module, we can connect to the internet and forward the location of the rider to the to be created application. We aim to use GPS, to get the current location and instead of sending it after accident as in [4] we aim to send it to the application. The application will then be able to show the time-to-time location of rider to his cared ones and this location data is further used in detecting the no honk zones to disable the horn. [4]

Durga K Prasad, Bh Sudha Rani and C. Vidya Sagar published a paper on a Helmet Operated E-Bike. Primary focus of their paper is on the Keyless locking control using a smart helmet. Their paper consists of a RFID Tag and its subsequent reader which is used as a key for the vehicle's handle locking mechanism. The other parts consisted of an Arduino microcontroller as the main processing unit. The helmet in this project had a resistive load sensor on the inside of the helmet and would be used to detect if it was being worn before starting the E-bike. This makes wearing of the safety helmet mandatory for the rider. [7]

Sreenithy Chandran, Sneha Chandrasekar, Edna Elizabeth N published a paper on Iot based smart helmet. It focuses mainly on accident detection and how an alert is sent. They invented a smart helmet with accelerometer, GPS and micro controller on board, which detects an accident when the input gained from the tri axis accelerometer exceeds a given threshold value. Their paper further discusses the accident notification system which is divided in client and server-based system where the microcontroller acts as the client and server cloud-based service. [1]

Power source for this system is a critical element, Daniele Bibbo, Silvia Conforto, Antonino Laudani, Gabriele Maria Lozito have discussed about harvesting solar energy for powering their system. The output power in case of PV cells depend on irradiation level and the micro controller requires a steady power supply hence they use an accumulator in their power supply unit and use the process of maximum power point tracking for getting the desired output. Taking Lithium based batteries for energy accumulation they further study the system for energy harvest i.e., array of PV cells and tested it in laboratory and outside in changing environmental conditions. [2].

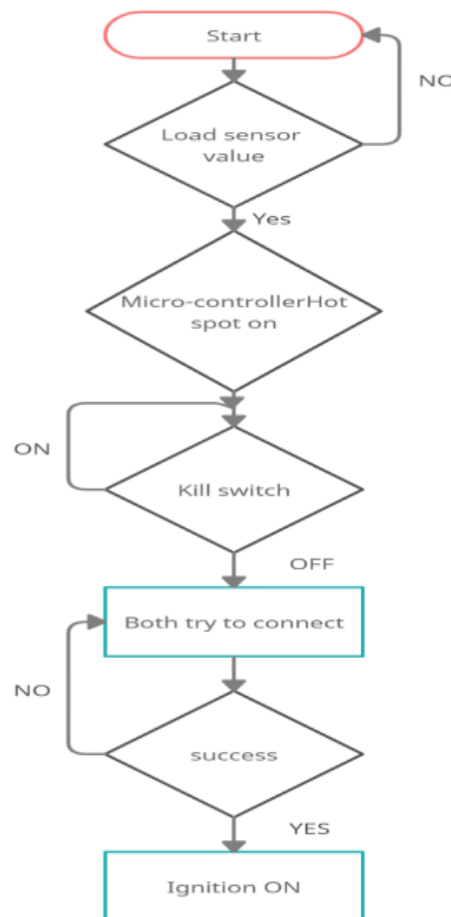
**Proposed Methodology:-****Overall Architecture:**

**Figure 3.1:-System Architecture**

Figure 3.1 explains the overall architecture of proposed system. The micro-controller NodeMCU can be used. The GPS module Ublox 6m can be interfaced with NodeMCU. The sim900 GSM module can be used to connect to the internet. The block diagram consists of the following components:

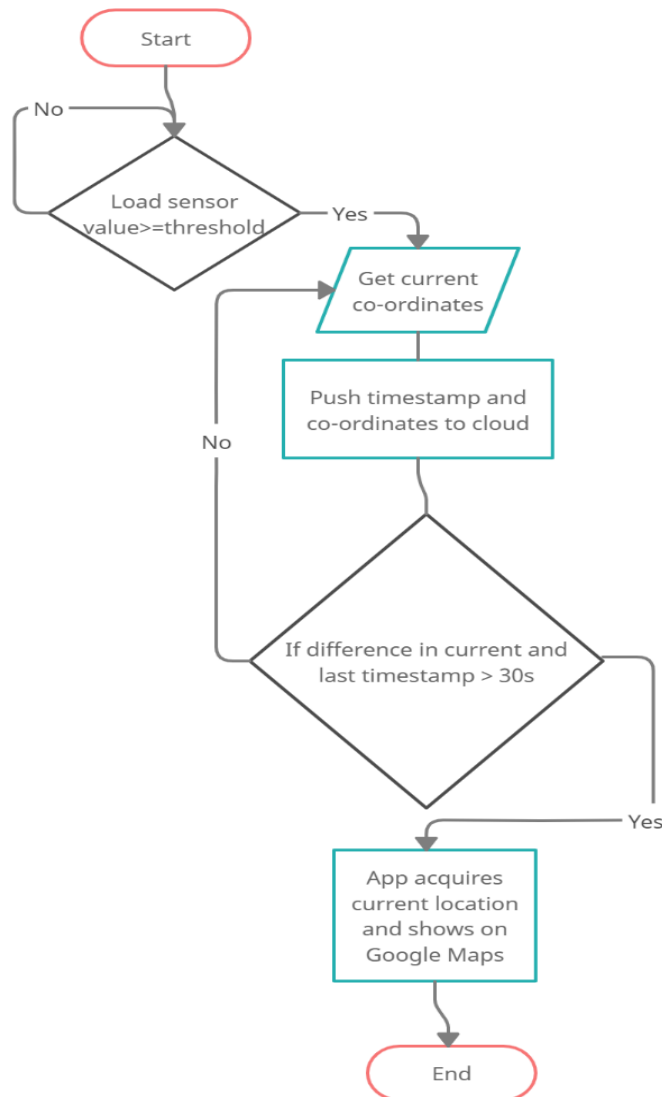
1. PV cell array can be used to charge the lithium-based battery.
2. Lithium based battery is used to power the Micro-controller (Helmet)
3. Micro-controller (Helmet) will get inputs from GPS, Accelerometer, load sensor and transfer data using GSM module.
4. Micro-controller (Bike) will get input from accelerometer sensor and cloud
5. Relay is used to turn on or off the ignition system and horn.

#### Smart Key:



**Figure 3.2:-** Flowchart of Smart Key System.

As introduced earlier the smart key integrated into the helmet is used to unlock both the handle lock and start the ignition. The micro-controller used in the helmet will be actively searching for the receiving end of the system i.e., the microcontroller used to lock and turn the ignition ON of the bike. The Microcontroller on the helmet will turn ON the pairing process once the load sensor inside the helmet reads value more than or equal to the threshold value. After this the rider will turn OFF the kill switch which will turn the microcontroller system on the bike ON and it would try to connect to the helmet Microcontroller. After the successful connection between the two microcontrollers is achieved, the handle lock would unlock and ignition of the bike will turn ON. As the microcontrollers have a limited connection range, (Theoretically set at half meter), the systems would not connect if not in range. If the connection between the two systems is abruptly terminated, the ignition would turn OFF.

**Realtime Location Mapping:****Figure 3.3:-** Flowchart of Location tracking system.

As we can see in figure 3.3, the system will work only if the rider is wearing the helmet. If the rider is wearing the helmet, load sensor value will be greater than the threshold value. Then, GPS will get the coordinates of current location and generate a timestamp, both of which will be uploaded on the cloud. In order to update the location every 30 seconds, current time and previous timestamp will be compared and would be uploaded on cloud only if 30 seconds have passed. The application will listen for updates on cloud and will acquire new co-ordinates every 30 seconds. After getting the new coordinates, application will use Google Maps API to plot the point on the map.

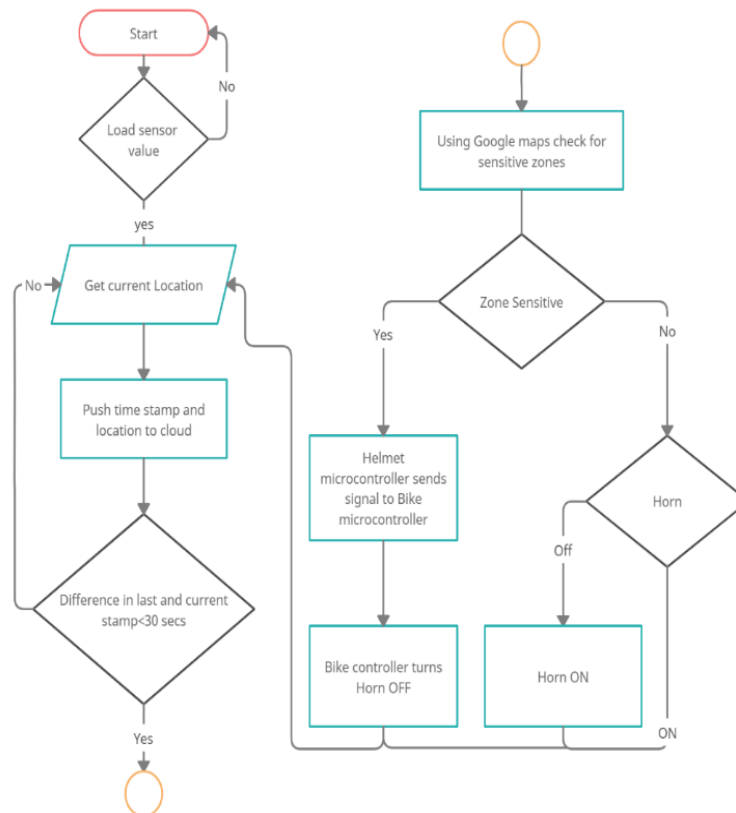
**No honk zone solution:****Figure 3.4:-No honking zone system**

Figure 3.4 explains the proposed solution for no honk zone. The system starts only when the rider wears a helmet. As soon as the rider wears the helmet the load sensor value crosses the threshold value. The GPS sensor with the help of GSM module sends the location of the rider and the timestamp every 30 seconds to the cloud. Google Places API is used to check for hospitals, schools i.e. no honk zones in 75 metres vicinity of rider's current location. This processing can be done on cloud. If the zone is a no honk zone i.e., sensitive zone then the helmet NodeMCU will send the signal to bike's NodeMCU. Based on this response, the NodeMCU on the bike will turn off the horn. If the response is that the area is not sensitive then the NodeMCU on the bike would turn on the horn if it is off or else do nothing.

**Power Source:**

Power source is the most important aspect of any design. As more and more features are added to the smart helmet the number of sensors will increase, thus increasing the power consumption. To get accurate readings the voltage should remain constant and no matter how much technology advances battery life remains an issue. We plan to power our system using Lithium based batteries which will act as accumulator for our Photo voltaic cell array mounted on the top of the smart helmet. The solar cells coupled with a small current storage unit will be sufficient to power our system.

A solar cell or photovoltaic cell is an electrical device which converts sunlight directly to electricity by photovoltaic effect which is a physical and chemical phenomenon. It is basically a PN junction diode where electrons are excited by the energy of photons. The power generated by these PV cells depends on the radiation incident on the surface area of the PV cell. The standard size of solar panels used on roofs and farms is about 77 \* 39 inches but mini solar panels are now available which range from 0.62. 55 inches to 8.85\*5.12 inches. These mini solar panels produce almost constant voltage but current that varies according to the light incident. A typical mini solar panel can generate about 0.06-4 watts of power.



HOW A PHOTOVOLTAIC CELL WORKS

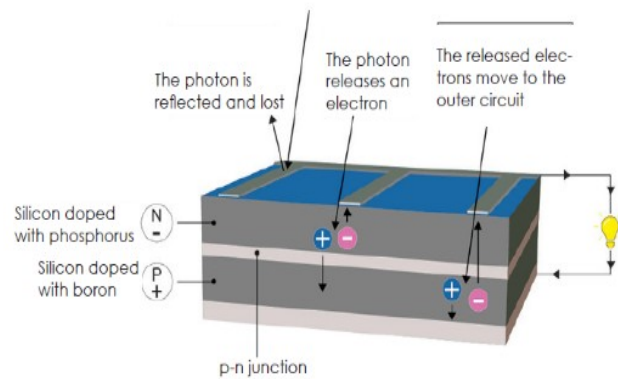


Figure 3.5:-Solar cell[8].

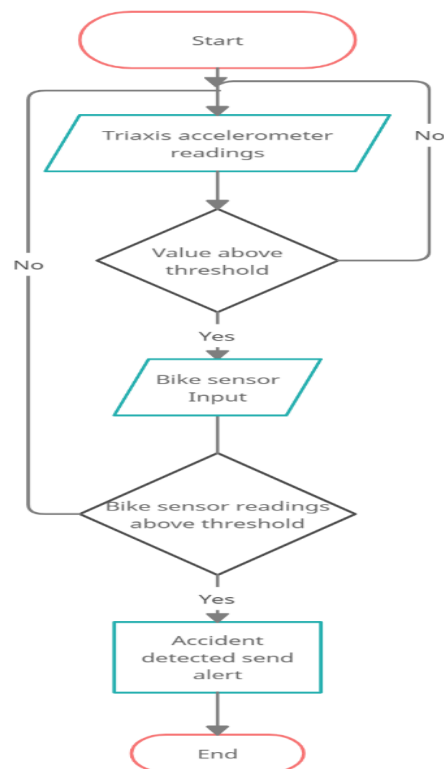
**Accident Detection :**

Figure 3.6:- Accident detection system

Tri-axis accelerometer sends reading continuously to the cloud. If the value sent by the tri-axis crosses a certain threshold then the cloud checks the triaxis sensor values of the bike. If it has crossed the threshold as well, then we are certain that accident has taken place else it may be just the helmet which would have got dropped. If the cloud senses the pattern, then accident can be confirmed and using the GSM and GPS, the location can be sent to the already entered emergency contacts. These contacts are registered in the application by the rider and the application shares the same cloud database.

#### **Future Scope:**

This system although effective can have many more sub systems integrated into it. An intercom system for riders to communicate with each other can be implemented. Intercom systems help riders communicate information regarding upcoming obstacles and any emergency that takes place. Smart obstacle detection system can be implemented in the further revisions of this system. An OLED display or holographic display can be implemented onto the helmet's visor. This would help rider navigate easier.

#### **Conclusion:-**

This paper proposes keyless ignition system which increases user satisfaction. This system also ensures that the person wears a helmet using load sensor and checks for bike's vicinity using hotspot connection between micro-controllers. The GPS and GSM module track the rider's real-time location and enables the microcontroller to connect to the cloud, through which features like disabling horn in sensitive regions and contacting emergency contacts in case of an accident. As an added benefit and for a greener environment, this system is powered by an array of photovoltaic cells which will keep charging a lithium-based battery source. This Smart helmet will make driving experience of the riders much better and safer.

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