Road Accident Analysis and Arduino Based Alert System

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Abstract— **Over the last two decades, Mumbai, and subsequently India, has seen a huge increase in the number of vehicles on the road. Suddenly, the demand and popularity of the private transport has raced ahead of the public transport by miles. The number of vehicles on the road is always directly proportional to the road accidents and injuries. As a result of the former increasing every year, it is but natural that the latter too, has gone up.**

Factors of road accidents include:

1. **Lack of education and awareness- There is a basic sense of traffic rules which every single person should have. Unfortunately, in our country, people are not sensitive to that. Also, it does not help that almost everyone is very casual and relaxed about the traffic-sense.**

2. **Weak law enforcement- India is a country which is known to have good laws regarding its road safety. However, these laws are of no use in theory, if they cannot be put into practice correctly. Our country still has many officers who do not take the rules seriously and are very lax in terms of implementation.**

3. **No technical support- According to WHO's Global Status Report on Road Safety 2018, electronic stability control is fitted in 70% of the world vehicles but it is only 10% in the vehicles in India. That needs to change if we want our citizens to feel safer on the roads.**

Keywords— Road Accidents, Victims, Global Positioning System (GPS), Global System for Mobile (GSM), Accelerometer, Golden Hour, Road Accident Injuries.

1. Introduction

A road accident, or a collision, occurs when a vehicle e.g., a car or a motorbike collides with another heavy or light vehicle, or with other pedestrians. Accidents also happen because of things like broken and unkept roads, oil spills etc. There are always two ways of preventing road accidents: (i) training the drivers to follow road rules and (ii) in case accidents do occur, to ensure lesser loss of human life and damages of property.

According to the National Crime Records Bureau (NCRB) data, 4,45,514 road accidents happened in 2018. The trend shows that deaths had increased in 2016, by 2.1% in 2016 as compared to 2015. In 2017, the deaths reduced by 1.1% but unfortunately, they seem to have increased again in 2018. Road accidents in the country have de-creased from 4,45,730 in 2017 to 4,45,514 in 2018 but the demises have increased by 1.8% (from 1,50,093 in 2017 to 1,52,780 in 2018). [2][3][4][5]

It was felt that we need to have clarity to understand the nature with which the road traffic accidents are happening and the magnitude. We needed to have both secondary and primary information. In that context, we informally approached the faculty at the School of Health Systems Studies, Tata Institute of Social Sciences, Mumbai and decided to carry out a brief enquiry looking into the varied aspects of road traffic accidents and injuries. We are also describing an Arduino based embedded electronic system comprising of three separate, interconnected modules viz., GPS modem, GSM module and an Accelerometer. This model will be used to send alerts to pre-defined numbers, whenever an accident takes place.

2. Methodology and Study

It was a short-term yet exploratory study where we identified two trauma cares, one private and one public facility in Mumbai. We identified 100 cases from there who were seeking treatment for their road accidents. We have compared the age bracket where road accidents are maximum, along with the reasons and injuries to give a complete view of the problem. Following are the brief information about them:

2A. Age of the Victim

As per our assessment, 42.7 % accidents happen to youngsters between the ages of 19 and 35. Comparatively, 7.3 % of accidents occur with people between the ages of 36 and 45, as well as 46 and 60. 9.8% of the accidents occur with people who are 61 and above. The lowest percentage of accidents have been known to happen to children, between ages 5 and 18, at 8.5%. The ages of 24.4% of the accident victims is un-known.

Most of the young adults who are victims of accidents, are at an age where there is history of immense peer pressure. In addition to that, they always have a thrill of driving.
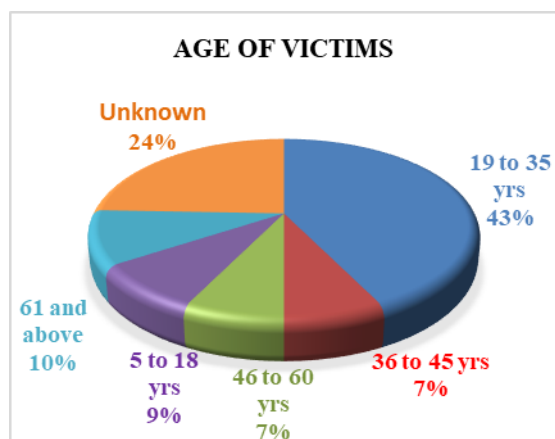

Fig,1

2B. Gender of the Victim

Similarly, we realized that 46.3 % of the victims were females and 53.7% were males. It is essential to realize that there is not much difference between the percentage of male and female victims. Also, it should be understood that less number of females drive vehicles as compared to men in our country, and, the same thing is observed to a large extent in public transport.
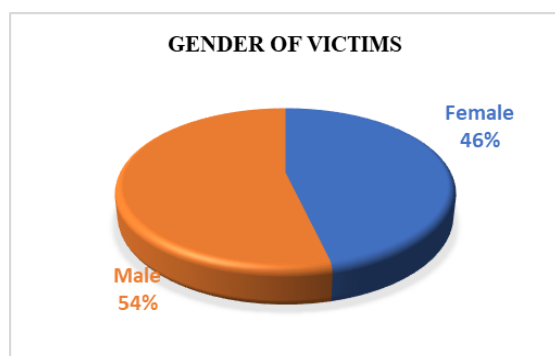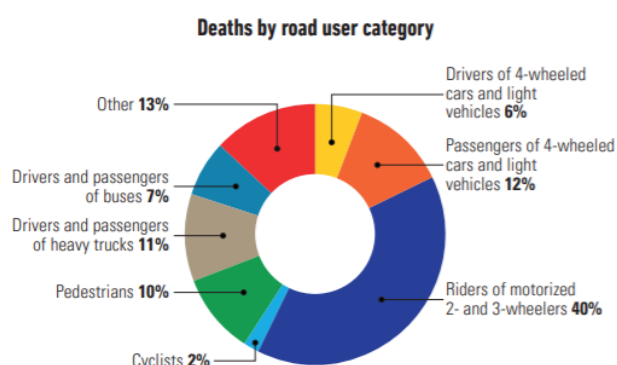

Fig. 2

Fig. 3

2C. Type of Accident

As per WHO's Global Status report on Road Safety 2018, it was found that 40% of deaths that occurred in India in 2016 were riders of motorized two and three wheelers. Two and three wheelers are more prone to accidents because they do not have any protection, which exposes them to more injuries. [1]

It has become very easy for the public to own two wheelers these days, due to easy access of low-interest loans and multiple incentives offered by public sector banks.

It was found that our review matched that of the WHO statistics. 25.6% accidents are motorbike accidents alone. 3.7% were bicycle accidents. 2.4% were autorickshaw accidents (three-wheelers), and 18.3% were car accidents (LMVs). Out of heavy-weight four wheeler accidents, 3.7% were truck accidents. There were multiple accidents where two vehicles were involved. 3.7% of the crashes involved cars and motorbikes, 1.2% involved buses and motorbikes, buses and autorickshaws and buses and bicycles each, 1.2% also involved cars and trucks and trucks and autorickshaws each. Some of the non-vehicular accidents took place because of disregard of traffic rules (at 3.7%), falls (8.5%), oil spill (1.25%) and rash driving and overspeeding (7.3%). Reason for 13.4% of the accidents are unknown.

Multiple vehicles are sometimes involved in conflicts due to factors like speeds of the vehicles, overtaking of vehicles and changing lanes simultaneously. Another major factor can be accidents happening at crossroads, where drivers have no clue about vehicles coming from the other sides.
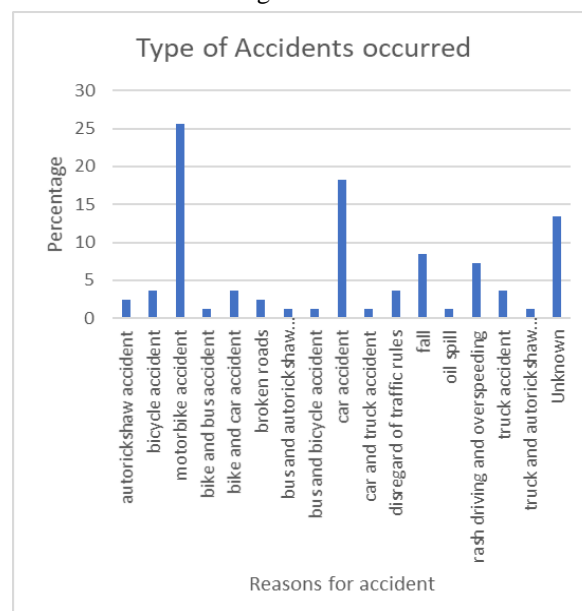

Fig. 4

2D. Type of Injury

The last parameter we compared was the type of injury that occurred. Majorly we observed that most accidents caused head injuries, along with injuries to the extremities. Given below is a graph where you can see that 20.7% injuries caused were leg injuries, more specifically injuries to the ankles and knees of both the legs. Next, 14.6% of the injuries were only to the head. 12.2% were hand injuries. However there were multiple incidents where more than one body part was injured at the same time. 3.7% of the injuries were both hand and leg injuries, 3.7% were also head and shoulder injuries, 1.2% were hip and leg injuries and head and hand injuries individually. A small amount of the injuries were face (2.4%) and pelvic (3.7%), shoulder only (2.4%) and there was one major spinal cord injury (1.2%). According to our survey, road accidents caused 4.9% deaths and 6.1% of the accidents were so serious that they needed to be taken straight to the Intensive Care Unit.
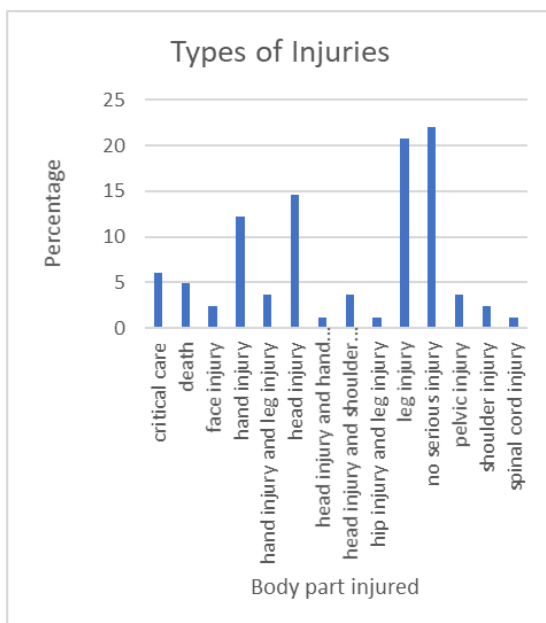

Fig.5

Conclusion: From our survey, we have been able to conclude that majority of the accidents happen to young males between the ages of 19 and 35. Most of these accidents are motorbike accidents, with extensive injuries to the limbs (hands and legs) followed by the head. It can be presumed that such is the case because a motorbike rider does not have any safety for his limbs, only has the helmet to protect his head.

Prevention of Accidents: There are few basic points that need to be considered while trying to prevent accidents from happening.

1. Education- Education plays a very important role in preventing road accidents. As stated earlier, drivers and people in general need to be tutored and explained that road collisions can be avoided with simple obeying of laws and more road awareness.

2. Law enforcement- Officials have to be honest and true to themselves while enforcing traffic rules.

3. Technical aspect- Finally, engineering solutions should be explored so that there is minimal destruction of materials. For this purpose, designs of vehicles can be tweaked to accommodate safety measures. Another aspect of it is to install safety devices to better road conditions and structures. [6]

4. Limitations

Some of the things that prevented us from getting a wholistic view of the problem was restricted volume of data and limited number of patients present physically in the hospitals at the time of interview.

4. System Diagram and Design

3A. GPS Modem

GPS means Global Positioning System and is used in our project as it will track the exact location of the accident. It will connect to the satellite for exact time stamp and date.
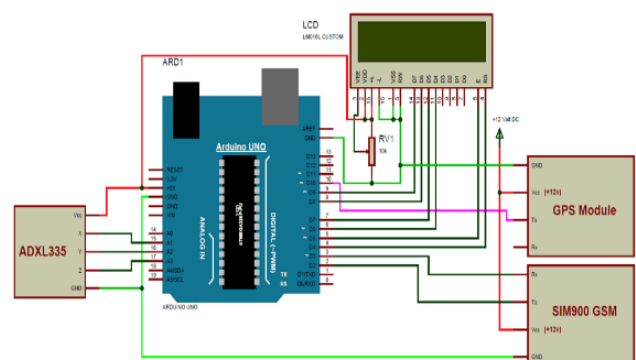
3B. GSM Module

A GSM module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system.

3C. Accelerometer

An accelerometer is an electromechanical device used to measure acceleration forces. Such forces may be static, like the continuous force of gravity or, dynamic to sense movement or vibrations. Acceleration is change in velocity, or speed divided by time.
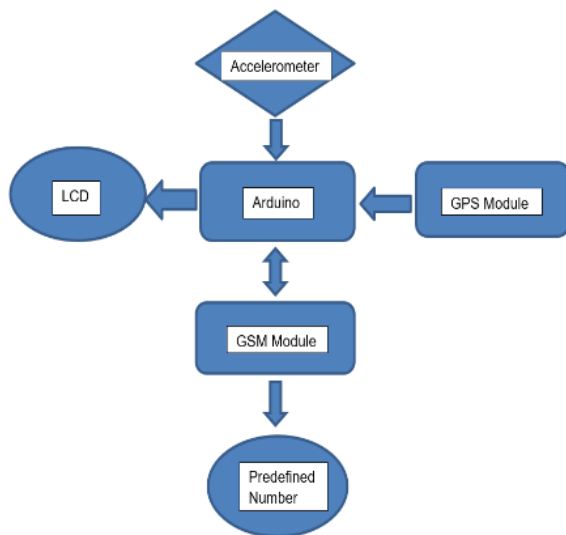
Fig.6

Fig.7

Usually when accidents occur, any vehicle, either swerves with a sharp turn or topples completely. We have designed a system where the accelerometer in the automobile will perceive the sudden change in the axis and that will be sensed by the Arduino. If the change is beyond a certain threshold, it will trigger the GSM module. The module will send a message to pre-defined numbers with the exact location of the accident (google link) and the speed of the vehicle at the time of the accident. These pre-defined numbers will be: a hospital, a police station and an ambulance number. After the message has been sent, it will be easier for the respective facilities to respond in-time so that the accident victim can be rushed to the hospital in time and proper treatment can be started. Thus, lives can be saved. [7][8]

5. Future Scope

In our current system, we are only able to send the alert to pre-defined numbers. We think that more advancements can be made in terms of sending the alerts based on the location of the accidents so that the nearest hospital or ambulance or police station will respond. Rigorous testing and validation should be done.

The system can be made more user friendly by adding a user interface. Through is the owner of the vehicle can decide how many and which numbers will be a part of the emergency contact list.

In the future, real time image transfer can be done by incorporating a camera which will get triggered when the accelerometer detects a change in the axis.

Conclusion

Thus, we have designed a system based on the survey conducted, that can detect an accident and alert the nearest hospital, emergency ambulance services and police station. This system will ensure that the required Healthcare service is given to the injured patient within the "Golden Hour" and will play an eminent role is saving the patient's life.

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