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Healthcare and Safety Systems in Vehicles

PHY1901: Introduction to Innovative Projects

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Slot: S1

Team V

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Abstract

WHO states cardiovascular diseases as the number one cause of deaths across the whole world. India has witnessed an alarming rise in the occurrence of cardiovascular diseases, strokes, diabetes and cancer diagnoses in the past 25 years. The chance of these conditions occurring in a manner which is disruptive and dangerous is also high while driving. This situation requires our attention as both the driver and others around them are at risk. Severe injuries may mask the role of a health ailment. This hypothesis is supported by the data collected on sleeping and background accidents. Reducing the risk or at the very least, minimising the consequences of the accident would greatly increase the chance of survival for the victims.

Our solution is a Health and Safety System Device which monitors the driver in a constant, consistent and accurate manner, which could potentially save lives by alerting all passengers in the car that the system detects something wrong with the driver. An imaging device would be placed in front of the driver, and will be responsible for detecting whether or not they are awake . If the response is negative, an alarm will be activated in a bid to wake the driver up. In the case of automated cars and vehicles, if the driver is sleeping, then the car will automatically shift to the emergency lane and stop. Strokes or other cardiovascular related emergencies are dealt with by informing the nearest hospital that the driver has suffered from an attack, and if the car possesses an autopilot feature, it will slow down and eventually stop in order to prevent further damage The sensors provided in the driver's seat will check the driver's blood pressure, heart rate etc.

We can also integrate existing technology to obtain more accurate data about the driver. Smartwatches and other devices which have inbuilt sensors that monitor these parameters can be linked and utilised to reduce the hardware required for its implementation. We need to evaluate the potential risk of a driver's acute incapacity to drive, and compare the risks with other major risks related to fatal motor vehicle accidents. Using our product, we wish to create a safer world for all drivers and motorists, in order to drive on the roads to a better future.

List of issues identified by each individual student:

Aaditya Hemant 19bai1098

1. Lack of organization causing people to lose track of items which can cause very unnecessary stress at times.
2. Loss of motivation in students due to reduced class interactions in online format
3. Eye strain for students and employees who have to constantly be in front of a screen for classes and work.
4. Bad sitting posture which leads to back pain.
5. Insomnia facilitated by habitual mobile phone usage late at night.
6. People living alone facing anxiety and depression due to lack of social interactions as a result of the recent quarantine.
7. Disruption in daily routines for people relying on services like deliveries.
8. Parents find it difficult to facilitate children's education from home along with their own work.
9. Boredom caused due to lockdown.
10. Misinformation spread on social media like whatsapp and facebook.

The topic I chose to address was the first one mentioned. Not being able to find items is something that affects everyone. If the item is of importance, for e.g. your wallet, keys or any important document or file, being unable to find said item can cause a large amount of stress. The person may be certain that their keys are in their home but still be unable to find it. A lot of time is also wasted as the person searches for it. A straightforward technical solution that came to mind was a small tracker. It can be in the form of a sticker that can be attached to items in your home. The person could use their phone which

would detect the location of the item. This would prioritize minimizing cost and size in exchange for range to be usable at homes.

Sahil Arora 19BCE1366

1. Women Security.
2. Disastrous floods every year.
3. No food to the poorest of the people.
4. No clean water to many people in rural areas.
5. Education loans and repayment (not cost effective)
6. Farmers can’t get easy loans for their growth leading to sucide
7. Indian Artistary missing.
8. Handmade clothes are not available anymore.
9. No safety guidelines of workers working in private construction.
10. Less effectiveness of online classes.

The topic I chose was of Women Security. I saw the ever increasing problem of lack of women and children security in our country. The idea was to create a wearable device which will send the person’s location to the contacts that were set beforehand. The device is supposed to be a single button unit, that is only supposed to do one work and that is safety analysis. This idea was all and all a good one but we didn't go with it in the end because for one, how does it differentiate from a mobile phone, the price wouldn't have made it any better and the areas without cell reception won't be able to use this service.

Subramanian Venkittanarayanan 19BAI1089

1. Obesity among students on highschool/ college campuses
2. Reformation of the prison system to rehabilitate rather than punish
3. Water conservation in large apartment complexes/ communities
4. Promoting creativity oriented courses for students
5. Decreasing litter and street pollution
6. Small products that slightly improve how we use things (scotch-brite with soap inside, showerheads with shampoo dispensers)
7. Digital wellbeing and online safety - how to stay safe and secure on social media
8. Cleaning lakes and keeping them unpolluted in bangalore
9. Promoting healthy lifestyles through sports and regular exercise
10. Student specific online portal to communicate notes, textbooks, event information, and updates about student clubs

The topic chosen by me was reformation of the current prison system. The reason I picked this was due to my belief that rehabilitation is far more effective than punishment. By teaching those who have committed crimes that they have the chance to choose a different path, and through self introspection, we can reform these people into good members of a productive society. By ensuring we treat them as human beings who have made mistakes, we can reduce the overall crime and create a welcoming community where change and progress are appreciated, thereby creating a system that seeks to improve through betterment and not fear.

Surya M.R 19MIS1165

1. Inability of businessmen to be present at meetings physically
2. Due to lockdown restrictions lack of physical activity of people leading to increasing obesity
3. Issues of interaction of students to teachers during online classes
4. Eyesight issues after staring at a computer screen for multiple hours during online classes
5. Increase of fraudulent activities eg fake college admissions during online admission
6. Newly appointed cut from job due to lack of seniority as company's funds drop
7. Students who got seats to study in a foreign university are stuck and cant join
8. Motivated new businesses are unfortunately shut down due to economic downfall
9. Hospitals not able to assist everybody due to the overflow of patients
10. Stress and depression levels increase due to isolation and loneliness

The problem that I chose to work on was the issue of eyesight faced by students attending online classes. Students are asked to attend around 7 to 8 hours of class and continue doing assignments and quizzes on the laptop to add on. Students try to prevent staring at a screen too long by reducing brightness or using a blue light filter but it is not enough. I thought of a management system where a college can organize and send all the work in a semester at intervals of time so the students can manage the time in front of a computer screen effectively . We did not go for this as we wanted to work on something more computer-based rather than something more management based.

Ayush Arya Sinha - 19MIS1066:

1. Lack of Open Grounds in cities to play games
2. Stress due to work pressure
3. Hair loss problem due to poor quality of water.
4. Frequent Electricity cutoff and Low Voltage Problems
5. Bad Time management due to workload
6. Increasing Anxiety and Low self esteem problem
7. Using online platforms for teaching due to lockdown and digitalisation
8. Home sickness because of staying far from home
9. Slow Internet speed
10. Waste Garbage Management

The problem statement I chose was the Lack of Open Grounds in cities to play games.Playing games keeps the body fit and Healthy.It works as a substitute for yoga and exercise. But in cities due to civilisation there are no open spaces left. Research proves that playing games reduces stress and anxiety levels and enriches a man with social skills which a lot of people suffer from. So for a solution to this problem I proposed to make arrangements over the top floor or the roof. The roofs of the schools and some gov buildings can be converted into playgrounds using artificial grass and tall nets.We didn't go with this problem statement because its a social problem kind of thing but instead we wanted to work on something more technical and entrepreneurial.So we decided to work on health care and safety system for vehicles.

Kshitiz Goyal - 19MIS1009

1. Lack of political participation by students
2. Lack of automation in basic data cleaning applications
3. Energy-efficient desalination
4. Earthquake prediction
5. Knowledge of plants and its detection using image processing
6. Increase in number of people suffering from depression
7. Modern slavery and forced labour
8. Permanent Solution to Water Shortage and Clean Water
9. Increasing yields and food supplies
10. Digitalization of small shops and businesses amid this corona pandemic

I chose the topic number 5 i.e. detection of plants using image processing as this topic was having a technical solution and this will help to identify any type of plant and tell us about the medicinal properties and also tell us about the climate and weather conditions required if we want that plant and all the characteristics of that plant and also the medicinal purpose of that plants for any kind of use without dependence on anything like networks and all we only require the app.

Naman Jain (19MIS1040)

1. Air pollution in India.
2. Voters didn't vote in elections and take these opportunities for granted.
3. Online Frauds.
4. Reservation in college admissions.
5. Safety issues of drivers and passengers in a vehicle.
6. Captcha reading by both deaf and blind people.
7. Unethical practices of students in the examinations.

8. Rash driving by bus drivers.
9. Effect of social media on youngsters.
10. Less importance of online classes.

I chose “Safety issues of drivers and passengers in a vehicle” because I found it interesting and unique. Also, this problem is a major one, around 170k accidents occur every year due to lack of safety systems in vehicles. I proposed a Healthcare and Safety system for vehicles that will ensure your vital signs to be normal and will be capable of taking necessary solutions at the time of any problem. It will analyse the driver’s vital signs and sleeping pattern using sensors on seat belt or a smart watch. Along with this, a camera will be installed that will monitor your reactions time to time using image processing. Overspeeding problems can be controlled by using a speed restriction device that will take input from the GPS. For example: in city traffic, the speed will be restricted to 40-50kmph while in highways it will be around 80-90kmph. Talking about the serious situations like strokes etc, the car will send a SOS to nearby police station/hospital along with the vital sign details and live location. Similar details will be sent to the speed dial contacts of the driver.

Healthcare and Safety in vehicles was the final topic chosen by the team. We felt that it addressed a major issue along with the potential to have realistic technical solutions.

Issues Identified

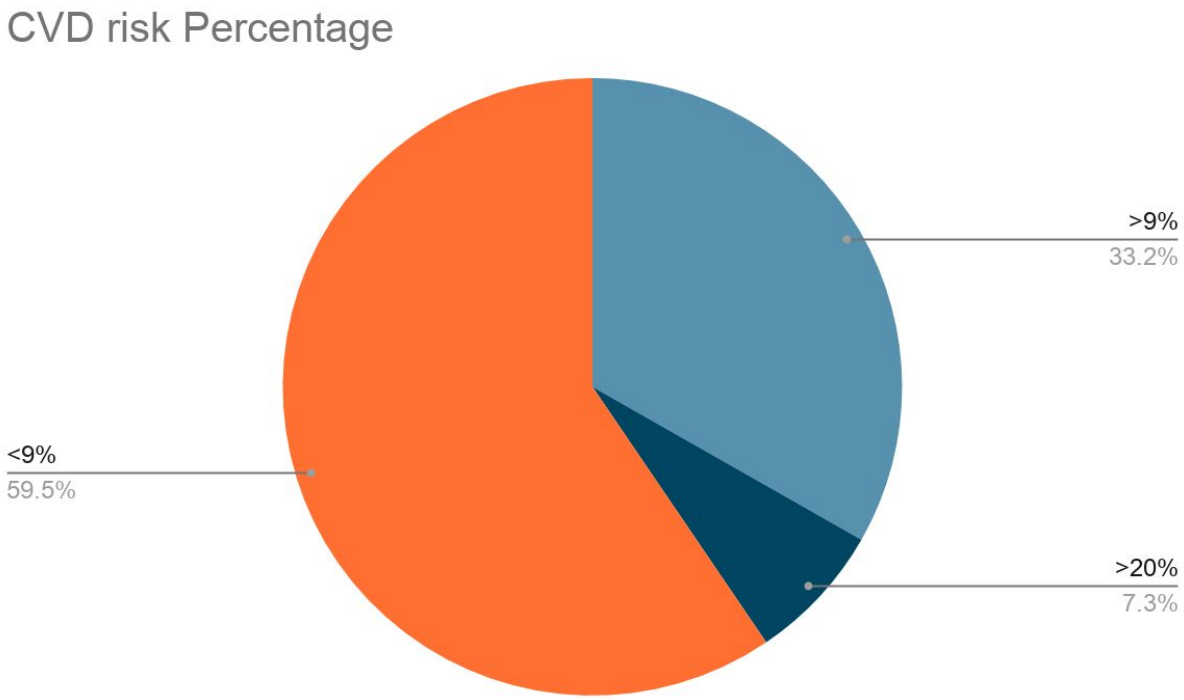
Road accidents are the most unwanted thing to happen to a road user, though they happen quite often. The most unfortunate thing is that we don't learn from our mistakes on the road. Most of the road users are quite well aware of the general rules and safety measures while using roads but it is only the laxity on part of road users, which cause accidents and crashes. Main cause of accidents and crashes are due to human errors. We are elaborating some of the common behaviour of humans which results in accidents.

1. Over Speeding
2. Drunken Driving
3. Distractions to Driver
4. Red Light Jumping
5. Avoiding Safety Gears like Seat belts and Helmets
6. Non-adherence to lane driving and overtaking in a wrong manner
   Various national and international researchers have found these as the most common behavior of Road drivers, which leads to accidents.
7. Delays in detecting accidents
8. Cardiovascular diseases

Cardiovascular diseases:

Heart diseases have become very common among men and women causing around 15 million deaths all over the world. There can be various reasons which lead to symptoms of cardiovascular diseases.The risk factors assessed were age, gender, total cholesterol, high density lipoprotein (HDL) cholesterol, smoking, systolic blood pressure and use of blood pressure medications. The drivers and the travellers are never aware of them getting a heart attack . More

than one third of the drivers (38.9%) had a CVD risk of 9% or greater. Nearly 10% of drivers (8.5%) had a CVD risk percentage greater than 20%.



Over Speeding:

Most of the fatal accidents occur due to over speeding. It is a natural psyche of humans to excel. If given a chance man is sure to achieve infinity in speed. But when we are sharing the road with other users we will always remain behind some or other vehicle. Increase in speed multiplies the risk of accident and severity of injury during accidents. Faster vehicles are more prone to accident than the slower one and the severity of accident will also be more in case of faster severity of accident will also be more in case of faster vehicles. Higher the speed, greater the risk. At high speed the vehicle needs greater distance to stop i.e. braking distance. A slower vehicle comes to halt immediately while a faster one takes a long way to stop and also skids a long distance due to the law of notion. A vehicle moving on high speed will have greater impact during the

crash and hence will cause more injuries. The ability to judge the forthcoming events also gets reduced while driving at faster speed which causes error in judgment and finally a crash.

Drunken Driving:

Consumption of alcohol to celebrate any occasion is common. But when mixed with driving it turns celebration into a misfortune. Alcohol reduces concentration. It decreases reaction time of a human body. Limbs take more to react to the instructions of the brain. It hampers vision due to dizziness. Alcohol dampens fear and encourages humans to take risks. All these factors while driving cause accidents and many times it proves fatal. For every increase of 0.05 blood alcohol concentration, the risk of accident doubles. Apart from alcohol many drugs, medicines also affect the skills and concentration necessary for driving. First of all, we recommend not to consume alcohol. But if you feel your merrymaking is not complete without booze, do not drive under the influence of alcohol. Ask a teetotaler friend to drop you home.

Distraction to Driver:

Though distraction while driving could be minor but it can cause major accidents. Distractions could be outside or inside the vehicle. The major distraction nowadays is talking on a mobile phone while driving. Act of talking on the phone occupies a major portion of the brain and the smaller part handles the driving skills. This division of the brain hampers reaction time and ability of judgement. This becomes one of the reasons for crashes. One should not attend to telephone calls while driving. If the call is urgent one should pull out beside the road and attend the call. Some of the distractions on road are:

1. Adjusting mirrors while driving

2. Stereo/Radio in vehicle
3. Animals on the road
4. Banners and billboards.

The driver should not be distracted due to these things and reduce speed to remain safe during diversions and other kinds of outside distractions.

Red Light jumping:

It is a common sight at road intersections that vehicles cross without caring for the light. The main motive behind Red light jumping is saving time. The common conception is that stopping at a red signal is wastage of time and fuel. Studies have shown that traffic signals followed properly by all drivers saves time and commuters reach their destination safely and timely. A red light jumper not only jeopardizes his life but also the safety of other road users. This act by one driver incites another driver to attempt it and finally causes chaos at crossing. This chaos at intersections is the main cause of traffic jams. Eventually everybody gets late to their destinations. It has also been seen that the red light jumper crosses the intersection with greater speed to avoid crash and challan but it hampers his ability to judge the ongoing traffic and quite often crashes.

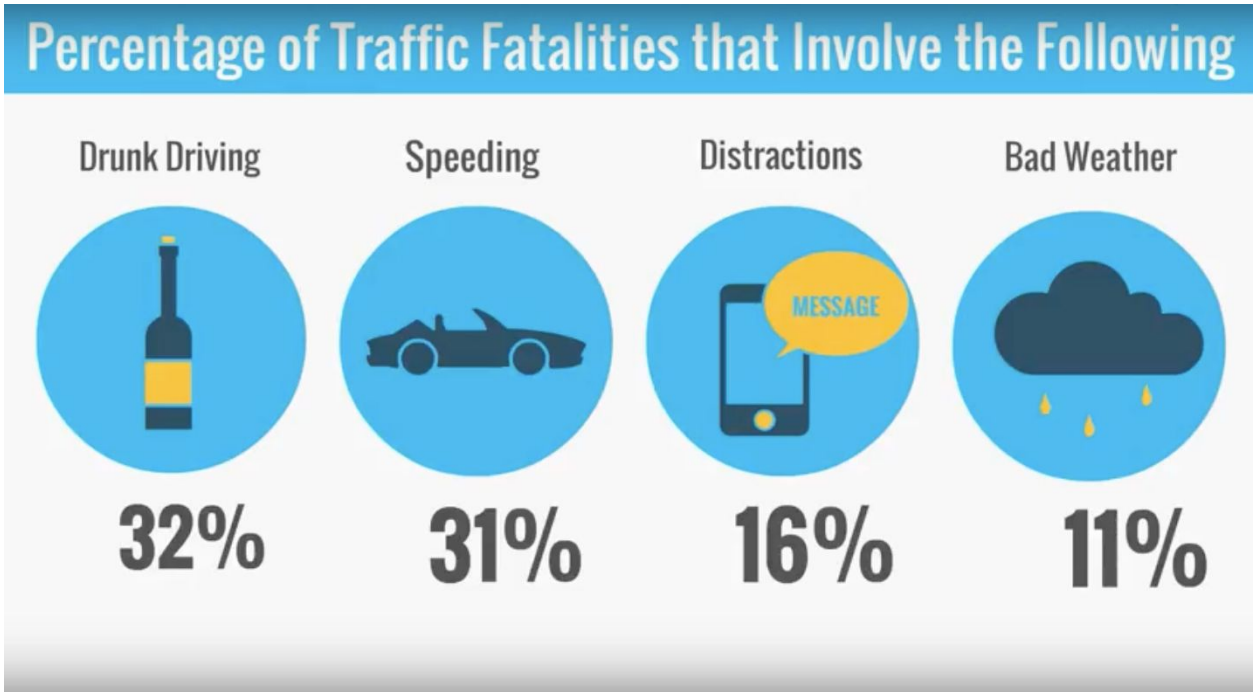
Avoiding Safety Gears like seat belts and helmets:

Use of a seat belt in a four-wheeler is now mandatory and not wearing a seat belt invites penalty, same in the case of helmets for two wheeler drivers. Wearing seat belts and helmets has been brought under law after proven studies that these two things reduce the severity of injury during accidents. Wearing seat belts and helmets doubles the chances of survival in a serious accident. Safety Gears keep you intact and safe in case of accidents. Two

wheeler deaths have been drastically reduced after use of helmets has been made mandatory. One should use safety gears of prescribed standard and tie them properly for optimum safety.

Delays in detecting accidents:

Delays in detecting and providing care for those involved in a road traffic crash increase the severity of injuries. Care of injuries after a crash has occurred is extremely time-sensitive: delays of minutes can make the difference between life and death. Improving post-crash care requires ensuring access to timely prehospital care, and improving the quality of both prehospital and hospital care, such as through specialist training programmes.



Brainstorming Ideas

- Cardiovascular diseases
- Drowsiness

- Driving while inebriated
- Overspeeding
- Business Model
- How to make everything cheaper?

Probable solutions

Monitor the driver's heart rate, facial expressions. Check for irregularities. Use of facial behaviour recognition software to identify tiredness. Use multitude of data to monitor driving patterns and distinguish between sober and drunk driving. Contacting nearby hospitals in the event of an accident. Send driver details. Self driving cars may drive themselves in case the driver has lost control. Monitor driving speed, compare with speed limit data, alert driver when overspeeding.

Sleep deprivation

Time monitoring the driver. Sensor to detect blood alcohol level and to compare to acceptable amounts. See driving patterns irregular movement of steering wheel, driver not driving straight. Facial image recognition to see blinking and head tilt patterns.

Monitor driver behaviour with camera. Facial recognition to check if the eyes are open. Check hand position on steering wheel. Monitor the driver over time for irregular acceleration

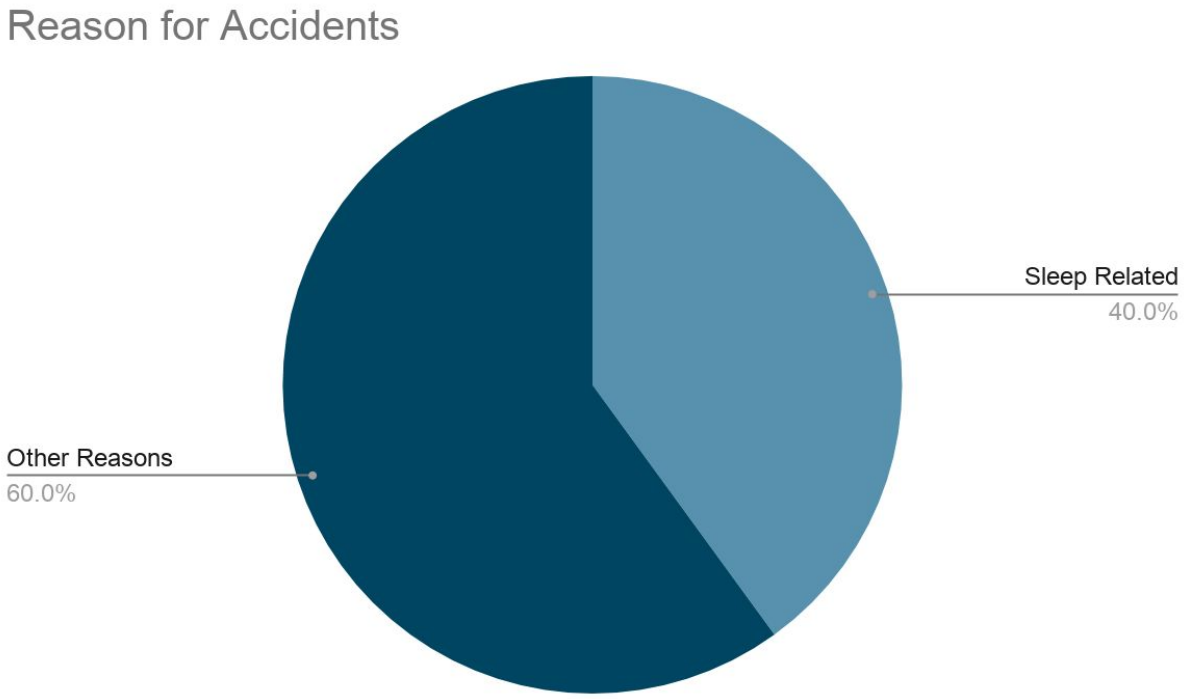
Alert systems as:

- Vibrate the steering wheel slightly to wake driver up
- Alarm to ring until driver wakes up and switches it off

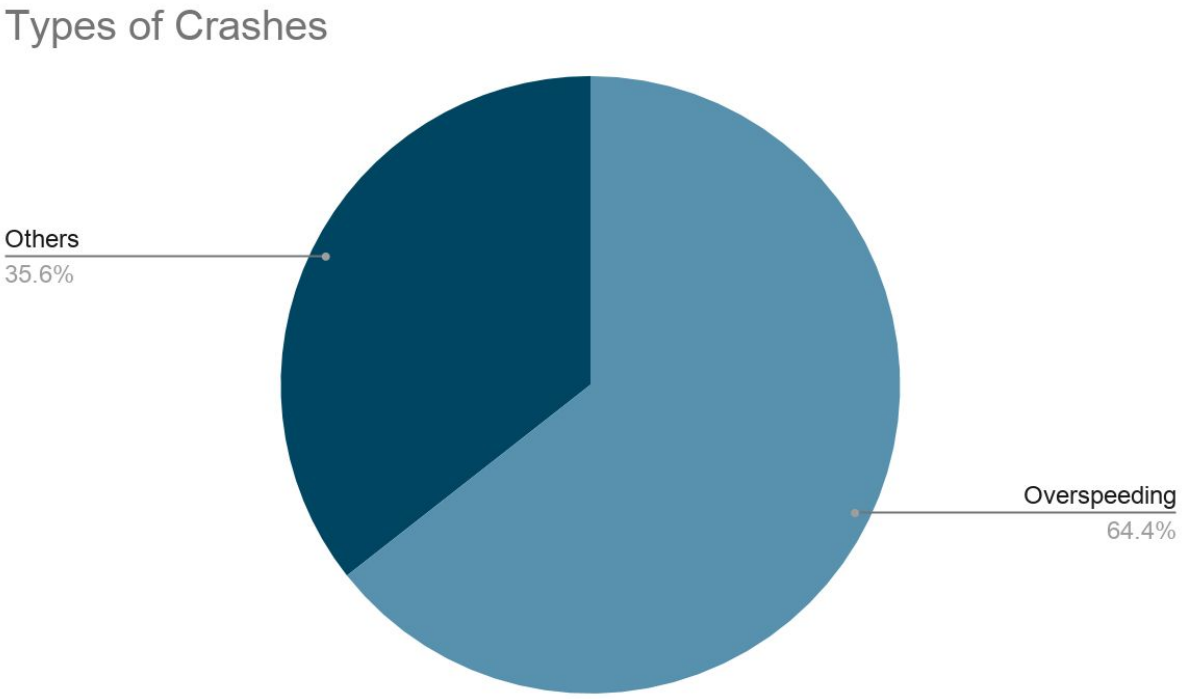
Over speeding

Accelerator restriction after reaching a certain speed. Speed limit provided by GPS used by the driver. Distance separation between vehicles using ultrasonic distance sensors. Use of ABS. Lane Departure checking to ensure the vehicle does not veer off course. Lane stability checking to check driving patterns are stable. Measuring erratic steering wheel movements can be incorporated as well.

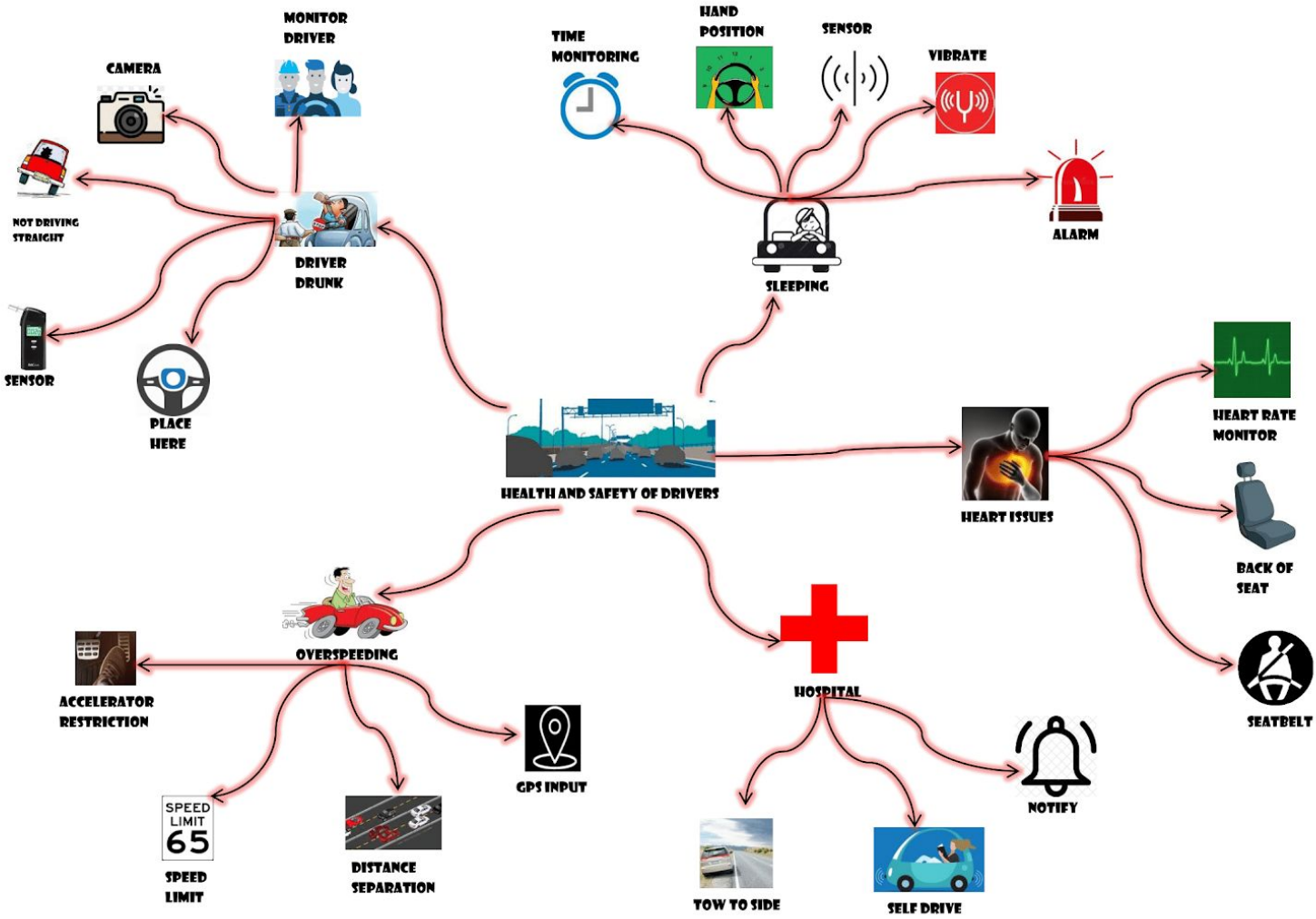
Experts recommend that adults should sleep for seven to nine hours a night yet many drivers still do not even get the minimum 7 hours of sleep. Lack of adequate sleep can affect judgment, mood, and ability to learn and retain information, and may increase the risk of serious accidents and injury. The estimated fraction of crashes due to insufficient sleep is close to 30%. Together with the fraction of motor vehicle crashes due to sleep apnea of 10%, this would raise the fraction of motor vehicle crashes due to sleep deficiency to 40% which is very high.



This is a major cause for accidents and it is not hard to see why. It is a major problem across the world especially in India. Around 3.19 lakh road accidents in India in 2019 caused by overspeeding: Govt. India accounts for about 5 lakh road accidents annually, one of the highest in the world More than 97000 people die due to accidents from overspeeding. A whopping 64.4% of accidents in India arise from overspeeding. It is a natural psyche of humans to excel but that needs to be curbed on the roads.


Types of Crashes
Others
35.6%
Overspeeding
64.4%

Our Mind Map


MONITOR DRIVER
CAMERA
NOT DRIVING STRAIGHT
DRIVER DRUNK
SENSOR
PLACE HERE
TIME MONITORING
HAND POSITION
SENSOR
VIBRATE
ALARM
SLEEPING
HEALTH AND SAFETY OF DRIVERS
HEART RATE MONITOR
HEART ISSUES
BACK OF SEAT
SEATBELT
OVERSPEEDING
ACCELERATOR RESTRICTION
GPS INPUT
SPEED LIMIT 65
SPEED LIMIT
DISTANCE SEPARATION
HOSPITAL
NOTIFY
TOW TO SIDE
SELF DRIVE

Our Solution

We identified critical issues that we had to tackle first:

- Minimizing accidents caused due to medical emergencies
- Recognising drowsiness patterns
- Identifying inebriation in the driver
- Designing appropriate alert and warning systems

An abnormal cardiac event can cause intense pain, loss of strength, consciousness, impairment of awareness. If a person suffers through this while driving they will lose control of their vehicle. leading to an accident. the lives of the driver, passengers and all people near the vehicle are endangered. if we can detect the symptoms we can prevent and minimize these accidents. We have two systems of monitoring the driver's condition.

1. Heart beat sensors to detect
2. Facial Recognition by way of a camera pointing towards the driver.

One possible emergency is a stroke. The most common sign of a stroke is a drooping of the face. A well trained image recognition model can detect this symptom before a human can. Every minute is of importance when treating a stroke. An early warning gives the driver time to slow/stop the vehicle before the stroke happens. Emergency services will be contacted automatically and given location and driver details improving response times which leads to increased chances of surviving for the driver.

Heartrate Monitors installed in your vehicle ensuring accurate detection of cardiovascular diseases

Through pattern recognition our facial recognition system can identify that the user is about to sleep. Additionally length of travel and time of day can be used as supplemental data to improve accuracy. Steering pattern and Vehicle position in lane monitoring is also done, erratic movements here indicate that the driver is not in condition to drive safely. All these combined will help us detect the state of the driver.

Drowsiness detection and sobriety checking using facial pattern recognition

We have two alert systems for warning the driver in case of detecting drowsiness. Haptic feedback warning and Auditory alarm warning. Initially on detecting drowsiness we vibrate the steering wheel which the user must turn off manually. This is an immediate process with minimal disruptions to not distract the driver during a false alarm. If there is no response from the driver we start an alarm. If the driver still does not respond and there is no change in the driver's state we begin safety measures consisting of contacting emergency services and if the vehicle has the functionality giving it instructions to stop safely.

Monitoring :-

Our project presents the design and implementation of vehicle tracking, monitoring, controlling and vehicle status (status about the engine, door and temperature) notification at anywhere by using mobile phone applications. The system consists of a Sensor-actuator module and communication module to acquire the input signals and control the vehicle functions and monitor the vehicle location by using GPS. To demonstrate the feasibility and effectiveness of the proposed system, vehicle doors, parking lights and side mirrors are monitored and controlled by the mobile phone along with vehicle tracking by using Google map and status notification for vehicle engine, temperature and door have been implemented and evaluated with vehicle.

Tiredness, sleep deprivation and drowsiness are a contributing factor to accidents as well. This is especially common in truck drivers. We wanted to create a cheap and easy way to notify the user when it senses they are sleepy and may allow the driver to rest. Lack of focus is the biggest obstacle faced by tired drivers and our device allows drivers to realize that they may not be in the best condition to drive and require rest.
We created multiple guidelines through which we will come to know if the focus of the driver is on the road or not. The first one is checking for the time interval between blinks or more commonly known as the blink pattern. A driver losing focus would have taken longer to blink than usual.
Second is observing the head tilt. When a driver loses focus he/she would want to rest his head along something. We can take a note of this change to know that such a condition is being asserted. Some other ways that can also be implemented are steering wheel accuracy. A person losing focus would have frantic steering.

We want to collect all this data and use this to generate results using ML models. This would surely not be completely accurate in the start but after months and months of data analysis we are sure that we can create a product which would be able to tell the person's current state accurately.

Another part of our idea is to handle collision detection. This part of our product is for people who drive on highways. When we drive on highways we need to maintain a minimum distance of approximately two cars. What we are trying to do is to use ultrasonic distance sensors and speedometers to analyze all the data. The ways we want to implement the collision preventer is to either slow down the car or provide a notification to the driver if he is too close to the car either on his back or front. This can really help in conditions where the driver could be saved.

In the unfortunate event of an accident, our device uses location tracking to identify the nearest hospital and send them the location of the driver. The accident is detected through a multitude of inputs, such as the driver's facial expression, sudden changes in speed, and collision detection. The driver's details are also sent to the hospital in order to provide the doctors with the medical information required to plan ahead and quickly save the patient's life.

Contacting :-

Road safety is an all-time global concern. Everyday a large number of human lives are lost due to accidents and delay in calling the rescue services. Over the past years improvements have been made and with the advent of smartphones, it is now possible to get the location of accidents using GPS. This will reduce the delay in providing the victim with immediate medical help. Even though there are new enhancements in the area of accident and/or fall detection there

is a need to focus on the integration part of all the above mentioned services for minimizing the delay in providing immediate help to the victim. We will develop an efficient system which takes sensory input from the surrounding environment and notifies the emergency service providers like hospitals and police stations about such events immediately using the concept of Internet of Things (IoT).

Quick Notification of driver location in the event of an emergency
Contacts nearest hospital and sends them driver medical details to ensure quicker response time

Advantages

- Modularity & scalability: We tried to create a system which was easily breakable into different parts with no individual parts being dependent on another. This would help us generate a good business model by providing customers the option to select and choose only the modules they require.

- Healthcare improvements: Our idea directly connects to the healthcare system for the nation, helping in increasing the access to healthcare and medical services where they might have been difficult to access in the past.
- Improving road safety
- Faster emergency services response: Due to automating the reporting system emergency services are alerted immediately. Location and status of the driver are sent so that response personnel can instantly jump to action.

Disadvantages

- False alarms may occur, potentially distracting the driver while they are driving. However, a series of checks have been implemented to ensure the driver can quickly and safely turn the alarm off, without causing a disturbance.
- The technology required to monitor a person's heart rate, and facial behavioural patterns is undeniably expensive. In order to provide quality technology that has been trained using machine learning and data science, we need high quality sensors and systems to ensure our customers are given quality technology that will actually make a difference in emergency situations. Thus, the cost of the product will be moderately, yet reasonably high.
- The time it takes to implement a device that can accurately read a person's facial expressions, identify a particular pattern, and obtain a conclusion based on the behavior of the person would be lengthy. We have to take into account that the more we train our model, the lower

will be the chances of producing false alarms. Therefore, an accuracy of greater than 85 percent would be required at the minimum before the device can be released commercially.

Difficulties faced

False Alarms

Since, it is a big project and many IoT sensors will be working on the process, there will be times when false alarms will be created. The chances can be reduced by performing in-depth testing of the system in every situation possible, even the rarest ones. Though, some loopholes can be left out, thus there will be a shutdown button near to the driver that will immediately stop the false alarm.

We were having issues related to how to measure the heart rate. We wanted to get the most accurate reading but this would need an entire ecosystem of products to go along with our product.

Reducing Cost

There is no point in developing an innovation that is not affordable for everyone. Reducing the making cost is one of the biggest difficulties that will be faced. So, the question arises how the cost will be reduced? Along with this, it will come as a boon to our nation if it will be developed in India.

The parts on themselves might be cheap but when combined with multiple systems throughout the car, the price of expanding increases exponentially.

We can develop our own sensors or devices for monitoring rather than getting it from outside. It can help us in reducing the cost and the product will be

“Make In India”. For example, for monitoring the vital signs, we can develop a sensor on the seat belt instead of collaborating with a MNC like MI or Apple for their smart watches.

Ensuring that our product is provided in multiple components, each serving a different purpose allows our customers to choose which functionalities they desire. It further reduces the cost of the product through modularity, offering affordability, as the customer does not necessarily need to buy all the components.