**Software Requirement Specification**

**1. Product/Project Overview**

Hundreds of accidents go unnoticed and unattended by the police all over the world. This is due to the absence of a mechanism, which can notify all the concerned authorities such as the police, nearest hospitals, insurance agents. Things haven’t changed much in the context of accidents in the last few decades.

Our product is *Accident Detection Kit,* which has many sensors, each dedicated to the sensing of certain parameters which help in the detection of accidents. The kit has a Raspberry Pi as System on Chip (SoC) and some of the sensors such as Vibration or Shock sensors, Tilt sensors, Fire and Smoke sensors, Pressure sensors etc.

On the occurrence of accident, the location of the vehicle is tracked in terms of latitude and longitude using *GPS Module*. The nearest police station and hospital is identified and the location value is sent to them so that they can timely arrival of help can be ensured. The GSM module sends notification to the concerned authorities. An android application eases the process of sending the notifications to the hospitals and police station in case of failure of *GSM module* sometimes. The *AWS* cloud is deployed to collect the data from the Raspberry Pi, implements the data analytics modules and notify. They are provided with a web interface where they can choose the options to generate the reports. Reports are generated weekly as well as monthly and are sent to the respective authorities for further actions using automated e-mail system.

**2. External Interface Requirements**

a. **User Interfaces**

*i. Web Interface*

The following Web Interfaces will be created as a part of this project:

1. *For Hospital Staff:*

* The hospitals located in the vicinity will get immediate notifications about an accident.
* They have to make sure that the doctors and resources are available and send a response back as soon as possible, so that the ambulance drivers are notified.

1. *For Insurance Companies:*

All accident details and logs will be maintained on this website, which will act as proof in order to avail insurance.

1. *For police Inspectors, Ambulances, Hospitals, Cab Companies, Schools, NGO’s and other interested organizations:*

* All statistics about accidents, such as the most prone areas, most common reason for the accident, most affected age groups, etc. are provided on this website on this website for all the relevant organizations.
* The trends for a given time periods will also be displayed.
* All details will be updated in real time. The statistics can be viewed for different time durations, such as daily, weekly, monthly, quarterly, half yearly, yearly, whole history.
* However, to ensure privacy and prevent misuse of data, there will be different access rights for each type of user.

ii. *Mobile Interface:*

The following mobile interfaces, in the form of android app will be developed in this project:

1. *For traffic police staff:*

The following 2 functionalities are implemented:

* Get the location of the accident immediately, as a pop up notification
* User friendly form to log all possible details about the accidents.

1. *For ambulance drivers:*

* The ambulance drivers located closest to the accident spot will get immediate notifications of the accident.
* If the driver is available and can reach the spot without delay, he can send his confirmation.
* He’ll get a notification about which hospital is the closest and has its doctors on stand -by to attend to the accident victims.

The app will be later extended to other platform such as iOS, Blackberry, etc.

iii. *Emails*

Automated emails will be sent to the Traffic Police Inspectors and Sub Inspectors *periodically*, that is, weekly, monthly, quarterly, half yearly and yearly. This will help them make better decisions in deploying their manpower and utilizing their resources. The mails will contain informative maps, graphs, pie charts which will highlight the most severe issues to be tackled. It’ll also contain the website link to get the detailed analysis.

b. **Hardware Interfaces**

Our project has the following hardware interfaces:

1. *Interfacing the Sensors and SoC:*

We have written code in Python to periodically get sensing information from the various sensors.

1. *Interfacing the SoC and Cloud:*

We make use of the ‘Nimbus’ platform.

c. **Software Interfaces**

*i. Operating System*

The Raspberry pi runs a ***Raspbian OS*.**

The AWS cloud server runs an ***Ubuntu OS.***

*ii. Web Server*

The software is being designed to run on ***Apache*** ***Web Server.***

*iii. Database*

We make use of ***MySQL*** Database for storing and querying our data.

*iv.Page Layout Tools*

For the web pages we plan to use twitter ***Bootstrap 3*** to ensure that are pages are responsive and mobile friendly.

*v. Data Visualization Tools:*

To provide an informative and comprehensive dashboard, containing bar graphs, pie charts, city maps, etc. to illustrate various stats, we plan to make use of ***Tableau*** tool.

*vi. API’s*

We make use of ***Google Map API*** to get the location details.

d. **Communication Interfaces**

Our project shall use the HTTP protocol for communication over the internet. It makes use of GSM technology for communication between SoC (Raspberry Pi) and Cloud Infrastructure (AWS).

**3. Functional Requirements**

Functional Requirements are the description of the facility or feature required. Functional requirements deal with what the system should do or provide for users. They include description of the required functions, outlines of associated reports or online queries, and details of data to be held in the system.

The functional requirements for our project are as follows:

**3.1 Detection of Accidents**

The detection of the accidents is done by placing the kit in the vehicle. The part of the vehicle to set the kit up depends on the place where the measurements of the required parameters can be done precisely. The sensing of the accidents is done by using the following sensors:  
  
a) The accident is detected using *Vibration Sensor* which senses vibrations. During the normal running of vehicles, the magnitude of vibration will be lesser in comparison to that of the vibration in case of accidents.

b) The *Tilt Sensor* will measure the orientation of the vehicle with respect to the ground. Usually when the accidents occur, the vehicles aren’t in the normal position as they run on the roads.

c) The *Fire Sensor* will sense the presence of fire or smoke caused due to the burning of fuel.

d) The *Pressure Sensor* will sense the amount of force with which the collision has taken place. This can be used to determine the severity of the accident. The accident would be generally more severe when the value of force/pressure applied during the collision is high.

**3.2 Storing in the Cloud**

The data generated from the sensors are collected in the cloud. AWS is used for the same. Further, data analytics is performed on the data stored in the cloud to analyze the behavior of accidents and uncover the trends it follows.

**3.3 Notifying the nearest Police Station**

The nearest police station can be tracked and the vehicle number, latitude and longitude will be sent to them. This will make sure that every accident is attended by the police and gets registered. The analysis will help in identify the areas which are very prone to accidents. This will help in the dynamic assignment of police, so that more number of police can be present near the areas which are more prone to accidents.

**3.4 Notifying the nearest Hospital**

The GPS Module can track the location of the vehicle in terms of latitude and longitude. The nearest hospital will be identified and the location value will be sent to them so that they can send their ambulance. The identification of the most prone areas will be done by the analysis. Further, the ambulances can be suggested to always be nearby some of the prone areas to reduce the time it takes for the ambulance to reach the accident spot.

**3.5 Determine the suitable place for relocation/construction of Schools / Hospitals**

The identification of the most prone areas will be done by the analysis. We can help the upcoming schools and colleges to choose a site for construction or relocation with least amount of traffic to make sure that the number of deaths caused due to the presence of schools in the prone to accident areas gets reduced.

**3.6 Obtaining Confirmation**

The Android app lets the ambulance driver, police and the hospital people confirm their arrival to the spot. Under circumstances when they don’t confirm it for some reasons, other options would be searched for such as trying to contact the second nearest hospital or police station.

**3.7 Sending mails to the Police Station**

The web interface can be used by the concerned person in the police station to generate and display the accident reports in an interactive manner. The interface also lets the user choose the options for the generation of the reports. The weekly and monthly reports are mailed to the concerned person for planning and strategizing things in a better way.

**3.8 Data Analytics Aspects**

The huge data collected from the vehicles using the sensors are analyzed by using data analysis concepts and certain predictions are done using the machine learning techniques. The decision tree algorithm could be used to determine the severity of the accidents. The clustering algorithms could be used to obtain better insights. The mispredictions could be minimized by using pruning techniques to trim the levels of the decision tree and produce optimum results.

**4. Software System Attributes**

**4.1 Reliability**

Reliability is the ability of a system to continue operating in the expected way over time. Reliability is measured as the probability that a system will not fail and that it will perform its intended function for a specified time interval. The key issues for reliability are:

* The sensors and board crashes and becomes unresponsive.
* The system fails due to unavailability of other externalities such as systems, networks, and cloud access.
* Log performance and auditing information about accessing the accurate geographical location and inform the nearest police station, hospitals and other services

**4.2 Availability**

Availability defines the proportion of time that the system is functional and working.   
Availability will be affected by system errors, infrastructure problems, malicious attacks, and system load. The key issues for availability are:

* A physical tier such as the cloud server or application server can fail or become unresponsive, causing the entire system to fail.
* A network fault or the low bandwidth internet can cause the application to be unavailable or slow down the response time.
* Inappropriate use of resources can reduce availability.

**4.3 Security**

Security is the capability of a system to reduce the chance of malicious or accidental actions outside of the designed usage affecting the system, and prevent disclosure or loss of information.

* Use authentication and authorization to prevent spoofing of user identity. Identify trust boundaries, and authenticate and authorize users crossing a trust boundary to access the cloud data
* Damage caused by malicious activity such as DOS attack, cross-site scripting and infiltrate the sensitive data stored in cloud

**4.4 Portability**

Portability is the usability of the same system in different environments. The prerequisite for portability is the generalized [abstraction](https://en.wikipedia.org/wiki/Abstraction_(computer_science)) between the application logic and [system interfaces](https://en.wikipedia.org/wiki/Interface_(computer_science)). When software with the same functionality is produced for several [computing platforms](https://en.wikipedia.org/wiki/Computing_platform), portability is the key issue for development cost reduction. The key issues are:

* The Android/ios app should work in all the environments like Linux or windows
* The Source code should give the same accurate results in all the running platforms

**4.5 Maintainability**

Maintainability is the ability of the system to undergo changes with a degree of ease. Maintainability affects the time it takes to restore the system to its operational status following a failure or removal from operation for an upgrade. Improving system maintainability can increase availability and reduce the effects of run-time defects. There are measures by which the quality of a design of modules and their interaction among them can be measured. These measures are called coupling and cohesion.

**4.6 Performance**

Performance is an indication of the responsiveness of a system to execute specific actions in a given time interval. It can be measured in terms of latency or throughput. Latency is the time taken to respond to any event. Throughput is the number of events that take place in a given amount of time. An application’s performance can directly affect its scalability, and lack of scalability can affect performance.

**5. Performance Requirements**

The system must be very interactive and the delays involved must be very less. So, in every action-response of the system, there are no immediate delays experienced by the system or user.  
In case of opening or accessing the cloud, searching the nearest hospital/ police station, popping error messages and saving the settings or sessions there is very minimal delay.  
In case of opening databases, sending mails/SMS and analyzing there are no delays and the operation is performed. When connecting to the cloud server the delay is based on the bandwidth speed and the configuration between the systems. The probability that there will be or there will not be a successful connection in less than the timeout period should be less for sake of good communication.

Information transmission should be securely transmitted to server without any changes in information

As the system provides the right tools for discussion and problem solving, it must be made sure that the system is reliable in its operations and for securing the sensitive details stored in the cloud.

**6. Database Requirements**

We would require a consistent and normalized database for the system. The database will be stored in the cloud for easy and secure access.

We have the following tables:

**Vehicle\_Data**

|  |  |  |
| --- | --- | --- |
| Attribute Name | Attribute Type | Attribute Size |
| VehicleID | String | 30 |
| Make | String | 10 |
| OwnerName | int | 10 |
| Specification | String | 30 |

**Sensor\_Data**

|  |  |  |
| --- | --- | --- |
| Attribute Name | Attribute Type | Attribute Size |
| Type | String | 30 |
| Analog\_Output | int | 10 |
| Digital\_Output | int | 10 |
| Specification | String | 30 |
| State | String | 2 |
| VehicleID | String | 10 |

**Accident\_Data**

|  |  |  |
| --- | --- | --- |
| Attribute Name | Attribute Type | Attribute Size |
| AccidentNo | String | 30 |
| AccidentDate | date | 10 |
| AccidentTime | String | 10 |
| AccidentType | Int | 1 |
| PoliceAttended | Int | 1 |
| VehicleID | String | 10 |
| SpeedZone | Int | 3 |
| Longitude | float | 10 |
| Latitude | float | 10 |
| TotalPerson | int | 2 |
| NoOfVehicles | int | 2 |

**Accident\_Type\_Data**

|  |  |  |
| --- | --- | --- |
| Attribute Name | Attribute Type | Attribute Size |
| AccidentType | int | 2 |
| Specification | String | 30 |

**Ambulance\_Data**

|  |  |  |
| --- | --- | --- |
| Attribute Name | Attribute Type | Attribute Size |
| Amb\_ID | String | 10 |
| Address | String | 30 |
| Longitude | float | 10 |
| Latitude | float | 10 |
| Phone | String | 10 |

**Police\_Data**

|  |  |  |
| --- | --- | --- |
| Attribute Name | Attribute Type | Attribute Size |
| Police\_Station\_ID | String | 10 |
| Address | String | 30 |
| Longitude | float | 10 |
| Latitude | float | 10 |
| Phone | String | 10 |

**4.7 Design Constraints**

One of the major constraints is that the system is prone to damage during accidents and thus we have to design in a way that it can tolerate the damage caused in accident. To overcome this we can place the system in secured way. We would also require sensors with good sensing ability to eliminate false accident alerts.

Another constraint would be connectivity. The device should always be connected to network to give alert signals to desired teams assigned. So we have to use good network providers and devices.

The notification alerts given on app should be quick enough to reduce the damage caused due to accidents.

**4.8 Other Requirements**

* Good connectivity.
* 24 X 7 availability.
* Good components and better design to produce effective results.
* Better UI to make it more user friendly