A Study in Fall

Can a tumble save lives?

By

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A STUDY IN FALL

A

MAJOR PROJECT SYNOPSIS

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Abstract

The purpose of my project was to model how a certain change in posture of a human body, can be used to determine the ambiance, and thereby working accordingly. Similar tests are used by car manufacturers to signal the airbags to inflate when needed. In testing, subject was regulated to conditions that can result in harm, under laboratory conditions.

The research is named under the line, 'A Study in Fall', Where the whole study is concentrated during the fall/jerk/accident of the user. The data gathered and assessment that works for is done inside the event. Hence the name, a study 'in' fall, rather than 'on' or 'of'. The research/project has been escorted/guided with the help of two professional doctors. Hence the correctness of the study is in favor of us.

I conducted several experiments using myself, and some few volunteers. I further added the knowledge of statistics to determine a pattern in the data. For each experiment, subject has to undergo a fall, or an unexpected anomaly in motion. Further refining of data using R processing, gave a clear window. Detailed study and whole story has been revealed on the inside of the book.

The practical implementation aka the project is named, 'Helpr'. This is a cell phone application, that works under the climactic part of any accident. Basically the provision of this application work under a very delicate situation when the life of a user hangs in balance, literally. It being a post alarming application activates its procedure after any calamity happens, though it runs always in the background as a service to the phone. With having just a tiny bit of overhead charge for the battery or processing, which is closely negligible.

The algorithm is subject to change/update in accordance with future experiments. I initially used the upper bound function, which after a few trials is captured in a window(stated inside). This whole experimentation and real-time data, helps in creation of the application from dust.

Further, the structuring and coding part is done under android environment with java as the primary language, this was chosen as it being popular at the time of its creation.

DEDICATION AND ACKNOWLEDGEMENTS

This dissertation is dedicated to sole idea of using this intent to make world a better place.

This project/research was supported/partially supported by anonymous funding, though menial. We thank our colleagues from *Sagar Group of Instituion* who provided insight and expertise that greatly assisted the project/research, although they may not agree with all of the interpretations/conclusions of this paper.

We thank *Dr. Alankar Sahu* for assistance and methodology, and *Dr. Shruti Iyer* for comments that greatly improved the manuscript.

Nevertheless, we express our gratitude toward our families and colleagues for their kind co-operation and encouragement which help us in completion of this project. We are also immensely grateful to their comments on an earlier version of the manuscript, although any errors are our own and should not tarnish the reputations of these esteemed persons.

AUTHOR'S DECLARATION

I declare that the work in this dissertation was carried out in accordance with the requirements of the University's Regulations and Code of Practice for Degree Programmes and that it has not been submitted for any other academic award. Except where indicated by specific reference in the text, the work is the candidate's own work. Work done in collaboration with, or with the assistance of, others, is indicated as such. Any views expressed in the dissertation are those of the author.

We hereby declare that the Project synopsis entitled "*A study in fall*" is our own work, conducted under controlled conditions and obligatory supervision of the guides at Sagar Institute of Research and Technology, Bhopal.

Any use of the system/code/algorithm/methodology/concept, without the consent of developer should be considered as an intellectual theft or threat to it.

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SIGNED: .....ABHINAV SINGH- 0133IT111003..... DATE: .....

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CHAPTER 1

INTRODUCTION

We live in a terrible little world, chaos and order hang in balance. People tend to think as there are no strings attached to them, but reality is a bitter truth.
In the words of Ultron " *I'm gonna show you something beautiful. You want to protect the world, but you don't want it to change. You are all puppets, tangled in strings,strings.* " With that being said, it is time to adapt or evolve, and the former one just made it through the narrows of bits and bytes to world of scripts and christ.

1.1 Objective / Purpose

Imagine a world, where the care could reach the needed in time, thereby affecting the living to mortality ratio in a positive sign. Chaos and order, as listed above are just the way of saying life and nature; unpredictable. While making this application, we were clear to ourselves that nature can't be tamed, what can be controlled is its aftermath. It is more of a follow-up system than a preventive one. Thus, it is safe to say that it is a causal system.

1.2 Problem Definition

The main system that stretches us out of the comfort was the matter of human safety. We had seen many development in categories such as women safety, health-care, and others. But what was critical was still missing out, leaving the needed to bite the dust.
Our main concern was not bigoted, but was generalized to prevent the life-threatening injuries to actually threaten the lives.

(...)Suppose, a scenario were a human is left hurt, unconscious and alone, that's where this application comes to rescue.

1.3 Practicality

The assistance of this algorithm ranges from everyone to everywhere, it is just like a personal insurance in a pocket, but added, it can actually help and save you.
Presenting *'Helpr!'*

FIGURE 1.1. Launcher icon of the application.

This here, is the implementation of the idea, the buzz of the talk. A mobile phone application, that tracks the human activity to sense the user's real time behavior. Thereby ensuring the user's health at all time.

· **q1** Why mobile app? Because, in this modern scenario, the only thing that a man never forget to have is his phone.

· **q2** Is it effective? Yes, as in terms of sensors, it uses the most rudimentary one, that every phone have. (Had since days)

· **q3** Is it cost-effective? Of course, A phone only cost a few thousand bucks, additionally this application has been provided for free.

· **q4** Course of action? Detailed study inside.

1.4 Technologies Used

For this project to incarnate a mold was needed, and that mold was found in everyone's pocket.

1.4.1 Software Requirements

· **s1** An OS - Android and Windows.

· **s2** Java RE.

· **s3** Eclipse juno.

· **s4** Android 2.1 or later.

1.4.2 Hardware Requirements

For this to work, we needed all these listed items, and to our surprise they all come bundled in, a smart-phone**

· **h1** Accelerometer.

· **h2** Gps.

· **h3** Internet. *

· **h4** Gyroscope. *

· **h5** Sim.

· **h6** Memory.

· **h7** Human. *

· **h7** A server station. *

*Optional; The more the merrier.

**Term used to denote a phone that has the least of listed item and supports parallel processing.

CHAPTER 2

RESEARCH

For a project to sustain, there has to be some hard work done on it, that describes it. That background work has been listed in here.

Research comprises “creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of humans, culture and society, and the use of this stock of knowledge to devise new applications.”

2.1 Introduction

Research in this dissertation is done on newtonian physics, that deals with gravity(mainly). Here earth’s gravity has been removed for true acceleration value, by the formula.

$$
\begin{aligned}
gx &= 0;\\
gy &= 0;\\
gz &= 0;\\
alpha &= 0.9;\\
gx &= alpha * gx + (1 - alpha) * x;\\
gy &= alpha * gy + (1 - alpha) * y;\\
gz &= alpha * gz + (1 - alpha) * z;\\
x &= x - gx;\\
y &= y - gy;\\
z &= z - gz;
\end{aligned}
\tag{2.1}
$$

2.2 Recorded Data

The data provided are the Accelerometer Values.
The interval per data is of 30milliseconds.
The data recorded is done by:
Sensor vendor: Bosch Sensortec GmbH*.
Name: BMA150 accelerometer. Type: 1. Version : 1
Range 9.81 m/s^2
For the sake of briefness, the graph has been stacked/clustered, as the sample space consists of 1901 record entries.
X-axis denotes time, Y-axis denotes acceleration.

*Gesellschaft mit beschrankter Haftung- German for “company with limited liability”

FIGURE 2.1. Graph depicting rest.

This state of rest is measured, when the phone is placed on a table, without any disturbance, (angle of placement doesn't matter.)

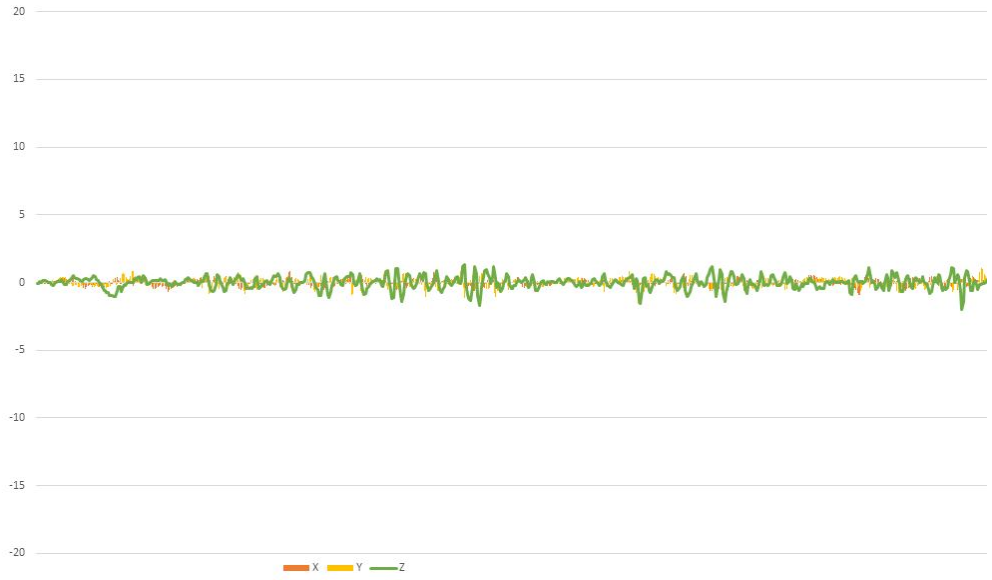

FIGURE 2.2. Graph depicting a walk/normal walk.

This state of motion, depicts a user to have a walk around the work-room/house with the device in either hands or in the pocket.
Though there would be an extended curve when placed inside pocket, but that is within the threshold value.

FIGURE 2.3. Graph depicting a fall.

This state of fall, is measured in controlled condition, when the user has a phone with him, and the user undergoes a jerk in motion, the extremities which are shown here are the data of need. There is a pattern in fall.

2.3 Fall pattern

There is a certain pattern, a uniformity in fall. If seen at the sample space, one can find that the acceleration suddenly increase. But if seen more precisely, then it is clear, that there is a lot of things going on.

An accident or a mishap, or the counter for our action, generally comprises with a free-fall. This free-fall, has a the following shape in the respective domain. Which is similar to the data been recorded.

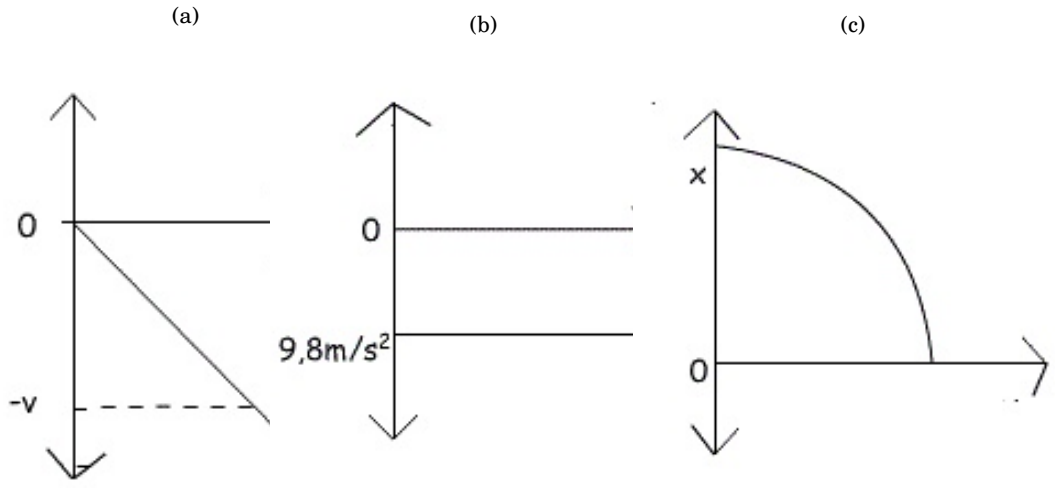

FIGURE 2.4. (a) Graph of Free-fall in terms of velocity/time. (b) Graph of Free-fall in terms of acceleration/time. (c) Graph of Free-fall in terms of position/time

2.4 Jerk Pattern

In addition to this free-fall, another counter that sets it off is the sudden deceleration. We follow the pattern as:

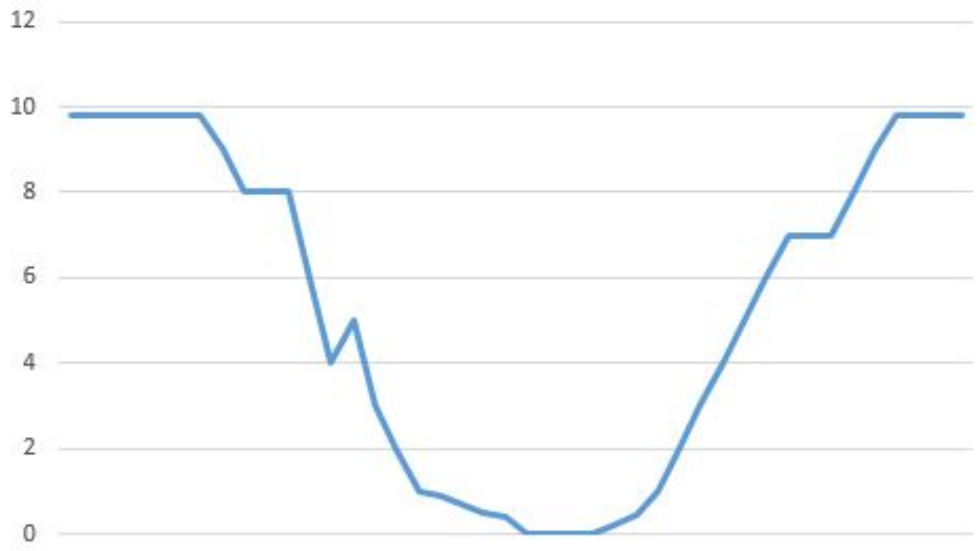

FIGURE 2.5. Graph for jerk in gravitational acceleration.

FIGURE 2.6. Graph for jerk in acceleration.

This pattern sets the trigger for our response system. Though this finding acts as an upper-bound for the actual act. More processing and data-refinement needs to be done, and is under processing.

CHAPTER 3

SOFTWARE REQUIREMENT SPECIFICATIONS

Any thing that happens in the world, should have a print on paper, to actually happen. This is the modern day analogy of the world; paper.
With that being said, A software requirements specification (SRS) is a description of a software system to be developed, laying out functional and non-functional requirements, and may include a set of use cases that describe interactions the users will have with the software.

3.1 Introduction

Here we move ahead from the general description to read out the more erudite terms.

3.2 Overall Description

An application that deals with the safety of the user, in conditions which are not regular for the user to have. This term is useful when the user under certain circumstances is unable to provide a signal for help to its contacts. This automated process does that for you.
Possible scenario is when, the user has lost consciousness towards the outside world. And what accompanies that is a distressed fall, or loss of balance of the user.
Procedure it follows is listed in chapter-5

3.3 System Feature

This application system, list out some environment variable, which are listed in the 'Manifest.xml' file.
It uses the min-sdk of 7.(Android 2.1.x - Eclairs)

While being targeted for sdk 19. (Android 4.4 - Kitkat)
It requires certain permissions such as:

· **p1** READ-PHONE-STATE

· **p2** ACCESS-FINE-LOCATION

· **p3** INTERNET

This system consists of 8 layout.xml and 14 classes.java:
CLASS.JAVA :

· **c1** SplashActivity *

· **c2** Register *

· **c3** RegProfile *

· **c4** RegWalk *

· **c5** RegShake *

· **c6** MainActivity *

· **c7** EditPreference

· **c8** Meter *

· **c9** BackBroad

· **c10** BackSense

· **c11** DisplayHelp *

· **c12** GpsTracker

· **c13** GetGps

· **c14** CallReceive

*These classes, have an activity layout for them.

3.4 System Models

To explain the working of this system, we are going to need the help of a few model and a scenario.

3.4.1 Scenarios

We consider the scenario for the modals that follows to be, the one when user, is casually walking and suddenly has slipped and fell through stairs, and has lost consciousness. Considering, the user is still alive.
User still has the phone is its pocket.
There is no one else to help.
Network of both, gps and gprs is reachable.

3.4.2 Software Development Model

In the development of this project. We have adopted a combination of Incremental and Iterative model.

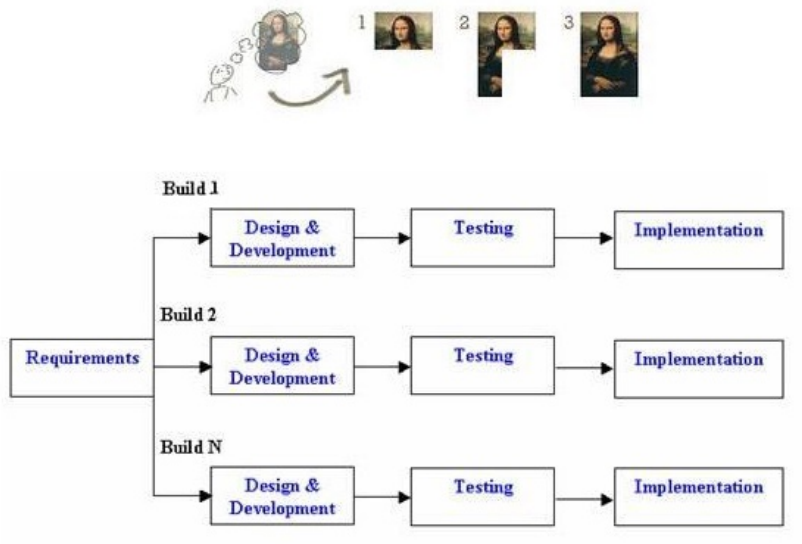

FIGURE 3.1. Incremental model.

Which in unison says, that at every build of incremental model, iteration follows.

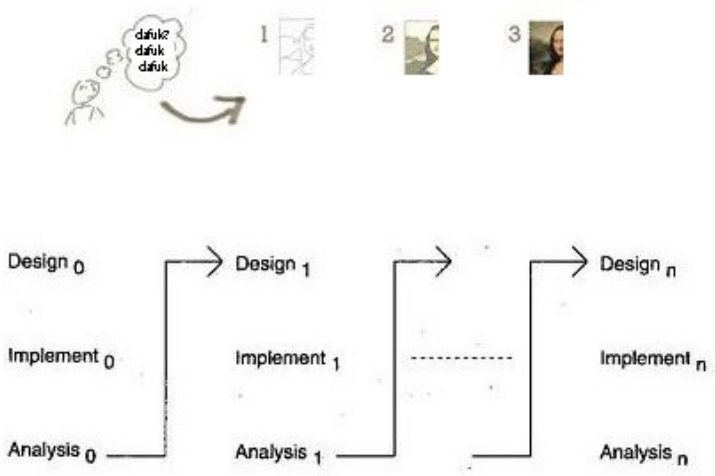

FIGURE 3.2. Iterative model.

3.4.3 Use Case Model

This model describes the user interaction with the system.
A use case is a list of steps, typically defining interactions between a role (known in Unified Modeling Language (UML) as an "actor") and a system, to achieve a goal. The actor can be a human, an external system, or time.
In systems engineering, use cases are used at a higher level than within software engineering, often representing missions or stakeholder goals. The detailed requirements may then be captured in Systems Modeling Language (SysML) or as contractual statements.

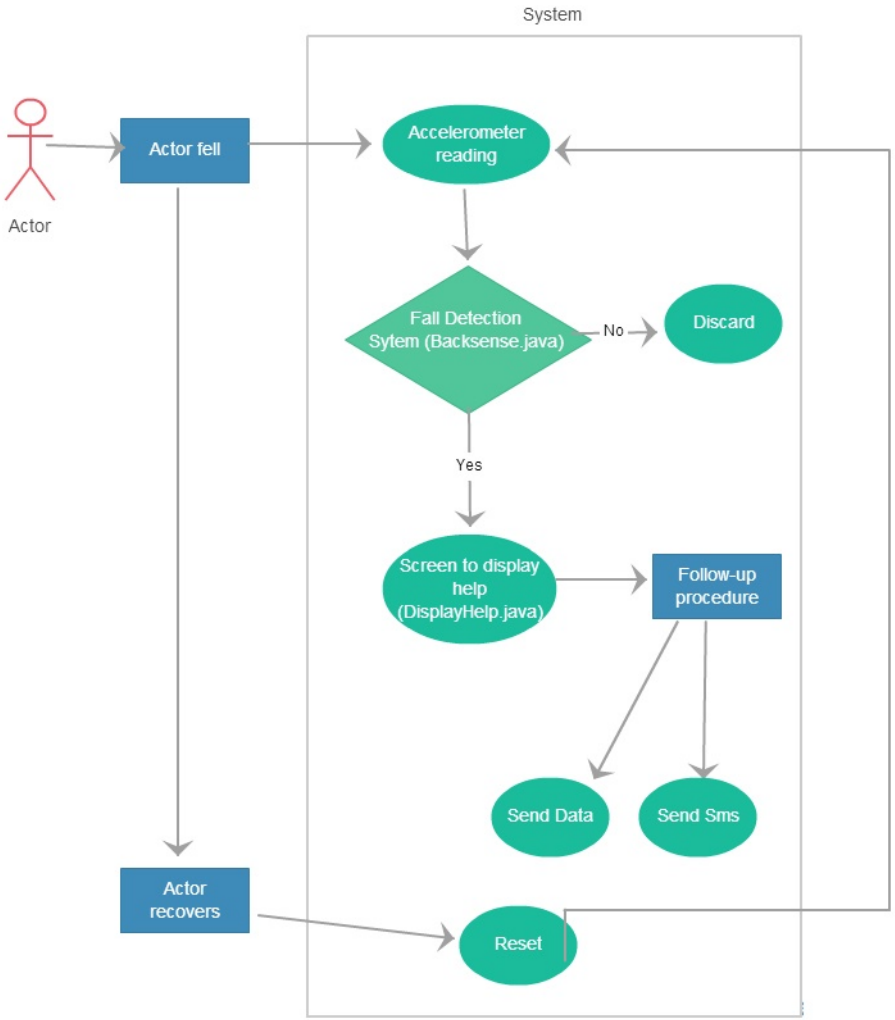

FIGURE 3.3. Use-case model.

3.5 External Interface Requirement

According to Richard Thayer, "External interface requirements specify hardware, software, or database elements with which a system or component must interface...."

3.5.1 User Interface

The 'Helpr' has no direct human user interfaces once it is initiated. All human interaction with application is managed by the Android background services and background listeners.

Though at the time of installation, a few GUI interaction sessions are there.

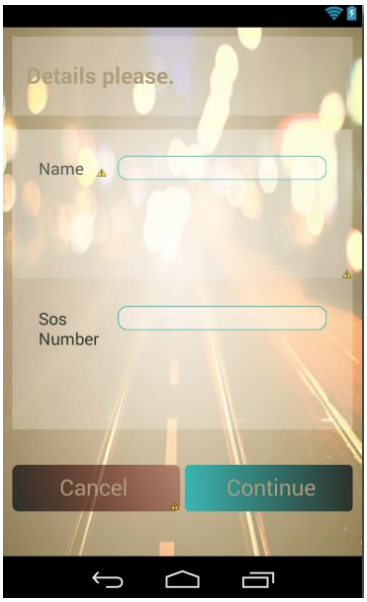

FIGURE 3.4. Screen-shot of Registration page.

Here the user register itself, by providing a their own name and a contact number, they wish to make the sos-number.

FIGURE 3.5. Screen-shot of profile selection page.

Here the user selects its profile, depending on certain clauses, listed in chapter-5.

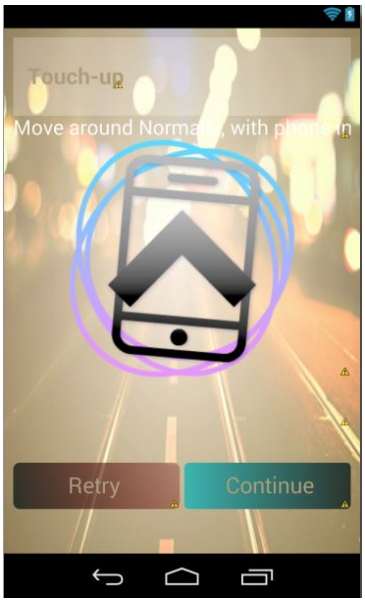

FIGURE 3.6. Screen-shot of physical activity(walk) page.

Here user does a physical interaction session, 'a walk with a phone', if it pleases you. So as to gather the base-line of the user's activity.

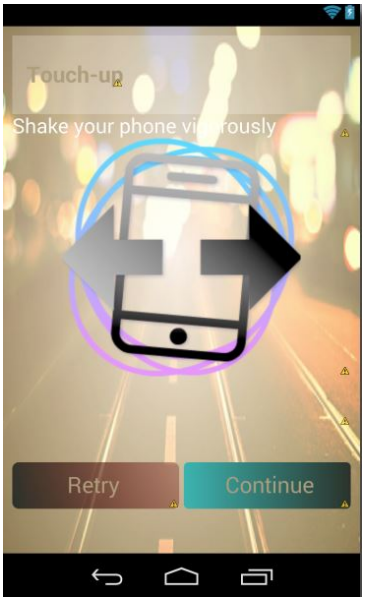

FIGURE 3.7. Screen-shot of physical activity(shake) page..

Here the user shake the phone, so as to have the maxima of the sensors.

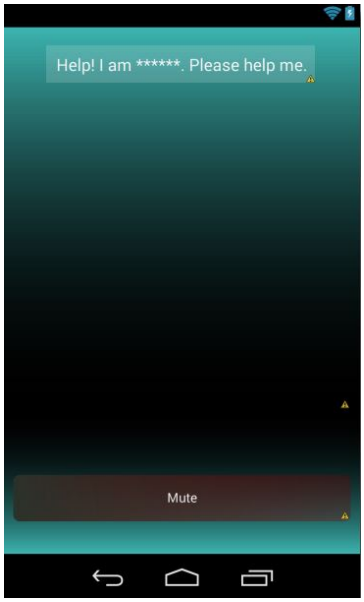

FIGURE 3.8. Alert page.

This is the alert page, which is only visible to user when triggered by human behavior, that the application considers as alarming or not-normal, (falling or getting in an accident).
The button at bottom is used to reset the sensor and halt the ongoing process, as listed in chapter-5.

3.5.2 Hardware Interface

This flow-chart defines the data flow and interactions that occurs between the hardware and software.
We have used:

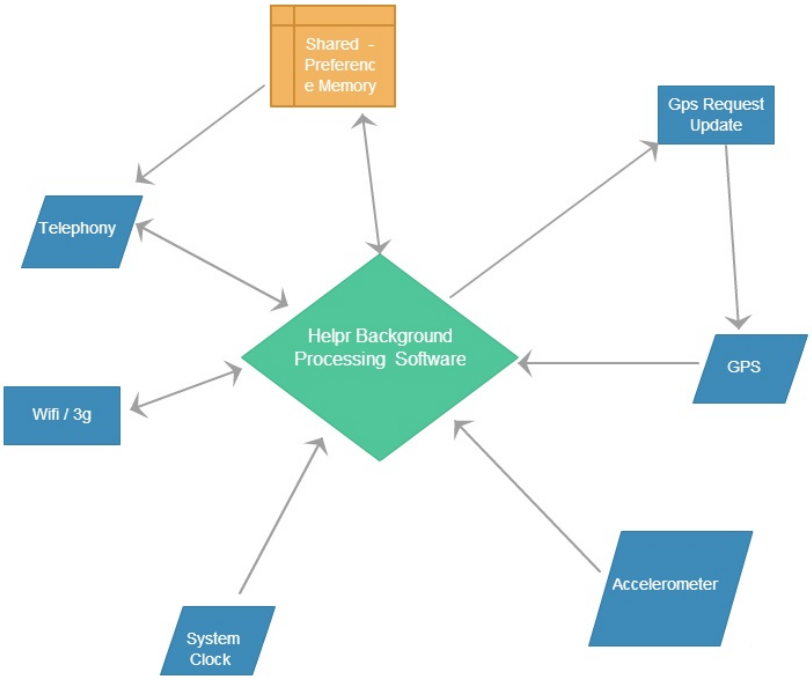

FIGURE 3.9. Hardware Interaction.

· **d1** Accelerometer: To track the vector movement.

· **d2** GPS: To track the scalar movement on globe.

· **d3** SharedPreferece Memory: To store and retrieve data.

· **d4** Telephony: To call and receive.

· **d5** Network module (cellular/wifi): To send/receive data to server.

· **d6** Clock: To have the current system clock.

3.5.3 Software Interface

This system uses the Android 2.1 or later operating system. Any earlier version is not suppported by this. In system data is stored and fetched via Sharedpreference memory. As being the data in smaller quantity, it is much faster and light-weight way of fetching it.
Global data key are (private):

· **g1** isSplashEnabled : Splash-screen.

· **g2** isRegistered : Registered.

· **g3** helprname : Name of user.

· **g4** helprnumber : Sos number.

· **g5** helprlat : latitude of accident.

· **g6** helprlon : longitude of accident.

· **g7** helpralertactive : Accident occured.

· **g8** HelprDataFile : Private keyword to access the data.

On server-side, a general wamp-server like arrangement is provided to store the data. This data insertion is done by a php web service, created just for the system.

3.5.4 Communication Interface

This system currently uses two types of communication,
SMS : Here the message is sent to the sos number in the following format.

$$Help!Iam\textbf{\textit{user-name}}.Ineedyourhelp.Iamat(approx) \tag{3.1}$$

$$Lat : \textbf{\textit{latitude}} \tag{3.2}$$

$$Long : \textbf{\textit{longitude}} \tag{3.3}$$

$$Comegetme! \tag{3.4}$$

INTERENT : a simple http-post is sent, in 'AsyncTask'. with name, phoneNo, lat, long, date.

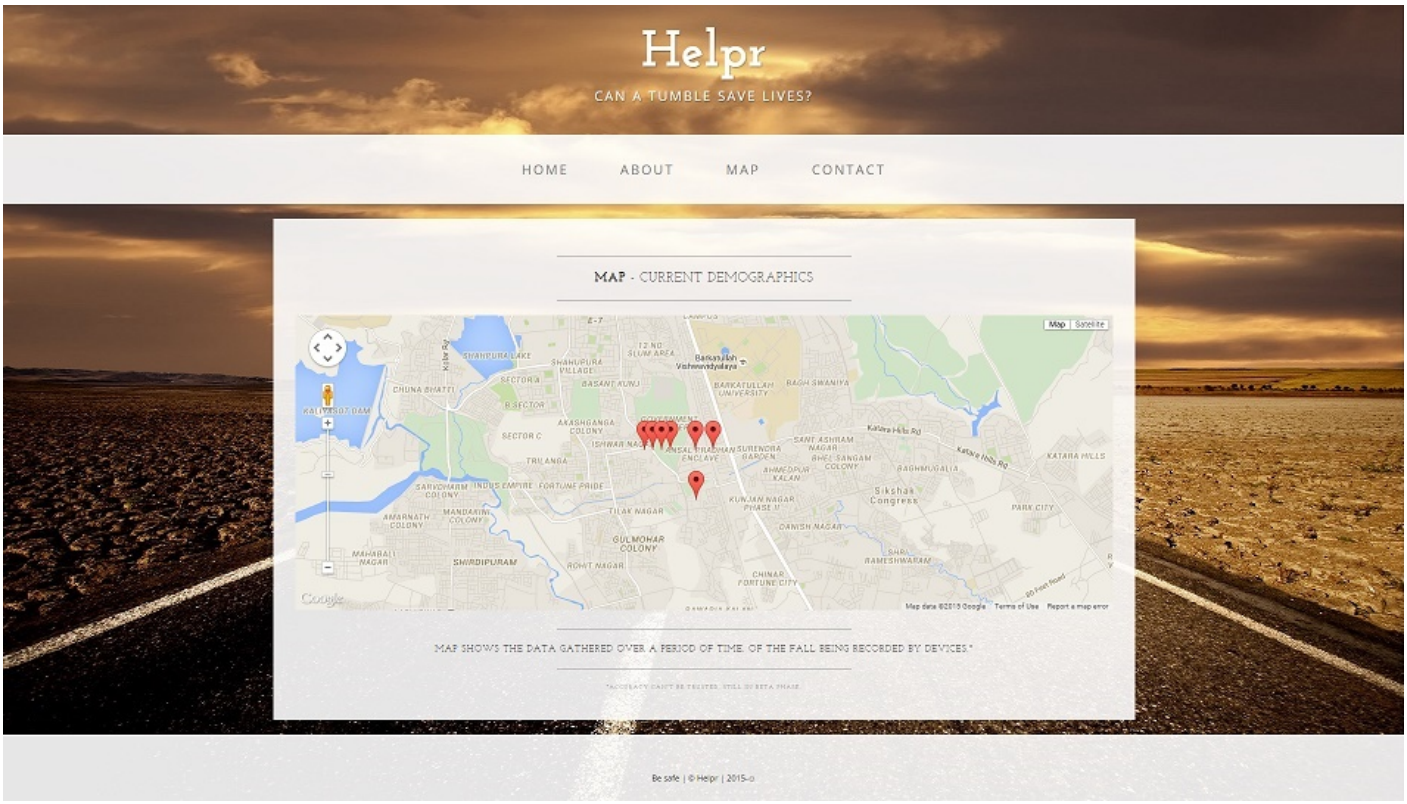

FIGURE 3.10. The web page.

Map shows the data gathered over a period of time, of the fall being recorded by devices.* The web page shown here, is hosted by the name of ***www.helpr.cf*** . All future updates and upgrades will be showcased from here.

*accuracy can't be trusted, still in beta phase.

3.6 Non-functional Requirement

Non-functional requirement are not straight forward requirement of the system rather it is related to usability(in some way).
In systems engineering and requirements engineering, a non-functional requirement is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviors. This should be contrasted with functional requirements that define specific behavior or functions. The plan for implementing functional requirements is detailed in the system design. The plan for implementing non-functional requirements is detailed in the system architecture.
Broadly, functional requirements define what a system is supposed to do and non-functional requirements define how a system is supposed to be. Functional requirements are usually in the form of"system shall do <requirement>", an individual action of part of the system, perhaps explicitly in the sense of a mathematical function, a black box description input, output, process and control functional model or IPO Model. In contrast, non-functional requirements are in the form of "system shall be <requirement>", an overall property of the system as a whole or of a particular aspect and not a specific function. The systems' overall properties commonly mark the difference between whether the development project has succeeded or failed.
(This write-up is solely due to the erratic behavior of latex editor to not leave a blank page)
Non-functional requirements are often called qualities of a system. Other terms for non-functional requirements are 'constraints', 'quality attributes', 'quality goals', 'quality of service requirements' and 'non-behavioral requirements'. Informally these are sometimes called the 'ilities', from attributes like stability and portability.

3.6.1 Performance Requirement

Sensors used for the development and deployment of the project is dependent on the machine (Phone). The phone used should provide viable performance, and ability to manage performance in deemed conditions.
Any fault generated is considered as hardware fault, and should be credited as hardware incompatibility issue, with partial software dependency issue.

3.6.2 Availability Requirement

This application used background services and listener which are active through the life-cycle of a phone. Also, allowing certain features could drain the battery life of the system with quite a large amount. Power back-up at ease is advised. However provision to stop the optional detection method is there for the user.

3.6.3 Reliability

This means the extent to which the application performs with required precision. This again is dependent of hardware; both of phone, and human interaction.
False result may occur, when the events are reconstructed.

CHAPTER 4

SYSTEM DESIGN

Systems design is the process of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. Systems design could be seen as the application of systems theory to product development. There is some overlap with the disciplines of systems analysis, systems architecture and systems engineering

4.1 Flowcharts

A flowchart is a type of diagram that represents an algorithm, work-flow or process, showing the steps as boxes of various kinds, and their order by connecting them with arrows. This diagrammatic representation illustrates a solution model to a given problem. Flowcharts are used in analyzing, designing, documenting or managing a process or program in various fields. Like other types of diagrams, they help visualize what is going on and thereby help understand a process, and perhaps also find flaws, bottlenecks, and other less-obvious features within it. Considering the above lines to be true, here a flowchart of the application system (almost complete).

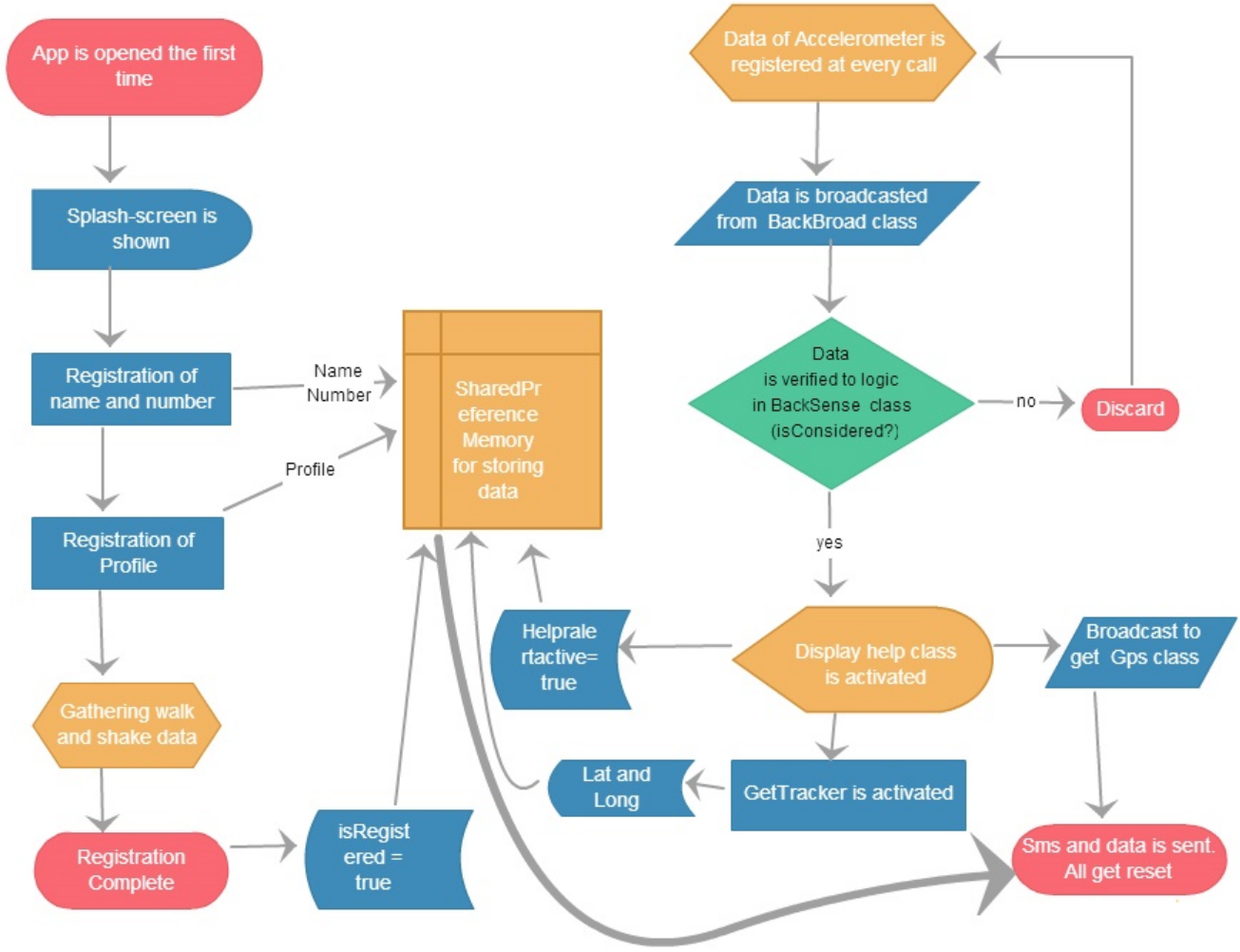

FIGURE 4.1. Flow-chart of System.

4.2 Database Design

No database has been used in this system.
Though in server, we use one, which has the following structure:
u197875796_extra : is the database name.
helpr : while this is the table name.

Column-name	Type	Length	Attribute	Default
sl	int	11	Primary-key	Auto-increment
name	varchar	20		
sos	varchar	10		
lat	varchar	20		
lon	varchar	20		
an_da	varchar	30		
sy_da	timestamp			Current time

Here, these terms are:

· **c1** sl : serial number or primary key.

· **c2** name : name of user.

· **c3** sos : user's sos number.

· **c4** lat : current latitude of user on map.

· **c5** lon : current longitude of user on map.

· **c6** an_da : system time of user's device.

· **c7** sy_da : time at which the database entry is created.

CHAPTER 5

CONCLUSIONS AND FUTURE SCOPE

Like all the good things, this too should come to an end.
Though it is solely dependent on the University and authorities to actually conclude something out of the report. Still...

5.1 Conclusion

The system has a definitive procedure, that when triggered, it automatically does a few things:

· p1 Get Gps position.

· p2 Text Sos number about the position.

· p3 Calls Sos number.

· p4 Sends Gps data to our server.

· p5 Receives all incoming call (till deactivated).

· p6 Play help audio through speakers.

The application system is a unique way to list out a calamity if happens. It comes very handy for everyone and anyone.
The application has a profile management that can be used to specify:

FIGURE 5.1. Screen-shot of profile selection.

· o1 Riders.

Frequent bikers or one who meets the traffic usually are the people of concern here.

· o2 Patients.

That includes people suffering from some sort of mental imbalance, pregnant females, elderly ones.

5.1.1 Riders

Follows are the data gathered by Government of India, that shows the real face of road safety from ground zero.
Note riders are meant by the one that uses vehicle for transportation on a regular basis. Person not suffering from any medical condition should check this one as there profile.

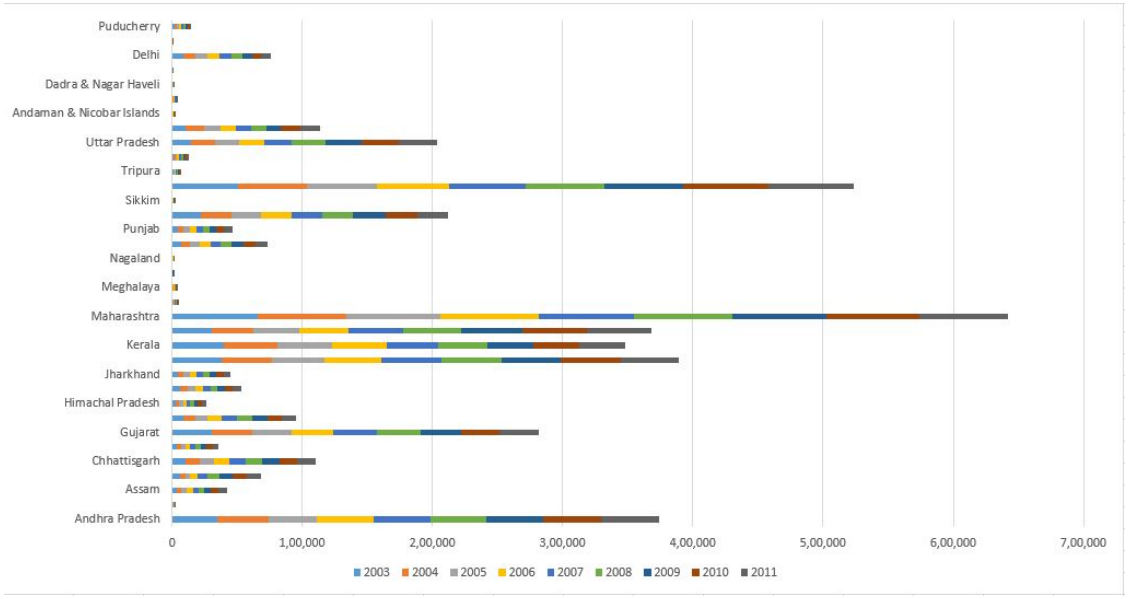

FIGURE 5.2. Graph of accidents in India in the year 2003-2011.

Now this is quite clear that, this is not good.

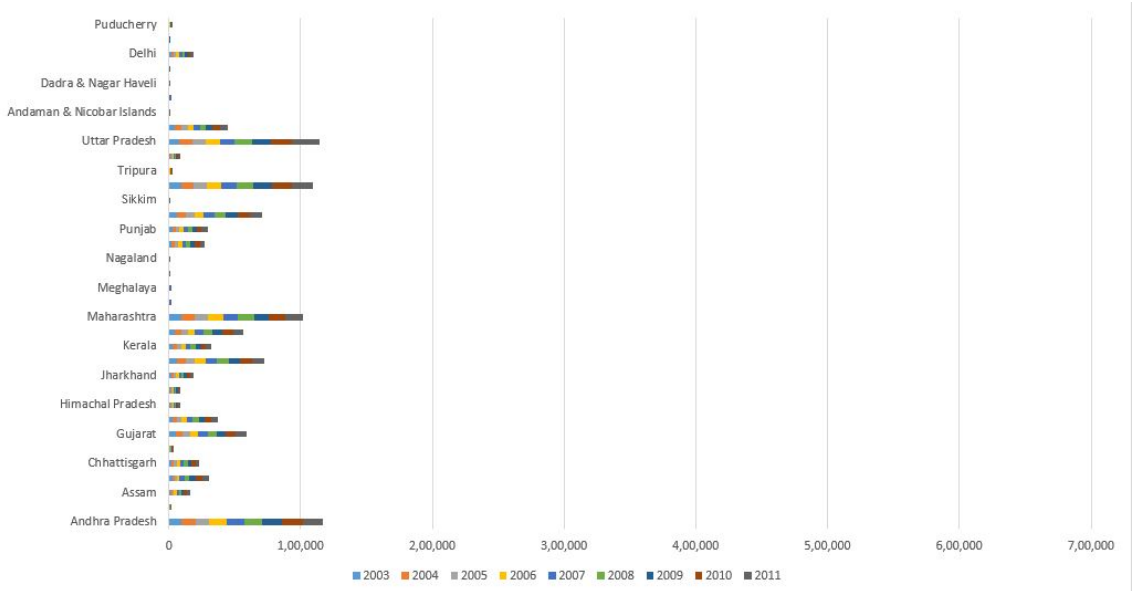

FIGURE 5.3. Graph of road casualty in India in the year 2003-2011.

Now, this graph speaks the bitter/ sad truth.
If we happen to apply our application with this, then there is a possibility of 0.24 - 0.6, that the data will get affected.
As the hazard can soon be informed of to proper authorities and channels.

5.1.2 Patients

Now this column include the category of people that has a certain trait, as listed:

· o1 Pregnant Females.

· o2 Parkinson's sufferer.

· o3 People with tangled co-ordination.

· o4 Elderly civilian with knee problem.

5.2 Future Scope

The future of this service is bright for the user as-well-as the non-users. How? It because the filtered data gathered in our servers will be later provided to the government authorities that can list out the potential danger zones in a scope.
Also the algorithm used needs a lot of improvement, which we are working on as well. Soon that would be uploaded to git-hub for future development.
Also, a provision for user to send the send, and initiate the sos at user's command is under planning.
Further, for implementation to global public, there seems to be two options for us:

· m1 Self marketing and suggesting people to use the application.

· m2 Contacting google, as they have a provision to embed application in their os, as default.

We appreciate your support and enthusiasm for you have read through-out the dissertation. We sure will be glad to hear from you, feel free to mail us at *abhushan@live.com*, *abhinv@gmail.com* for this matter or more.

Recommendation letter by Institute

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