VehiSafe(NFC based vehicle emergency response system)

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Chapter 1

Introduction

Some statistics:

1. One serious road accident in the country occurs every minute and 16 die on Indian roads every hour.

2. 1214 road crashes occur every day in India.

3. Two wheelers account for 25

4. 20 children under the age of 14 die every day due to road crashes in in the country.

5. 377 people die every day, equivalent to a jumbo jet crashing every day.

6. Two people die every hour in Uttar Pradesh – State with maximum number of road crash deaths.

The no. of road accidents and the fatalities caused by them are very high in India. One of the most important factor for this high rate of mortality is general public apathy and the bystander effect. To counter this problem we designed a system which ensures prompt delivery of mail/SMS in case of emergency by simple tap of phone on the NFC sticker. The Email is sent to multiple parties and the person who wishes to help can immediately contact the emergency contact no. stored on the chip. The system utilises a mobile application and a backend server code which work as a Publish subscribe model in unison.

Chapter 2

Problem definition

1. To create an application which securely transmits key identification information about the accident over Internet to the back-end which then further distributes the critical information to the appropriate agencies over email. The information transfer should be secure and the latency should be kept to an absolute minimum because the application is very time sensitive and every second may translate to the difference between a life saved or wasted.

2. The accuracy of the information supplied should be enough to accurately identify the location. We plan to use latitude and longitude from GPS sensors to accurately identify the site of incident, the GPS co ordinates can accurately report the location up to 8 meters.

3. Privacy consideration of users is very important and we plan to use a two way encryption to tackle this problem. The algorithm we have choosen in AES. The personally identifiable information has to be encrypted to ensure security. The application logs every read from the chip so that in case any future misuse is detected it can be traced back to the miscreant.

4. The size of the sensor is very limited and it stores at max 144 bytes, so the data has to be split to ensure maximum information is maintained. We include a special key in the chip which will act as a key to look up information in the main table.

5. The chip should in the worst case be able to give the phone no. and name of the emergency contact which can be used to contact some responsible person, who can ensure the victims well being.

Chapter 3

Requirements

3.1 Hardware

1. **NFC sticker** NFC is a passive type of chip, on which we can store information. The speciality is being a passive chip it requires no power source and is resistant to elemental components like rain,sun etc.

2. **Smart phone with NFC reader** Most of the smartphones nowadays come with NFC readers. We read this functionality to read the information from the chip.

3. **Server** We need a server to house the back end we have written and this server should be able to handle concurrent requests efficiently.

3.2 Software

1. **PHP backend** The logic that communicates with the SMTP server to send mail is programmed in PHP. We need the server to have PHP enabled to ensure our communtication happens seemlessly.

2. **Android** The Application is programmed exclusively in Android as it is the most widely used mobile operating system.

Chapter 4

Real World issues and considerations

4.1 Where NFC chip should be placed on vehicle?

As NFC chip has the emergence information of the person, chip should be placed in such a place so that at the time of accident it should be easily visible to anyone for proper scanning of the chip. Issue is with the type of accident.

4.1.1 Scenario 1

Let's assume mode of transportation is car. If we place NFC chip in front of the car, say on mirror or the hood of the car. Then if accident is a head-on collision then most affected area will be wind screen and the hood. In the accident, chance of destroying the NFC is very high, also NFC will be become invisible due to the dent on the vehicle. So front is not good for the placement.

4.1.2 Scenario 2:

If we place NFC chip in back of the car, say on rear bumper. Then if car is hit my some other vehicle say truck then most affected be the car rear side. Here also, chance NFC will be destroyed is high or NFC will be become invisible due to the dent on the vehicle. So backside is also not good for the placement. Accident happening from backside is much higher than the head-on collision

4.1.3 Scenario 3:

If we place NFC chip on **leftside/rightside**of the car, say on door. Then if car is hit my some other vehicle side way on some crossing then most affected area will be car doors. Here also, chance NFC will be destroyed is high or NFC will

be become invisible due to the dent on the vehicle. So left/right side is also not good for the placement. But probability of accident happening on side ways is very less as compared to the previous two scenario.

Conclusion: Placement of NFC should be on left or right side of the car instead of the front or backside.

4.2 How much NFC chip should be placed, for high precision of the system?

Deciding how much NFC chip be placed is again a research topic. But single NFC is not safe, as accident type can never be predicted, also it's related to human life so probability that single NFC will be destroyed is very high as compared to the multiple. So, minimum two NFC should be placed on the vehicle.

4.3 Anonymity of the user, who is reporting the incident.

For this system to work very efficiently, anonymity is very important. Because in India people are very afraid of doing any thing where police are concerned. So if the user information remain hidden from everyone then they will freely use this application.

Keeping this in mind, our system will only send information to the emergency authority related to the victim rather than user who has reported the incident. ¡bf¿ But for avoiding miss use of this system, we are keeping track of all requested, so that incase the information is miss used, then it can be used to identify the reporter.

4.4 Assumptions:

1. We are assuming per vehicle there will be two NFC chip associated with it.
2. No miss use of information placed on NFC chip.

Chapter 5

System Design
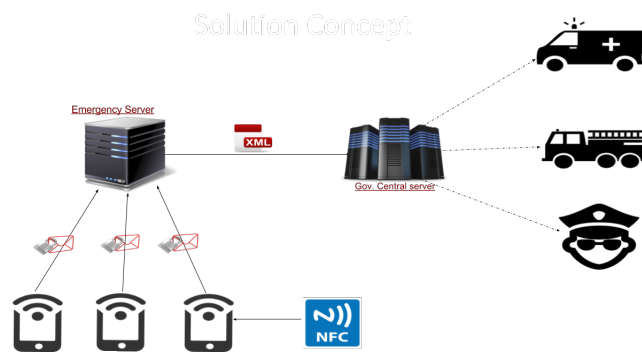
5.1 Architecture

Figure 5.1: System Design

The system design is as shown in figure.

1. The mobile scans the information from the NFC tag.

2. The information is decoded and parsed.

3. All the other information like the current GPS co-ordinates and the UID of the user is forwarder to central server.

4. The information is logged and converted into a pre-formatted email and forwarded to respective authorities.

Figure 5.2: NFC Chip

5.2 Detail Design

5.2.1 Prerequisite and Assumption

Below are the **prerequisites** for system to function:

1. Well setup database of the citizens/users having at least these information "unique id","full name", "address", "vehicle reg. number", "registration address", and "type of vehicle"

2. A web service (REST) which will allow "trusted" third party to fetch the user detail given the user "unique id"

3. An application or device which will write the data on to the NFC in encrypted format, so that no one will able to read the data written in NFC tag.

Note: To fulfill above prerequisite we have created our own dummy database and mobile application which will write data on the NFC.

Below are the **assumptions** for system to function:

1. As we there is as no such police, hospital and fire extinguisher database server exist, we have to create of own. So to full these were are sending email to three TAs, representing these services each.

5.2.2 NFC Writer App

Using this app. we can write the "unique id", "emergency name" and "phone number" on to the NFC (Figure 5.2.1). The unique id is AES encrypted, so that other than emergency authority no one should able to understand what is written because app data can be read from any NFC reader device. App will
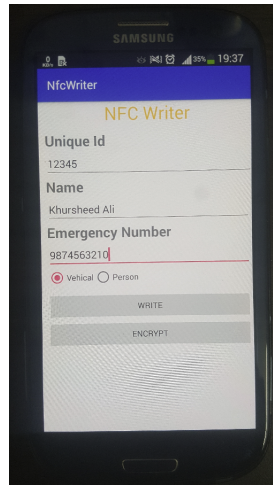
Figure 5.3: NFC Writer mobile app.

only work on those mobile which has NFC writer hardware in it other wise app is of no use.

How to use NFC Writer app?

1. Install the "NFC Writer" app.

2. Open the app.

3. Enter the "Unique Id", "Emergency number" and "Emergency Id" (Figure 5.2.2) .

4. Bring NFC chip near the mobile device (minimum distance require is 5cm)

5. Click on write button, it write it on the NFC and will give the status alert.

5.2.3 VehiSafe App

This is the emergency service app. used by citizens. After installing this app. they have to login on this app for the first time through "Twitter", "Facebook" or "Google". After the successful login, app is ready to use. Its very simple use, as at the emergency app. must very user friendly.

How to use VehiSafe?

1. Install the VechiSafe app.

2. Only for first time, open the app and login into the app
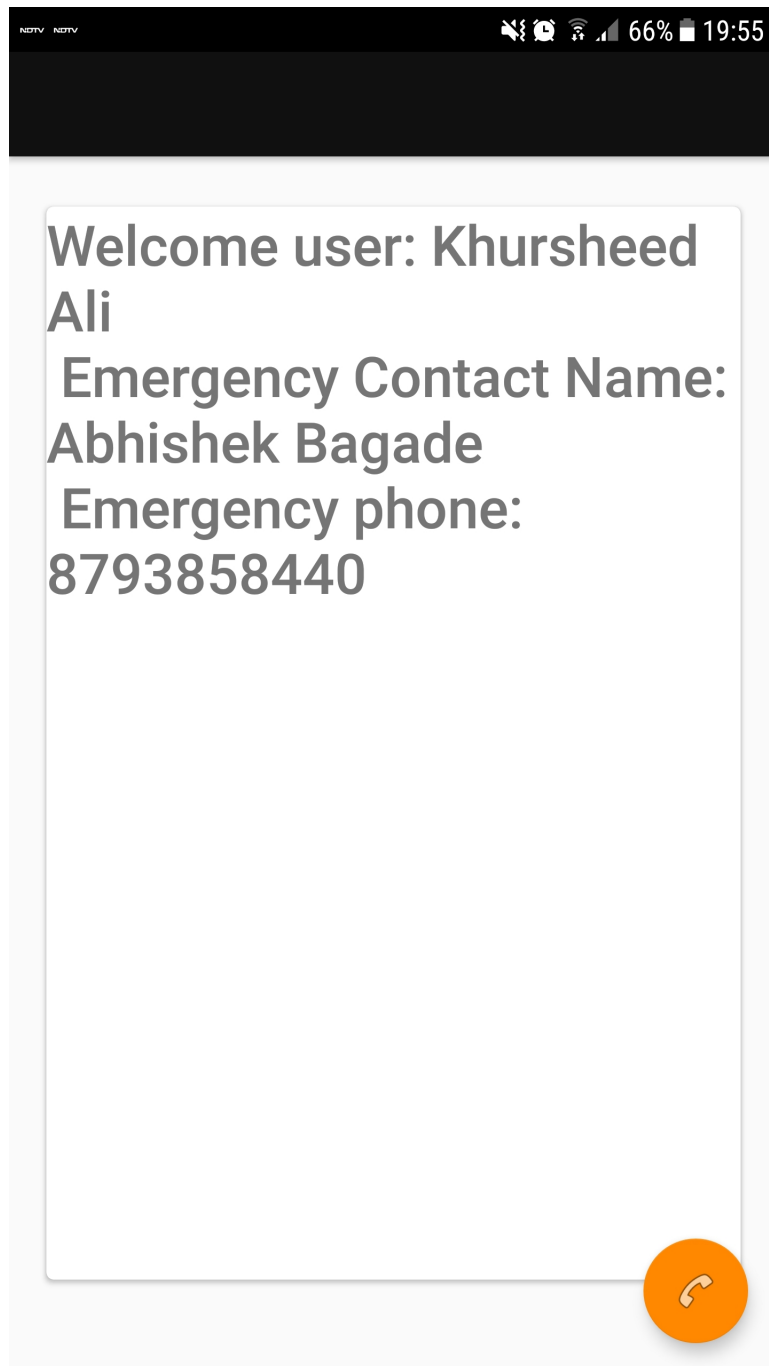
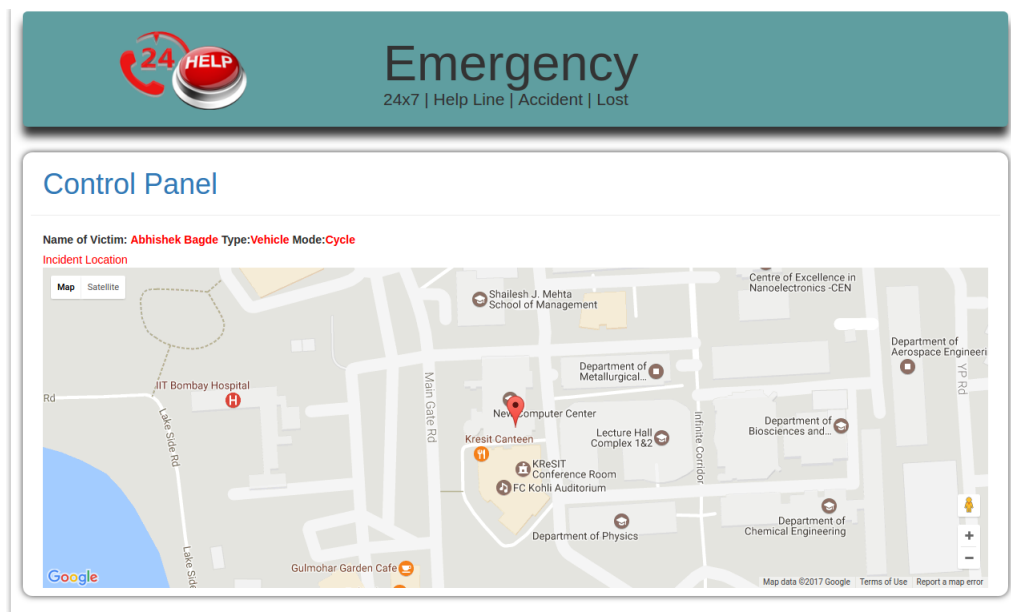Figure 5.4: Vehisafe app. after scanning of NFC chip

Figure 5.5: Accident location of victim

3. Enable your GPS location and Internet (wifi/mobile data). As apps tries to find the exact location of the accident and contact with the emergency server via internet.

4. At the emergency, just scan the NFC of the vehicle. App. will automatically sends the location and data in NFC to emergency server (Figure 5.2.3).

5. App. also gives the calling option, user using the app can directly call on the emergency phone number of the victim.

5.2.4 Emergency Server

"Emergency Server" which handles the requests. Its job is log every request and the contact with the emergency services. Logged request from the dashboard (Figure ??) of server. Server sends email (Figure 5.2.4) to the concerning parties. From server admin of the server can easly the location of the emergency, from where request has been generated. See figure 5.2.3 its shows the location of the for victim "Abhishek" and a. oS thetype of vehicle which meet with the accident ervlser always give the monthly and yearly status about emergencies occurred (Table 5.1).
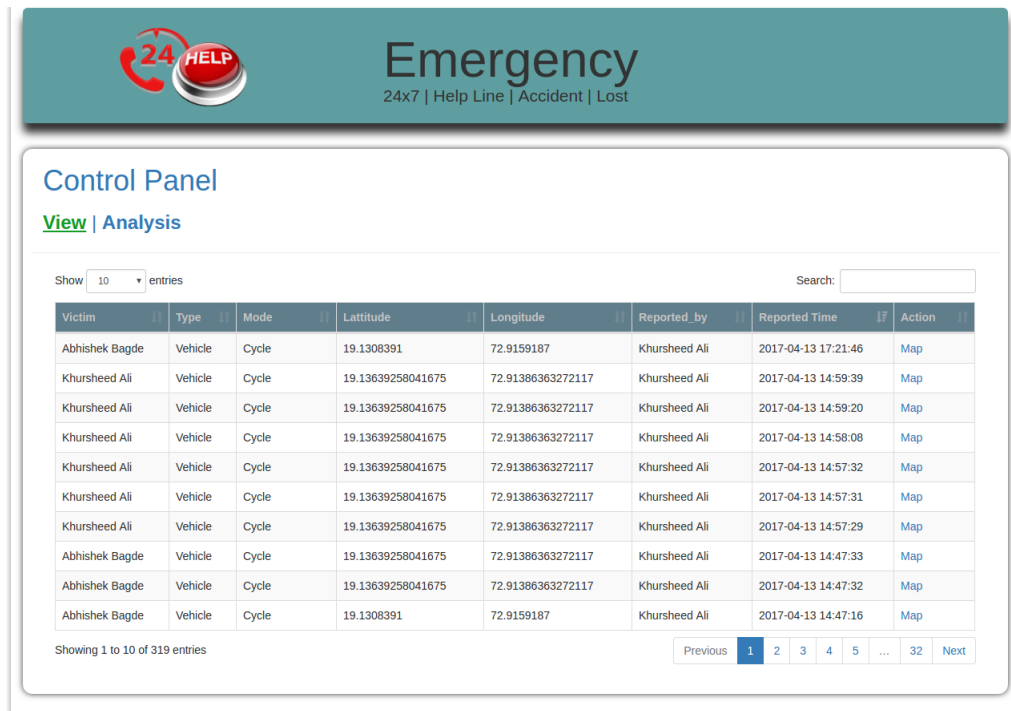
Figure 5.6: Dashboard

Email (figure 5.2.4) sent to the emergency authorities have location of the incident and some important information about the victim like "Full name", "address" and "contact information". These may be used to communicating essential information to other. We can also the medical record mentioned in it so that, it will help doctor to diagnosis it very fast without depending on someone else.

By using the yearly or monthly statics measures and be taken by authority for reducing the emergencies. Example by seeing from line graph (right) figure5.1 we can see that in September month accident due to cycle is very much as compare or the other months. So authority can try out to find the reason. There are many application of these analysis graphs.
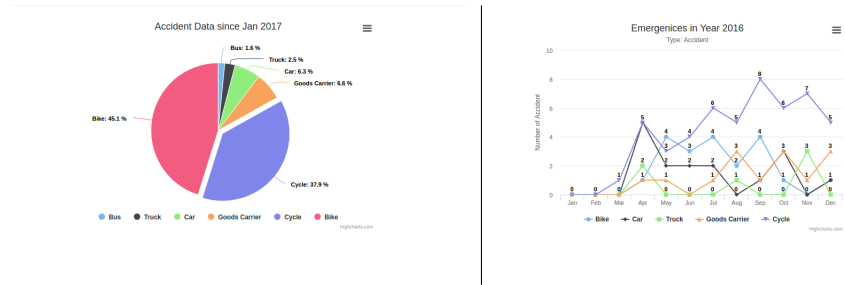
Table 5.1: Analysis

Figure 5.7: Sample email

Chapter 6

Test Cases

Test cases	Expected output	Actual output
Id written on NFC should not be in human readable format	Id should be encrypted with salt and key	Used AES algo. for encrypting the data. **Passed**
As NFC scan max distance is 5cm, so App should be easy to scan	NFC should be scanned by the mobile irrespective of whether App is open or not.	Used NDEF packet format for opening the App automatically. **Passed**
Data transfer from mobile to server should be encrypted	Send encrypted uid from the App to server and decrypt information at server itself.	Successfully able to send the encrypted data to webservice by post method. **Passed**
Email should be sent to the emergency services with location of incident.	Automatically email should be triggered as soon as NFC is scanned	Successfully able to email the client using "cse.iitb.ac.in" mail server. **Passed**

Web Server should log each and every request.	Every scanned request is logged in DB and should be viewed from HTML	Displaying all request on the php page with recent request on the top. **Passed**
Web Server should able to handle the multiple request with delaying and request	Should able to handle 100s of request simultaneously	Yes, server was able handle multiple request. Tested using multiple device scanning the NFC simultaneously **Passed**
Web Server should the exact location where accident has happened	Map showing the marker showing the emergency spot	we are having latitude and longitude where accident has occurred. It is being shown on Google map correctly **Passed**
VehiSafe app power usage should be efficient	Battery utilization when not in use should be very less and also when in use	Power consumption is very very less, its near to negligible as its not complicated application **Passed**
VehiSafe app Internet usage should be efficient	Mobile data consumption should be very less otherwise people will not use the app.	Tested on Wifi and also on Mobile data, its only send few packets, therefore data usage is in KBs. **Passed**

Chapter 7

Future Work

Right, now our scope was just limited to the emergencies like vehicle accident or person accident. we made our architecture so modular that it can extended other type of emergencies. Example "emergency at home with old age parent", when responsible person is out of home and old parents are alone at home then at the time of any type emergencies as they can't call or call can take time, this device can work very well. Let's say at home, there are two NFC say "Green" and "Red". Green denotes everything is alright at home and Red denote some emergency. While leaving from the home, one can instruct old parents to just scan the Green chip/sticker at every hour showing everything is alright or Red one at the emergencies. As soon as scan is done with trigger out the email to respective authority.

Another application of this is "Fare/Mela" where children usually get lost. We can have NFC sticker with our children and instruct our children to ask nearby to scan if they are lost. This will help parent to locate their location independent of anyone. Same is also applied on Pets, NFC can be placed on their band. In case of lost we can scan and get the infromation out.

Chapter 8

Conclusion

The main concern for us the seamless integration of the different types of service we were using to accomplish various tasks. We used Google FireBase framework to accomplish the authentication of users, we integrated Google maps to depict the current location. The encryption was done to ensure the privacy of the users. As we lacked the facility of NFC writer, we had to create a separate NFC writer app. We had to learn the protocol used to write the data into NFC chip i.e NDEF. We had to do reverse Geo-coding to get the address of location using latitude and longitude. The goals were realised at least at the prototype level and the full production version would need to be more optimised and refined. The intent filter functionality allowed us to directly send the info after tapping phone on an NFC chip, we don't need to open the app to send the information. This has ensured that the response rate is exceptionally fast.