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SOS-Systems Design: Using Decision Making Based on Risk Computation

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Abstract: ***The aim is to propose a method for finding out the best suitable person and automatically communicate him/her the location of the victim. The public safety is a hot issue in world, primarily women safety in India. The police are facing difficulties to get location in big cities where population density is unevenly distributed. My idea is to send the location of victim to police and most reliable person in his/her contact list. I am trying to use the SMS service with feature of panic button service. Panic Button service would be an application cum service that would be installed in the android phone. Once installed user cannot turnoff it and end user will not observe any running instances/activities of the application. Whenever we boot the phone the application also start with the rebooting. In my study, I am trying to put the decision making ability in application so that program can choose the right person to communicate, which includes these parameters.***

1. ***Decision making based on hardware triggering.***
2. ***Decision making based on Localized Risk and time sensitive Risk.***
3. ***Nearest police station to be contacted.***
4. ***Finding out the most nearest and most reliable person***
5. ***Finding out the person with whom you recently contacted.***
6. ***The Acknowledgement of the SOS to be received..***

Keywords: Risk Analysis, Decision Making, Android Broadcast Receiver, reliability of decision, expert system artificial intelligence, SOS, location tracking etc.

I. INTRODUCTION AND MOTIVATION

The safety of the citizen is the prime concern of any governing body throughout the world. If we talk about India women safety is a prevailing issue, due to massive population and uneven population distribution sometimes it becomes difficult for police to keep track of every criminal activities. According to DNA news survey there 130 active police for the protection of 100,000 citizen in India, Logically it is a very small ratio then what should we do in such critical situation? Blame Police? , Blame Government? No we can`t do that because blaming is not a sign of a responsible citizen.

There have been a number of initiatives from the national government or the judiciary which have touched upon issues of violence and crimes against women.

1. The National Policy for the Empowerment of Women, 2001.
2. In 2006, Domestic Violence Act

Prevention/reduction of these crimes:

1. Instilling the ethical values in & among the male gender.

2. Installation of CCTV cameras in public places.

3. Clean and safe public toilets for women.

4. Improved infrastructure, including pavements and street lights.

5. Improving the public transport system.

6. Restriction on drinking in public places.

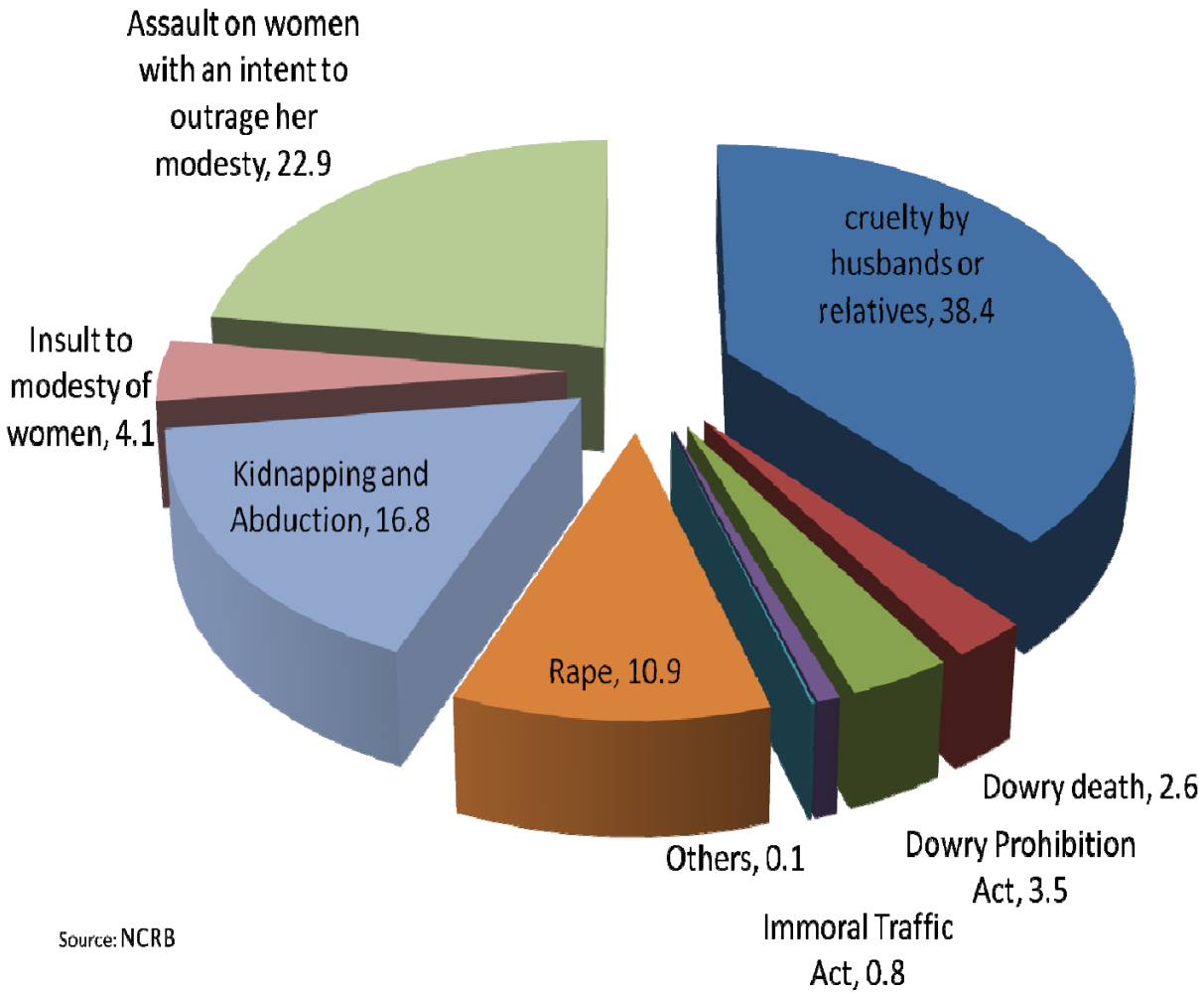
7. Increased police presence and more recruitment of women in police, as well as gender-sensitization of the entire police force.

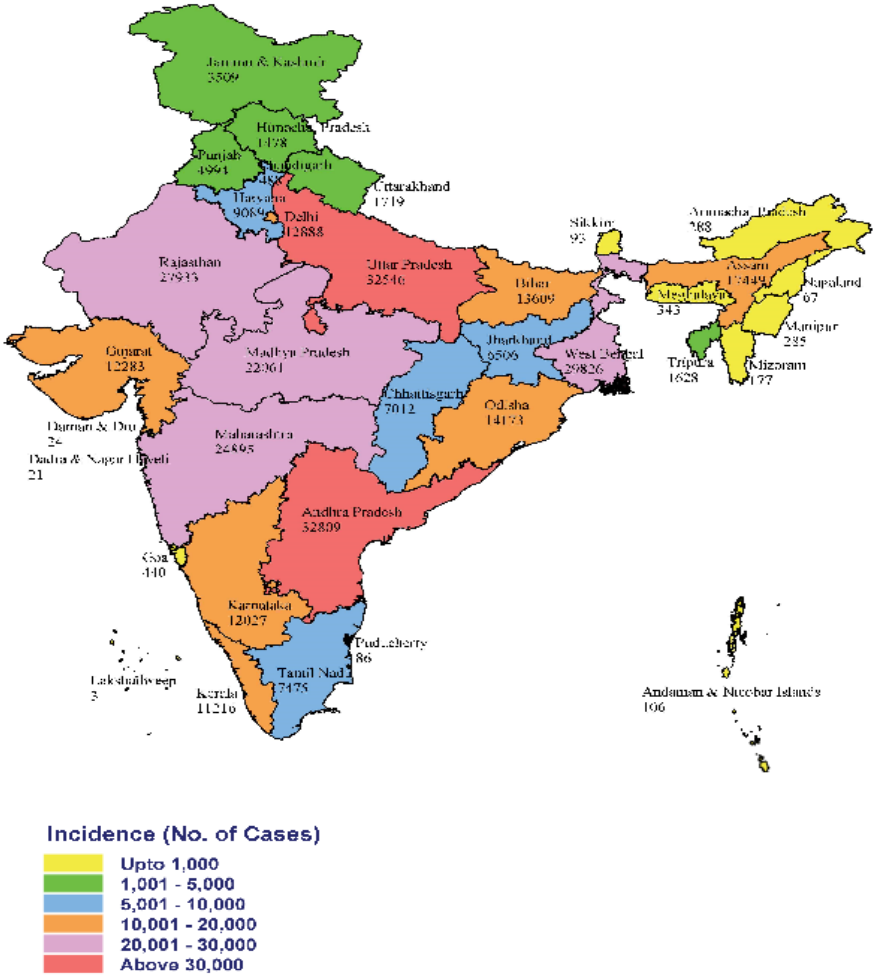
8. Deployment of uniformed as well as plain-clothes police personnel in public places.

9. Increased publicity of helpline numbers, accompanied by effective and immediate readdresses of complaints of sexual harassment received through the helpline.

10. Awareness campaigns regarding sexual harassment.

Crimes against Women in India for Year 2014





These all initiatives are for the mass population but ensuring individual's safety is a very difficult job for any government.

My initiative is towards ensuring individuals safety because one`s safety is all`s safety.

Today Android smart phones have become an integral part of human life; my idea is to create a safety application that can help citizen in life threatening situations. The application will be having its own intelligence that can be used for warning, SOS messaging and if needed collecting evidences. We want our application to detect the severity of risk and situation and accordingly choose the right person from our contact list to call or connect for help.

I also want our device to be intelligent enough to warn the person in risky regions and also should be able to guide him/her to nearest safe place.SOS applications are coming with the start of this mobile age, But problem with these applications is that they all are static, we fed them with one are two static numbers and when we require help only those numbers are contacted. My idea is to dynamically choose the most suitable number for communication in risky situations. In that way we can ensure help more effectively.

II. Proposed System Model

I am proposing a model based on risk assessment, my idea is to design a more real system rather than more optimal system because in case of uncertain risk no system can be claimed as optimal.

The risk factors that we are considering are:

1. Time
2. Time Sensitivity

3. Distance from safe location
4. Distance sensitivity
5. Acknowledgement

- Time (T): This is the standard time of the area where victim is roaming. For simplicity and calculation ease we have divided the total span of 24 hrs into 3 parts and given them static risk values.

1. 06:00 to 12:00 = 2
2. 12:00 to 20:00 = 1
3. 20:00 to 06:00 = 3

We will always monitor the current time and report the risk of current roaming on the basis of these risk values. We will use these values for alarming purposes.

- Time Sensitivity (T_s): This is the product of risk values of time with the sensitivity in which the person is roaming. For example in a densely populated location even if it is 2:00 hrs the risk not as high as compared to a area with less populated region.

Time Sensitivity= Static Time Risk x Sensitivity of the area

Sensitivity of area is the data which we will be getting from department of police and this can be treated as a future scope for calculation of risk for now.

- Distance from safe location (D): This is also a risk assessment factor which will help in calculating the information related to risk escape. If you are into risky situation how much time is going to take you to escape from risk and our application is going to guide to the nearest safe location.

- Distance Sensitivity (D_s): This is a very crucial factor in risk calculation. This is the product of Static Time Sensitivity and Distance from safe location. Why are we considering it crucial because in high risk situation we cannot consider the D as risk escape parameter for calculation of risk. For example if you a bike in day time the 10 km is not a large distance but in night time the same distance is felt large.

Distance Sensitivity = Distance from safe location x Static Time Risk

- Acknowledgement: If you went in a risk situation and you called for help. The situation becomes more critical if you don't receive the ACK that help is on the way. Our focuses on this factor pretty much so that if application doesn't get acknowledgment it tries to either contact the concerned person again and again or choose a better person the contact.

These all factors will provide us the Rank of Risk, we call it as Localizing Risk.

The Localizing Risk is a triplet of Time Sensitivity, Distance Sensitivity and Acknowledgment.

LR = {Ds, Ts, Ack}

On the basis of above risk rank we are going to warn or guide our user and help him in getting out of the risky region or situation.

Now after doing the risk analysis, we will warn our user about the risk situations and ask him/her to get out of the risk situation.

Risk Escape:

The Risk Escape consists of

1. We may ask user if wants us to contact the best possible help/person.
2. We may ask user if he/she wants us to guide him/her to nearest safest place.
3. The Panic Situation when user press panic button and where we automatically decide who should we connect.

When a person hits panic button we send the GPS coordinates of our user to three different people who are:

1. The nearest person.
2. The most reliable person.
3. Police/Ambulance/Emergency.

For deciding, who we should put in the above categories, we are considering the three kinds of people in our contact list:

1. Most Contacted Person
2. Most Recent Contacted Person
3. Recent Most Contacted Person

From the above list we will take the common people and who lies at least in two categories will add up their current ranks and the person who has least summation of ranks is the most reliable person for the current situation.

Rank	Most Contacted	Most Recent Contacted	Recently Most Contacted
1	Person A	Person B	Person E
2	Person B	Person C	Person F
3	Person C	Person A	Person A
4		Person E	Person B
5		Person F	Person D
6		Person D	Person C

Now question is how we will choose the most reliable person out of these?

My theory says:

We will take out the common person among these and add up their rank now the person with least sum is the most reliable person.

Now here we can see there are two persons with similar summation A & B so we choose A over B, Because A is having higher rank in the list of most contacted person.

So here Person A is proved to be most reliable person.

Now going into the panic situation we are going to contact three person and we will be sending the coordinates of our user to them.

1 The nearest person.

2 The most reliable person.

3 Police/Ambulance/Emergency

The Acknowledgement:

The Acknowledgement is most important factor that we are looking after contacting people.

What we are expecting is that the person to whom we have contacted for help should reply us with the acknowledgement that help is on way.

So if we do not receive acknowledgement of the SOS we increase the poke factor that means we re-communicate the person again and again for help it includes voice calling as well if our poke factor becomes too large and person is not responding.

III. PROPOSED MATHEMATICAL MODEL

Let y = f(x) be the Solution for given problem ofHigh Risk Decision Making in AI

and S be the system such that ,

$$S = \{ St , E , I , O , DD , NDD , Fs , Sc , Fc | Øs \}$$

Where,

St = Start state of system i.e. the required setup for our application is ready

Where ,

required setup = Application is installed on Android Device.

E = End State of system i.e System Always Active , In panic situation system sends GPS coordinates and Reinitialize itself.

I = set of Inputs = {LocationCoordinates ,TimeStamp , PowerButtonHits, NeedSafeLocation , PhoneBookContacts}

LocationCorodinates= {LocationCorodinates |LocationCorodinates□(Latitude , Longitude) for a Current timestamp }

TimeStamp= {TimeStamp |TimeStamp□ Android TimeStamp }

PowerButtonHits = {PowerButtonHits |PowerButtonHits□ $[0,1]^+$ }

0 = Power Button is not pressed

1 = Power Button in pressed.

NeedSafeLocation = {NeedSafeLocation|NeedSafeLocation□ $[0,1]^+$ }

0 = don't show nearest safe location

1 = show nearest safe location.

PhoneBookContacts = contacts of people to whom system will send SMS or call in case of emergency

= {PhoneBookContacts|PhoneBookContacts□ $[[a\text{-}z]+ [A\text{-}Z]]^+$, { 10, [0-9]*}}

O = set of Outputs = { WarningMessage , GSafeLocation, EmergencySMS , EmergencyCall}

WarningMessage= warning message displayed to user if risk becomes higher.

={WarningMessage |WarningMessage□ [a-z]* , [A-Z]*, [0-9]*}

GSafeLocation = safe location pointed out to the user on google map.

EmergencySMS = emergency message sent to three contacts= {EmergencySMS |EmergencySMS □ [a-z]* , [A-Z]*, [0-9]* }.

EmergencyCall = call the persons to emergency contact list

Fs = set of Functions used in constructing the system. = {Fheckpowerbtn , Frisk , Fsafelctn , Fsms , FcallFcheckack}

Fcheckpowerbtn = function that keeps a track of whether the power button is pressed or not.

i/p : {SystemActivity}

o/p : {TimeStamp,PowerButonStatus}

PowerButonStatus : 1 = power button is pressed , 0 = power button not pressed.

Frisk = function thatchecks n conducts analysis of risks to carry out further measures

i/p : {LocationCorodinates, timestamp.}

o/p : { warning message | warning message if riskseverity = higher}

Fsafelctn : function that searches and displays the safe location to user if asked for.

i/p : {NeedSafeLocation}

o/p : { GSafeLocation}

Fsms = function that send SMS to PhoneBookContacts if asked for help by user

i/p : {PhoneBookContacts}

o/p : {EmergencySMS }

Fcall = function that calls the PhoneBookContacts one by one till one of them picks up if there is no acknowledgement received in response to sent SMS.

i/p : { AckowledgmentStatus, PhoneBookContacts }

whereFcheckack.op = output of check acknowledgement function.

o/p : { Active Calling to PhoneBookContacts}

Fcheckack = function that checks if there was any reply from PhoneBookContacts to the sent SMS

i/p : {Reply from PhoneBookContacts}

o/p : {AckowledgmentStatus}

DD = Deterministic Data

No. ofConatacts selected as EmergencyConatacts

NDD = Non Deterministic Data

Risk Situation, Output of carrying the various measures like sending SMS, Calls etc.

Sc = Success Case

The System works correctly for all test cases and gives the desired result

Fc = Failure Case

If cell phone battery is dead ,removed from phone,or damaged then it is not possible to carry out these measures.

IV. Design and Analysis of System

I saw a few applications on Google Play Store with the same concept, but I found many bugs in these applications, and I tried to overcome these in our system, but major drawback all these applications are static and can only work like an alarming mechanism.

So my application is a background service, I made my system to become part of the existing android systems rather than acting as new layer application.

This System is divided into 6 parts:

1. Location Tracker
2. Risk Analyzer
3. Warning System
4. Guidance System
5. SOS System
6. System Refresher

1. Location Tracker: It continuously updates the Risk Analyzer with the location of our End-User, So that Risk Analyzer can compute the Risk.
2. Risk Analyzer: This takes the Timestamp and Location from Location Tracker to calculate Localizing Risk Triplet and when risk becomes high it activates the warning system.
3. Warning System: It gives the warning message to end user that he/she is in risk situation and ask him if he/she needs guidance, if yes it calls the Guidance system.
4. Guidance System: Locates the nearest safe location to end user on Google Maps and if user needs it communicates the person who might be able to help.
5. SOS System: At moment if our end-user in panic hits Power Button of the phone, SOS system sends location coordinates cum help message to nearest person, reliable person and police. This system contains SMS and Call services.
6. System Refresher: It consists of Android Broadcast Receivers and Power Button hits counter; it continuously checks for power button hits or if phone is getting rebooted. Its job is to make system available all the time and let the SOS system know about Panic Button Hits.

Our system is itself a service which is attached to phone so even if you reboot your phone there is no need to explicitly reopen the applications, it automatically awake itself.

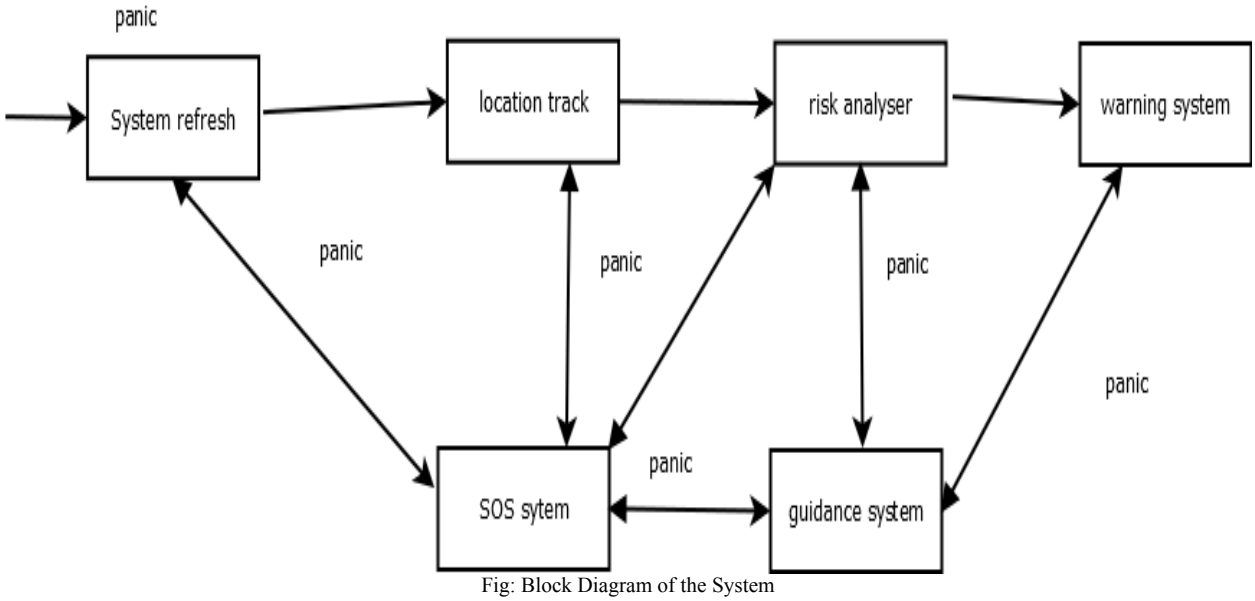


Fig: Block Diagram of the System

4.1 Algorithm:

Input: Location Coordinates, Time Stamp, Power Button Hits

1 Initialize the System Refresher Service.

2 If power button is pressed go to step10.

3 Continuously take the coordinates & timestamp.

4 Pass them to risk analyzing function.

5 If Risk becomes higher give warning message.

6 If asked for safe location guide user to nearest safe location on Google maps.

7 If asked for help choose the three persons go to step 7.

8 SMS them the location of our user

9 If not Continuously blinks warning message on screen if interrupted by user go to step1

10 Register the time stamp and start the counter if the count reaches 10, check the last time stamp if difference is 10 sec go to step 6 or else go to step 2.

11 Check if SMS inbox the "OK" text message from the three persons to whom you just sent coordinates, if you do not receive SMS with in 1 minute go to step 10.

12 Send the SMS coordinates to the person from whom you haven't receive Acknowledgement and then go to step 11 or else go to step 1.

13 Check again for ACK of the person to whom you send coordinates in step 10 if not received with in 1 minute go to step 12 if yes go to step 1

14 Initiate the call procedure and play the recorded SOS message during the call if calls not picked up, choose the second person in the respective class and go to 7.

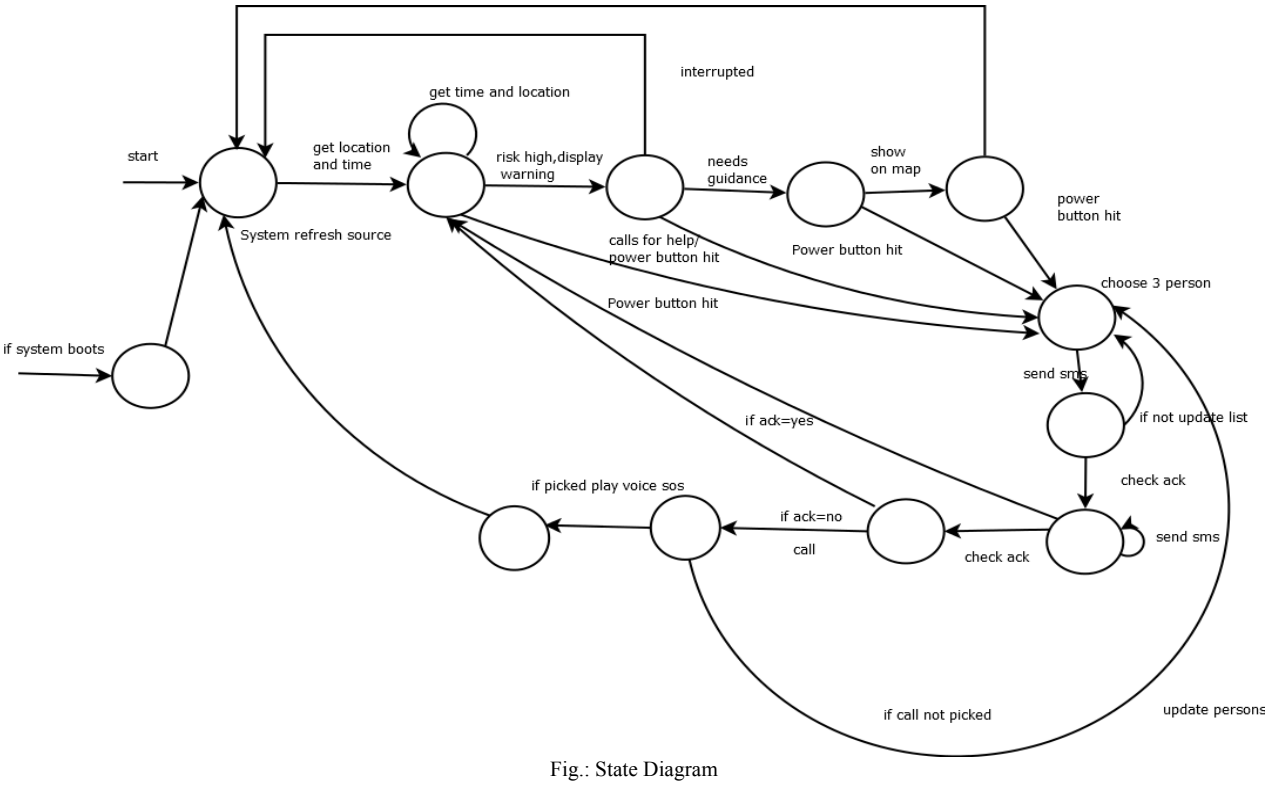


Fig.: State Diagram

4.2 Implementation of the Algorithm:

Minimum requirement Android APK 14 (Ice Cream Sandwich 4.0.0)

Programming Language: JAVA

Minimum RAM: 512MB

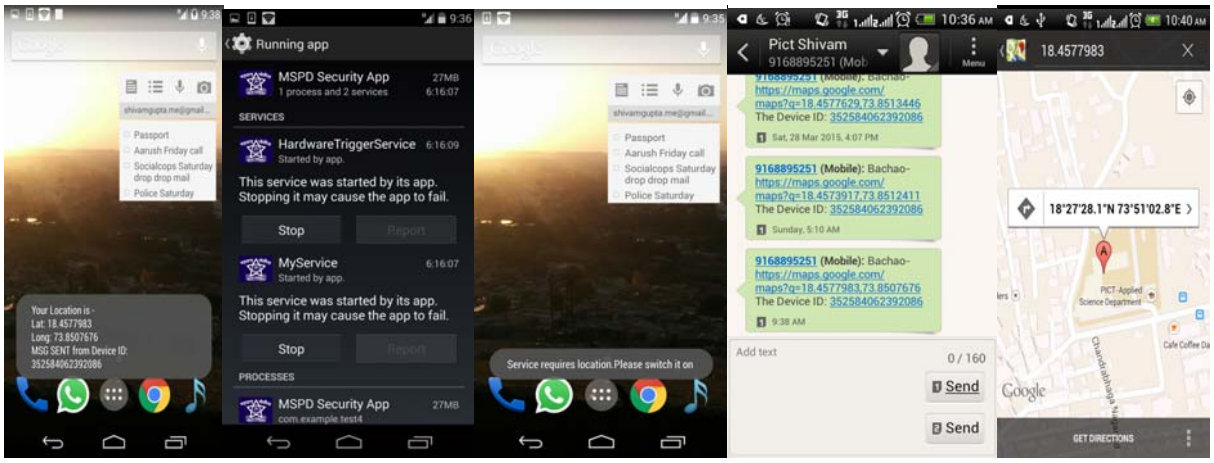
SMS Service, Internet Service

We have used these Android Classes for Implementation:

1. Android BroadCast Receiver: for hardware triggering and intent reception
2. Android Service Class: for creating services of class
3. Android Intent : For Managing intents and events on the device.
4. Android ContactsContract.Contacts: for getting information about call logs.
5. MulticlickEvent.JAVA class: This is our class file which register power button hits if hit counts become larger in than 10 in 5 sec it initializes Myservice.java
6. MyService.Java: This class consist of SMS service and notification service.
7. Android SMS Service: we have used this service to send SMS
8. Android GPS service : we have used this for getting the fine location of our user.
9. Android Google Maps API: This is a Google API to locate any coordinates on Google MAPS
10. Anayzer.java: This class file basically analyze risk on the basis of location and time and give warning message on screen

Other than I have used some inbuilt android features and functions like vibration, notification bar etc. Our applications main service is called as HardwareTrigger Receiver, which initiate the broadcast receiver this HTR is initiated by our main service thread known as HardwaretriggerService.After individual events respective service or thread is called.

Outputs:



V. PRO'S AND CON'S

Pro's :

(i) Work as system service available all the time, No need to reinitialize every time.

(ii) Very low power consumption.

(iii) Acknowledgment based decision making.

(iv) Safe location guidance system.

(v) Works even if phone is locked.

Con's :

(i) Undefined optimality.

(ii) Needs enough talk time to send text messages.

(iii) Can`t work if GPS is turned off.

VI. Conclusion and future Enhancement

I observe that a lot of crime occurs in situation where victim is not warned or he/she takes improper decisions, where decisions made by machines are pure computations so they have good decision making power, although my aim is only to guide our user because the systems which are designed to work with uncertainty cannot have optimal solution for every possible situation so I tried to make our system more real by considering almost every possible situation we can.

I tried to overcome the issue applications booting, by making this application a phone based service, I tried to overcome the issue of intentionally/accidently uninstalling the application by hiding every running instance possible. In that way user will be safer.

Future Enhancements:

In future we are thinking of many proposals to add:

1. The Sensitivity of locations and time that we gave in our proposed model, we going to add in our applications so that we can refine our localizing risk.
2. I am thinking to track the activities of Facebook and WhatsApp, So that we can send SOS message to the friends of user who are online and near to him/her at moment.
3. I am thinking to add evidence collection mechanism, so that our application can automatically record a voice session or take pictures So that they can be proved as evidence in Court.

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