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Sentinel – A Neighbourhood based Live Location Streaming Safety APP for Women and Children

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Abstract

The most cruel problems in the world are the ones that happens beyond our sight in the dark. There are some savage monsters in this beautiful world that does kidnapping, harassment and what not. There are apps out there which gets the location and sends a message to the nearby police station, family and friends but these kind of things always tend to happen when they're all away. So it will be too late for the police to reach the scene. Have any kidnaps been seen nearby a police station? Of course not!. They dare to do these by thinking that no one sees them. Well let's say no to that anymore.

The solution is 'SENTINEL'. The Sentinel app alerts the locals of that particular area where the victim is stuck with just a click of a button. It will keep the victim informed about how may rescuers are alerted, how many are on-scene and whether the police are alerted or not. The locals are responsible to keep their area safe. So in turn this app gives them a chance to prove it and be the hero of their own locality.

Key-words: GPS, Flutter, Live Location, Streaming, Women's safety, MVVM, Cloud Computing, Sentinel.

1. Introduction

In today's world with the technological advancement, there are a lot of devices created for this very purpose that is stated in the next section. Still a lot of people don't even know whether these devices exist and even if they do people may not always carry a voice controlled stick with a taser or a pepper spray and a location tracker with them on their day to day time. But almost everyone from a

5 year old child to a 70 year old men and women has a mobile device and they know how to use a app in these days.

Being this as the advantage, instead of creating more gadgets, there should be more apps that has an easy interface for everyone to use. Sentinel app is created for this very purpose. Within just a click of a button everyone in the surrounding is alerted and real-time location will be sent along with a map of live tracking movements.

According to the Annual National Crime Record Bureau's (NCRB) Crimes against Women (2019) dataset released on 29th September 2020. The dataset is altered to get the total crimes that was against women on the mentioned year, it is clear that, there were a total of 4,67,882 crime cases against women registered in India and there were averagely 16133.86 crimes were happening against women. The crime rate shows an increase of 7.3% from the predecessor year(2018 – 3,78,236 cases). The registered crime per lakh women population is 62.4 in 2019 whereas in 2018 it was 58.8.

By using Sentinel Application, majority of the cases can be averted, since 47.6% of the cases are filed on assault, rape, kidnapping and abduction of women.

2. Related Works

Dongare Uma et al., [1] proposed a voice activated app to send a message of the victim's location in a latitude and longitude format and also limited only to the pre-saved contacts and then be notified whether the messages are delivered to those pre-saved contacts or not. The audio recorder records for a period of five minutes after the activation of the app as an evidence. The victim can also make voice calls from their contact list. The limitations are (i) the spoken keyword converted into text may or may not match the saved keyword. Victim will be in high anxiety at that moment and there are chance that their voice may be shaky and might not return the correct keyword. (ii) The message is delivered only to the registered contacts and these things tend to happen when they are away. (iii) say if the victim is hiding from the criminals and tries to say the voice activation keyword, the victim can be identified of their hidden location by the criminals.

Magesh Kumar.S et al., [2] proposed an app called IPROB which is activated when the mobile recognizes the shake that is set to a predefined threshold. The app then starts recording the audio. An notification is sent to the victim itself, if that is left unresponsive only then the app sends the location in a latitude and longitude format to the pre-set emergency contacts. When the alert is triggered, the guardian's phone then repeats an continuous alert of "YOUR CHILD IS IN TROUBLE PLZ HELP… PLZ HELP…". If the guardian's phone is set to silent, it automatically overrides to

general mode for the alert. If the guardian confirms, then the emergency services are contacted and it contacts the victim's devices and sets to speakerphone mode. The limitation are (i) the app sends the location as a message by using a network provider and cannot be streamed as a live location. (ii) If the victim is hiding from the criminals and starts an alert, the app will compromise the victim's position by enabling to speakerphone when guardian responds.

Vaijayanti Pawar et al., [3] proposed an app called SCIWARS - Spy Camera Identification and Women Attack Rescue System. It has two modules. The first one is when an infrared ray is identified, the user is then notified and it is up to the user to file an complaint or not. The second one is when the victim continuously presses a button then a message of their location in a latitude and longitude format is sent to the pre-saved contacts only. The app then starts capturing images for 45 seconds and is stored in the phone's storage for evidence. The limitations are (i) the alert message is sent only to the registered contacts. (ii) No matter how secretly the app saves the image files in the phone's storage, if the app's data is cleared, all of the related files to the app will be deleted so the evidence will be lost.

Bhaskar Kamal Baishya [4] proposed an app to provide security. It has 2 modules. The first module works when the victim presses the SOS button, the app then sends a message of their location only to the pre-saved contacts. The second one is integrated with microcontroller for the safety of belongings and senior citizens. If the microcontroller detects an unusual activity, the app then notifies the user and if the user responds, an alert is triggered. If the user does not respond under the defined time interval, then an automatic message is sent to interrupt the microcontroller for an alarm. The limitation is that the app sends a message with latitude and longitude only for the registered contacts yet again.

Dr. Sridhar Mandapati et al., [5] proposed an app called ISafe App. When an alert is triggered, the app then sends a message of their location in a google map link format to the pre-saved contacts only. The app also has audio, video calls, first-aid help, fake call options. It also has a option to send audio – video recording via email (or) gmail if in case the user is not in a position to be able to speak about their situation. The limitations are that (i) it sends a location with a google Map link and is redirected to the map only with the last known location of the user and (ii) We cannot expect people to check their emails at times like these and even if they do, the victim will be unknown to the status of the email whether the email has been read or not and whether the help on the way or not.

S. Juhitha et al., [6] proposed an app that is activated when the mobile device is shaken to a specific frequency or by long pressing the lower volume button, then an alert with the location is sent to the pre-saved contacts as a SMS and a call is made to the master contact. If the emergency contact

person has the same app, they can monitor the victim's location. The limitation is that it can alert only the pre saved emergency contacts.

Sakthi Prabha R [7] modeled a device which is activated with a press of a button. After activation, it sends a message of the victim's location in latitude and longitude format to the pre-saved emergency contacts which is stored in the microcontroller. The location will be updated after every while with a delay set on the microcontroller. The limitation here is yet again the alert is sent only to the pre-registered emergency contacts.

Dantu Sai Prashanth et al., [8] proposed an app that is activated when an SOS button is pressed. After activation, an alert is sent to the pre-saved contacts with a map navigation. The app also provides option to call services, first aid information and emergency helpline numbers and a chat channel called pubnub. The limitation are: (i) the app sends alert only to the pre saved emergency contacts with location updates. (ii) the victim will not be in a position to chat with other people at the time of distress.

Dhruv Chand et al., [9] proposed an app called Women's Safety App which is activated either by shaking the phone or by pressing the panic button. Then a message of the location of the victim along with their contact details is sent to the pre – saved contacts and the police. The limitations are (i) the message only contains the current location and is not updated. (ii) These things tend to happen away from police stations so there will be a delay no matter what, to reach the scene and that delay might cost a life.

Ravi Sekhar Yarrabothu et al., [10] proposed an app named Abhaya which is activated with a click of a button. After activation, a message with the current location of the victim is sent to the pre – saved contacts as a google map link. The app then sends this message after every little while as set on the timer. The limitation is that we cannot expect the guardian to close the map and re-open it with every updated location message received and also the alert is yet again sent only to the emergency contacts.

Abhijeet Paradkar et al., [11] proposed a prototype-only system called All in One Intelligent System. This system can either be developed as a Arduino board or as an Application. It has features such as voice recording, GSM, Taser for Self – defense, intrusion detection, SOS button for the alert to the pre-saved contacts, Screaming Alarm, Video Recording. The limitations is that it alerts only the registered emergency contacts.

N.L. Vamsi Priya. K et al., [12] proposed a gadget for the safety of women. The gadget is activated with a press of a button. It can be worn as a band or a watch. When activated, a SMS is sent to the pre-saved emergency contacts and also to the police. The limitations are (i) the location is shared only with police and registered emergency contacts so there will be delay to reach the scene as there are 8 out of 10 chances they are far away from the victim, (ii) the location is sent is only with the last current location, no dynamic location updates are done.

R.R. Khandoker et al., [13] proposed an app called Lifecraft. It is activated either with voice or by a click of button. After activation, it sends a SMS with the victim's location to the pre-defined contacts only and also starts a recording to keep it as a evidence stored in the phone's storage. The message will be repeated to the pre-saved contacts for every 5 minutes with location update. It also shows the victims, a safe zone and it also provides offline mode. The limitations are (i) the SMS with location is sent only to the pre-saved contacts. (ii) The SMS with the location is updated only for every 5 minutes which is a huge delay. (iii) The apps suggested safe zone cannot be trusted as these kind of criminal activities takes place mostly on the non-suspect areas.

N. Islam et al., [14] proposed an gadget with three button embedded on it. The three buttons is for different purposes each. First button is, when the victim is facing eve-teasing, then the module will get the current location and will send them as a SMS to the pre-saved contacts. While the other two buttons, functions the same way but the purpose are different. One is for when victim got snatched while the other is for when the user got kidnapped. The limitations are: (i) it is not feasible for the victim to have this gadget with themselves every day. (ii) The three separate buttons which basically does the same function will not be of great help to the victim. It will just put the victim in a dilemma in the distress moment.

B. Vijaylashmi et al., [15] proposed a prototype with both hardware and software involved. The hardware part monitors the change in body temperature, accelerometer, pressure sensor through an ADC. If any of these are abnormal or if the emergency button is pressed, the speech circuit will be activated to emit a loud noise and prepares a Taser to attack the criminal with for self-defense. It also sends the location as an SMS to police control room and to pre-saved contacts on the microcontroller. It is trackable using google maps. The limitations are: (i) making a loud noise is not of any good to the victim if the potential crime scene is happening somewhere deserted place where most of the cases takes place usually. (ii) The location message are forwarded to the police and pre-saved contacts and this kind of crimes always tends to happen far away from any known people and the police.

3. Proposed Methodology

This mobile app proposes a location streaming system based on the current neighborhood where the victim is stuck so that they can get help as soon as possible. It has features like showing the user whether there is an internet connection or not with respective screens, the app will not use any sound so that the victim can be stealthy. The help is just a button away. All that user have to do is press a button at the time of distress, then a horde of people will be alerted around the neighborhood with the victim's details on their screen like name, contact, and their current live location. When a sentinel has reached the scene or nearby the victim, their details will also be collected as a proof. The victim can summon as many sentinels as they need. Sentinels are alerted until the victim decides to turn off the alert.

A. Database Architecture

The database has three collections as shown in Fig.1 under which there will be documents which will have fields. The collections are areas, records and users.

The users collection will hold every registered user unique id as documents and each of those documents will have details like name, contact and home location as fields respective of those users.

The victim module begins with a registration if the user is a member or login if the user already exists. The user will be presented with a screen with a alert button which is the home page of the app. In times of distress, the victim can just press the button to summon sentinels in their current area locality. The screen shows the victim with how many sentinels have been notified.

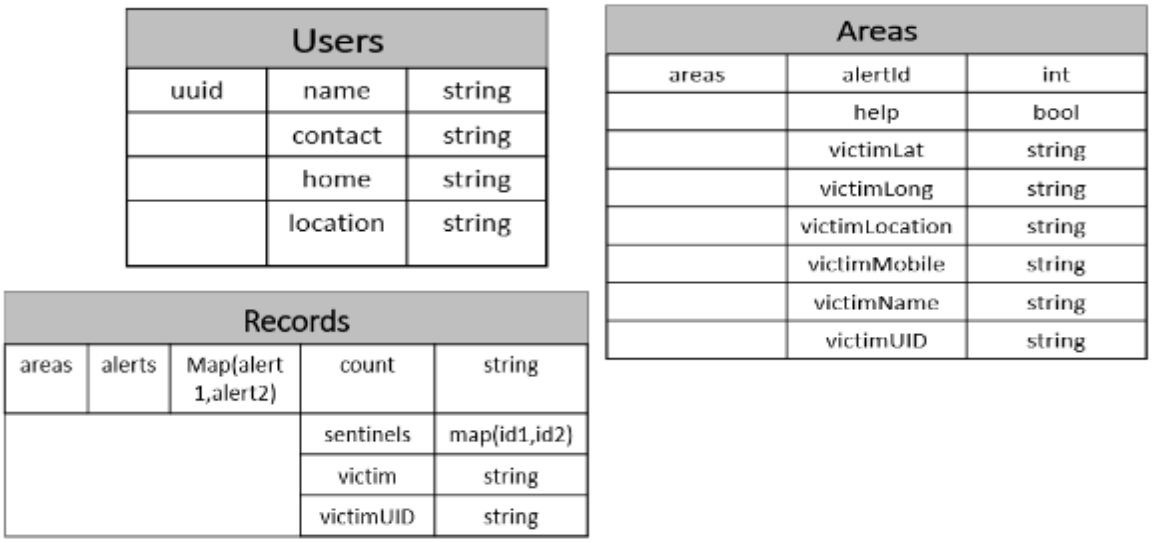
When the victim decides to end their alert call, the victim should press the cancel button then the app would ask the victim to enter their passcode that only they knew when they registered. If the passcode matches the alert will end. The areas collection will hold areas as the documents and each of these areas will hold details like alert ID, help, victim’s Latitude and Longitude, victim’s Location, victim Mobile Number, victim Name and their unique ID as fields.

The records collection will again hold areas as the documents and each of these areas will hold map of alerts under each map, there will be a record of how many people reached the scene, who reached the scene and the victim Name with their unique ID as fields.

- The users collection are responsible for the collection of users registered.
- The areas collection are responsible to continuously check for an alert call and to hold the alert details.

- The records collection are responsible for holding the data on who have reached the scene as a proof for future investigation.

Fig. 1 - Database Architecture of Sentinel App



B. Module Description

The Sentinel App consists of two modules victim module and sentinel module depending on the access rights of the individual operating.

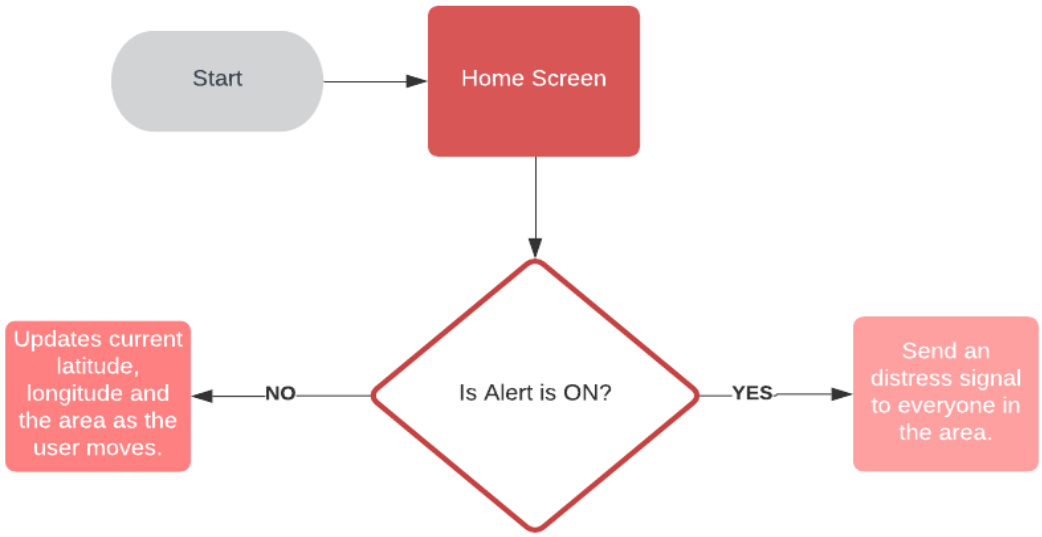
The users of the application must always create an account prior as soon as the app is downloaded so that they can use the app with just a click of a button at the times of emergency.

The app also supports google signup feature so that the new users can sign up quickly and use it right away at the times of distress.

1. *Victim module:* The victim module as shown in Fig.2 begins with a registration if the user is a member or login if the user already exists. The user will be presented with a screen with a alert button which is the home page of the app. In times of distress, the victim can just press the button to summon sentinels in their current area locality. The screen shows the victim with how many sentinels have been notified. When the victim decides to end their alert call, the victim should press the cancel button then the app would ask the victim to enter their passcode that only they knew when they registered. If the passcode matches, the alert will end. The app targets everyone in the local where the distress signal is from, to maximize the probability of chance of survival and also to get as many helping minds together to save the

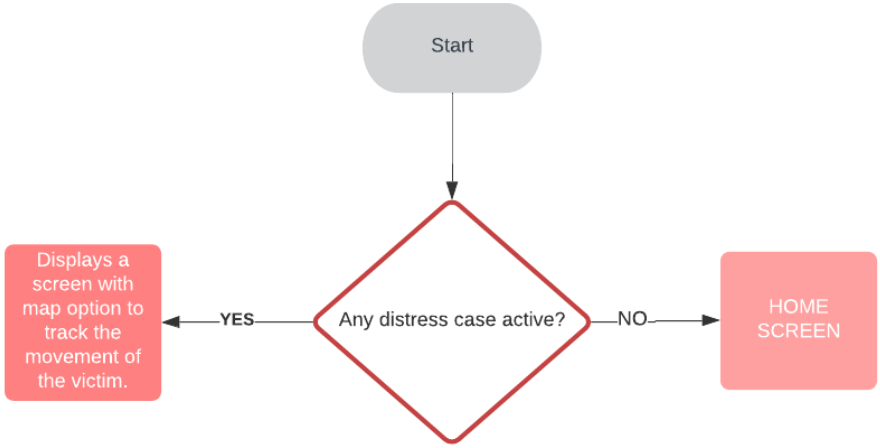
potential victim. The victim can decide when to stop the distress signal, as a certain amount of people gathered at the scene.

Fig. 2 - Victim Module of Sentinel App



2. *Sentinel module:* The sentinel module as shown in Fig.3 begins with the same registration or login and will be presented with the same home page as victim because one cannot be labelled that they will be victim or sentinel, anyone might need help in these days. So, when a victim alerts the surrounding, the sentinel will then be displayed with the alert screen containing the victim's Name and victim's Contact along with their live tracked location in a in-built map button. When the sentinel presses Go to Maps Button, the sentinel is then redirected to the map screen with a location pin on both the victim's and Sentinel's current location. The location is updated for every 5 seconds.

Fig. 3 - Sentinel Module of Sentinel App



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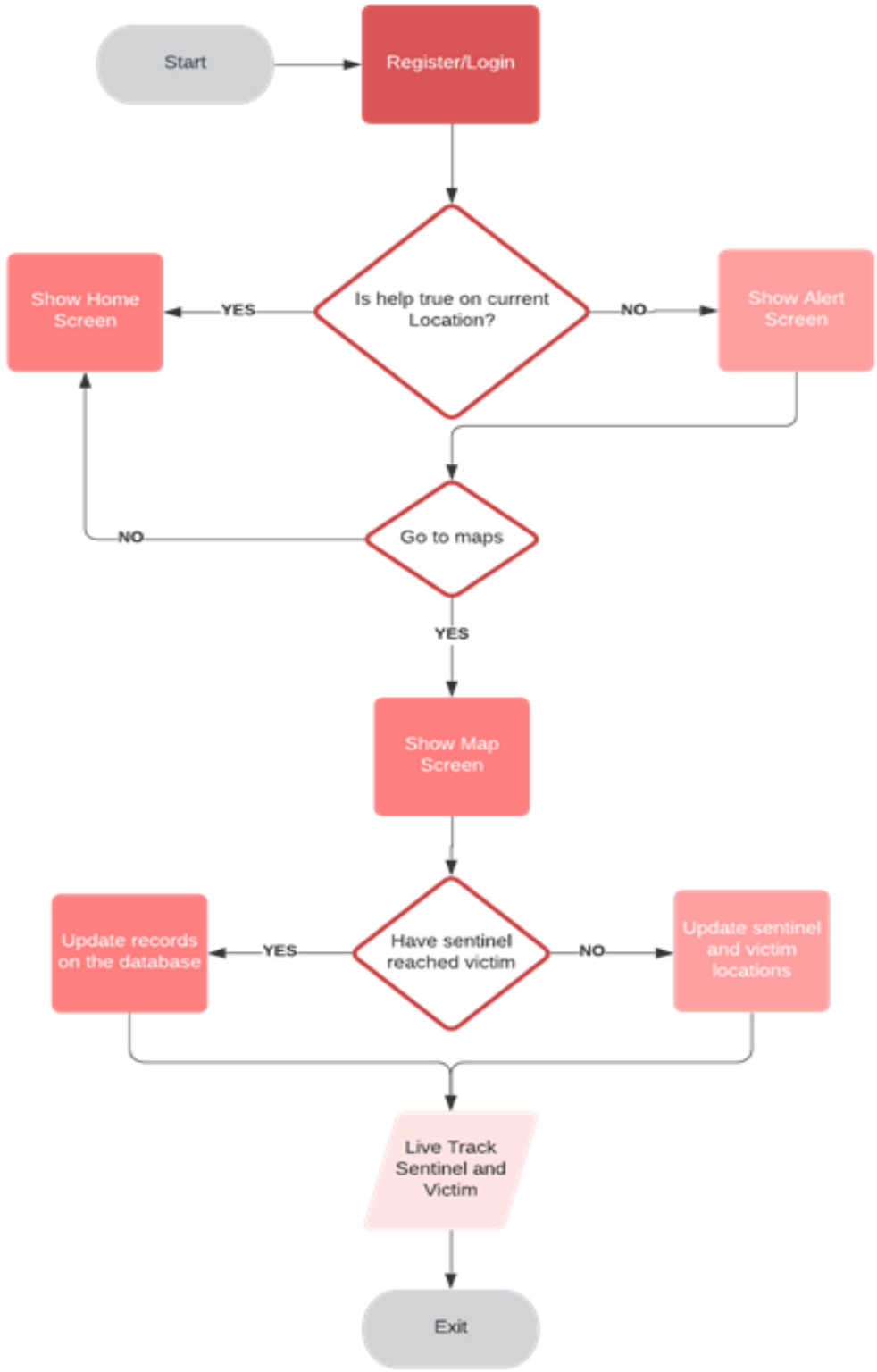
The following Fig.4 shows the entire function of the sentinel application on how it switches to victim module and sentinel module when the necessary condition is met or by the user action.

Fig. 4 - Workflow of Sentinel App



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4. Working

The application starts with the splash screen when opened. The app shows the next screen accordingly as it suits the below test cases:

Case 1: If a new user opens the app for the first time and will be presented with an opening screen as shown in fig 5 and they can redirect to the Sign Up page as shown in fig 6 where they can register themselves by providing their name, emergency contact number (preferably the personal number), email, password, passcode and their current location will be tracked automatically as their home. Then if the user presses the register button, the app then registers the user in the firebase database and then redirects them to the home page.

Fig. 5 - Onboarding Screen

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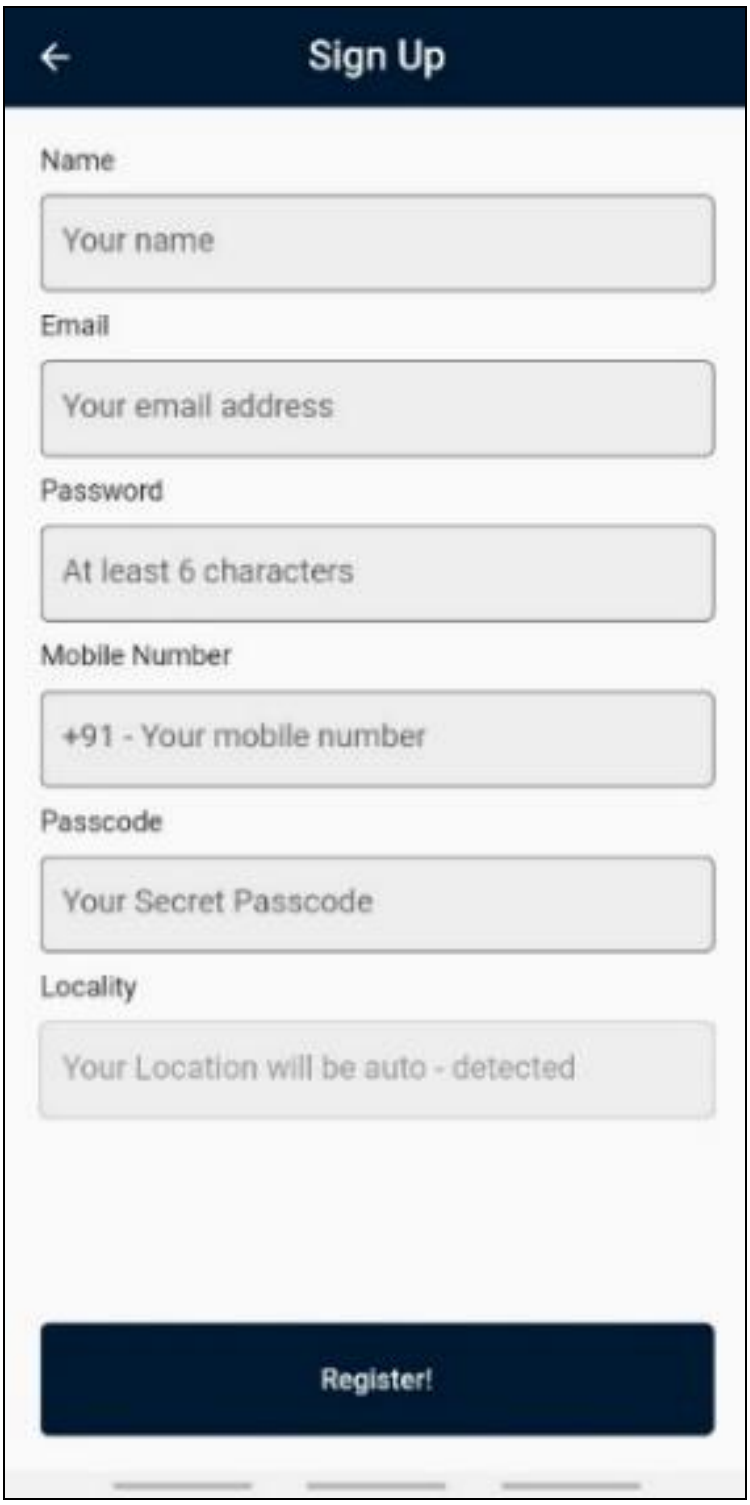
Fig. 6 - Sign Up Screen

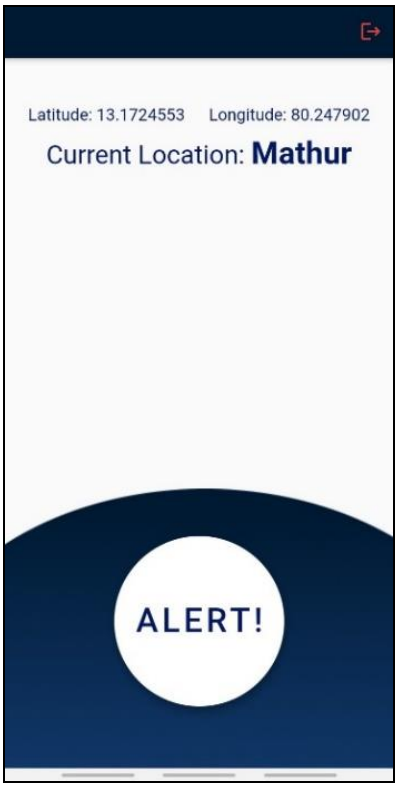


Case 2: If a user is already a member and opens the app after installing, the user can be navigate to login page as shown in fig 7 and sign-in by using their email and password. The app then validates the user and will redirect the user to the home page only if the given details are valid.

Fig. 7 - Login Screen

Case 3: If the user is already logged in and closed the app, and if they try to reopen it later, the app will then automatically log them into the home page as shown in fig 8.

Fig. 8 - Home Screen



Case 4: If the user is at trouble and presses the alert button, the home screen will then show how many sentinels are notified and along with a cancel button to diffuse the alert. In order to diffuse the alert, the user must enter their passcode to verify and stop the alert as shown in the fig 9 and fig 10.

Fig. 9 - Alert Pressed

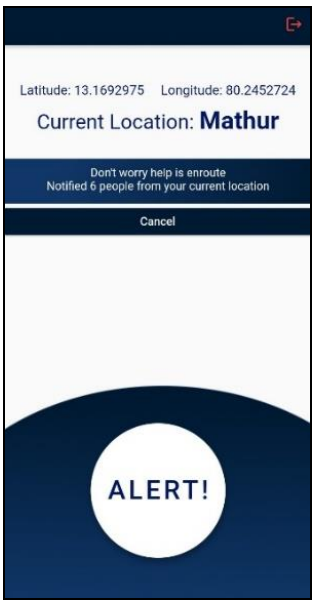


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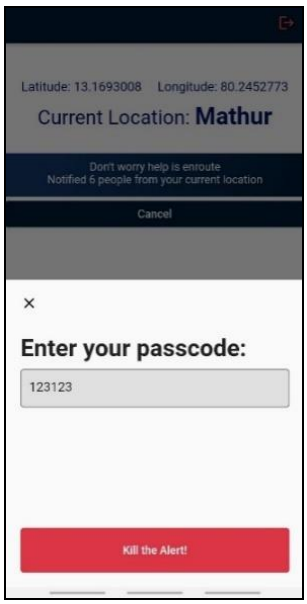
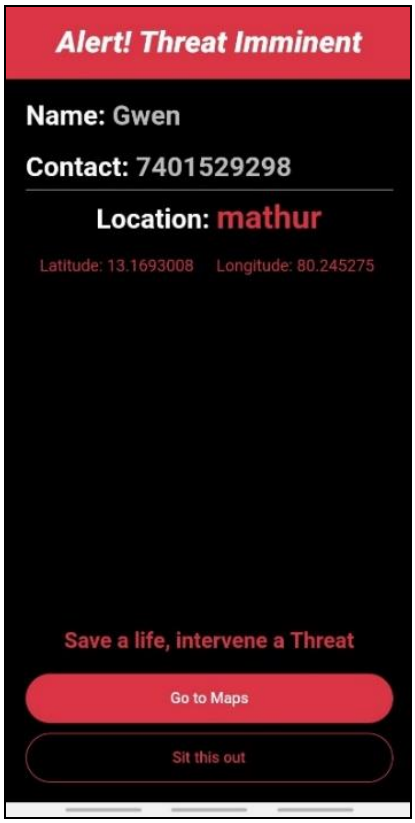
Fig. 10 - Passcode Modal Sheet



Case 5: If the user is already logged in and if any victim in their home location is at trouble, no matter where the victim is from, the app will alert everyone in that specific location and will redirect them to the alert screen (as shown in fig 11).

Fig. 11 - Alert Screen



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The above are the test cases which will be used to render respective pages on the screen.

The home screen has a huge alert button along with the user's live tracked location showing latitude and longitude on the screen. The home screen also has a logout button at the top-right. In times of distress, the victim can press the alert button once and their name, contact number along with their location will be live streamed to the sentinels in that specific area where the distress has been signalled.

The alert screen will have the victim's details and their live location tracked along with a ready to use in-built map in just a click away of "Go to Maps" button as shown in fig 11. The alert screen also shows how many people have reached the scene and whether the police had been informed. When the Go to Maps Button is clicked, the app then redirects the sentinel to the live tracking map screen with both sentinel's and victim's location on map as shown in fig 12.

The app also provides a UI that lets the user know that there is no internet connection by constantly listening to the change in internet connection.

Fig. 12 - Map Screen Showing Sentinel and Victim Location

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When alert button on the home screen is pressed, the victim's current area will be calculated using latitude and longitude of the current location and will be sent to firebase to search the document with the same area name and help is set to true for that specific area. The latitude, longitude and the details of the victim along with their uuid (user unique id) will also be sent to the firebase database.

Then the sentinels of that area will listen to these changes using a stream provider and those details will then be displayed to the users of that specific area. The sentinels can then locate the victim on a live in-built map to help the victim.

The police are informed anyway because the app will alert everyone in the particular area where victim is stuck at, so therefore the police in that area who has the sentinel app will also be alerted.

The victim is the only person who can stop the alert because cancelling the alert requires a passcode which the victim only knows.

The sentinels when presented with the alert screen can navigate to maps and track the victim and intervene for help. The app also detects which sentinels reached the scene by calculating the distance between sentinel's and victim's latitude and longitude using the haversine formula. So, therefore when a sentinel is 10 meters near the victim, their user unique id is collected in the records collection under the area name as the document.

The distance is calculated by using the following function:

The function takes the victim's and sentinel's latitude and longitude as the input. The function then checks whether no latitude or longitude is null. The formula the function uses is given below.

$$\text{Distance} = r * c$$

Where r is the radius of the earth. (Here, the r value as 6371 to get back the distance in kilometers.

And $c = 2 * \text{atan2}(\sqrt{a}, \sqrt{1-a})$, where $a = (\sin(\text{lat2-lat1/2}))^2 + (\sin(\text{long2-long1/2}))^2 * \cos(\text{lat1}) * \cos(\text{lat2})$

Here, lat1 and lat2 in cos function is taken in radians.

lat 1 and long1 is the latitude and longitude of the victim respectively whereas lat2 and long2 are the coordinates of the sentinel.

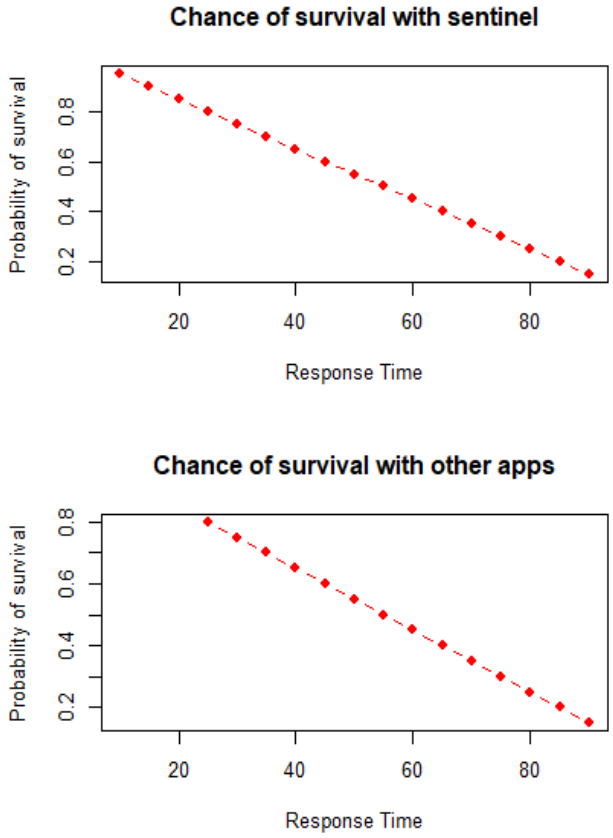
When the sentinel distance is less than 5 km from the victim, the application then makes a record of the sentinel's details in the backend for future references.

The app also keeps a track of how many people reached the scene by incrementing the count field in the records collection when each sentinel reaches the scene. This can be very useful in investigating the case in the future with a handful of witnesses.

5. Result and Analysis

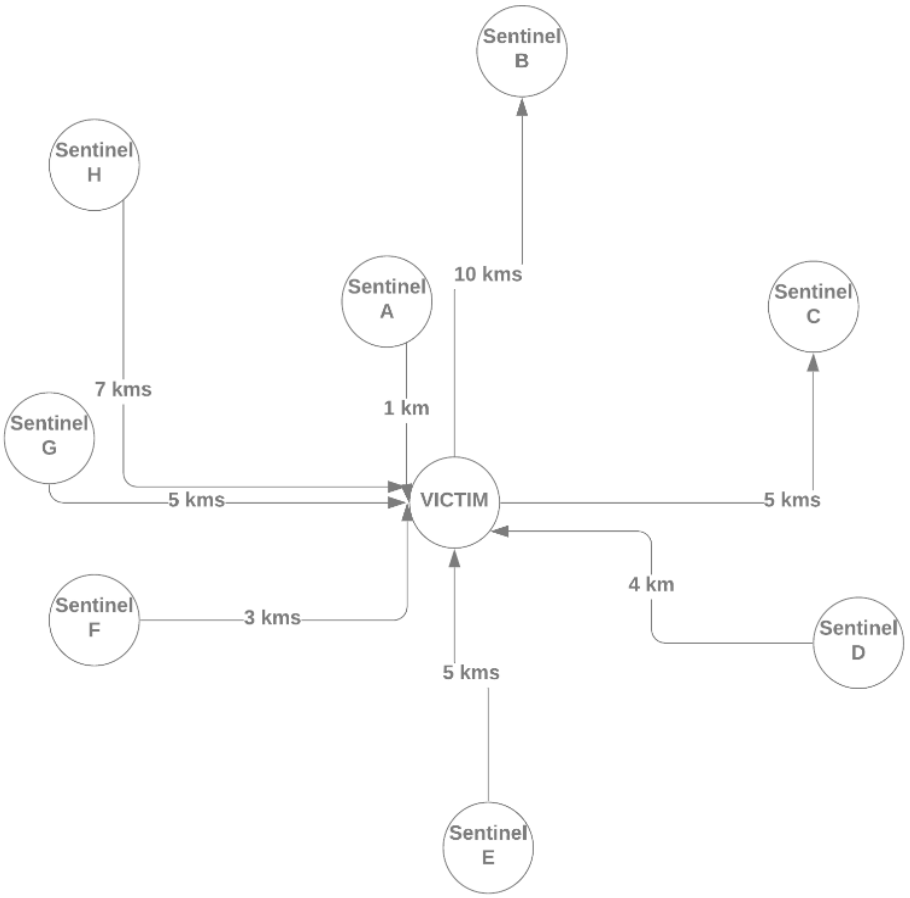
The result can be concluded by analyzing the test cases. First case is that when the family, friends and police are all away from the victim at the time of distress at least a minimum of 20 km or worse case way more than that. So even if the victim decides to send an SOS Alert to the pre – registered contacts, it will be too late for them to reach the scene on time which decreases the probability of surviving for the victim. As for every 1 minute delay, the probability decreases by 1%. The second test case is that when the victim has the sentinel app and starts an alert, the people's response time would be way faster than the other ways. Every single one in the region will be alerted and everyone will be aware how many people have reached the scene and whether the information has reached the police. As seen in Fig.13, with the increased response time, it dramatically increases the survivability rate along with it.

Fig. 13 - Survival Probability vs Response Time (Sentinel vs Other Apps)



From the following fig.14, it is safe to say that whoever is nearby can reach the victim as faster than the others and can prevent the threat from happening.

Fig. 14 - Visualization of Potential Crime Scene with Sentinels Nearby



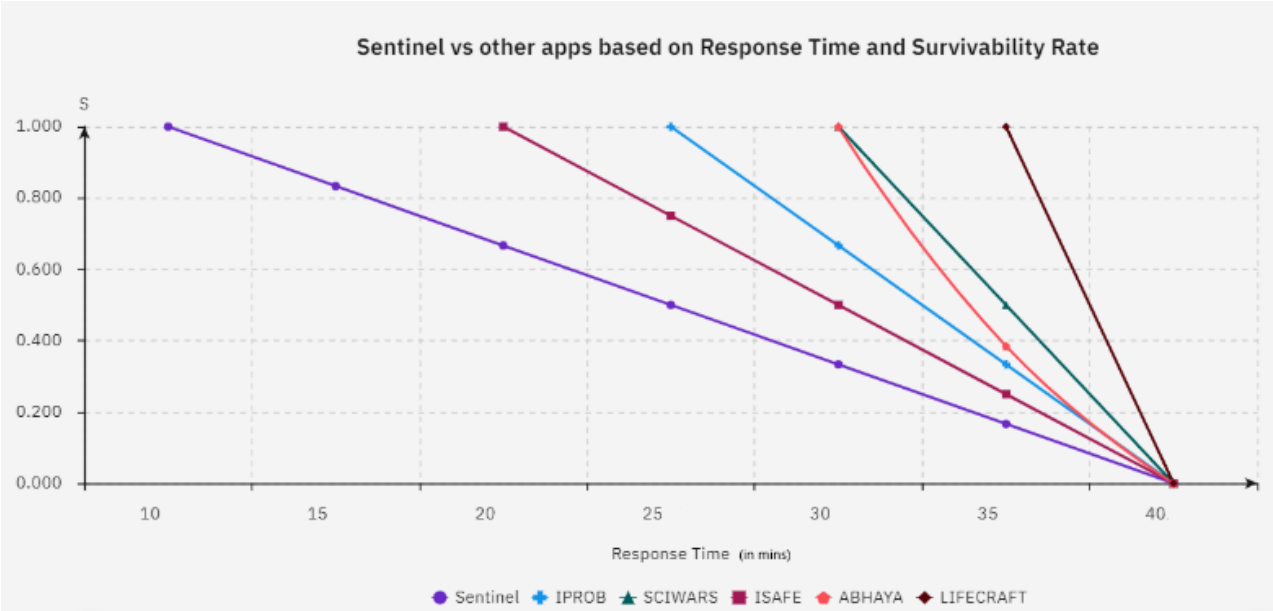
It is clear that sentinel A is nearer to the victim than other sentinels. So sentinel A can reach the scene first and verify that it's not a fake call. If 3 sentinels vote that it is a false alarm, then the distress will automatically be cancelled and all their details will be stored in the backend database for future references. Unlike other apps, the sentinel app not only alerts the family, friends and police but also everyone in the area to get all the help one can get.

Table 1 - Evaluation Metrics of Sentinel vs Other Apps

Apps	Metrics					
	Response Time	Survival Rate	In-Map option	Pass message to stored contacts	Location Accuracy	No internet option
SENTINEL	10 mins	95%	Yes	Yes	High	Yes
IPROB	25 mins	80%	No	Yes	Medium	No
SCIWARS	30 mins	75%	No	Yes	Medium	No
ISAFE	20 mins	85%	No	Yes	Medium	No
ABHAYA	25 – 30 mins	75% – 80%	No	Yes	Medium	No
LIFECRAFT	35 mins	70%	No	Yes	Low	Yes

From Table. 1, it is clear that Sentinel performs better than the comparative applications developed for this very purpose. The survival rate of Sentinel app stands at 95% since the response time is relatively faster when compared to other apps. So, therefore the response time is inversely proportional to survivability rate. isafe is the second app which has the high survivability rate with 85% survival rate whereas abhaya and iprob starts with a 80% survivability rate. The rest of the apps are at below 80% since the location are sent as a SMS message. The guardian has to reopen the new messages with location update again and again to get the location of the victim which takes up the time and also it is the same case for isafe app but the messages are sent with a google maps link which will make the response time lesser when compared with other apps excluding sentinel.

Fig. 15 - Visualization of Table.1 in Terms of Survival Rate and Response Time for each Application



From Fig.15, it is clear that the sentinel app can respond in 10 mins as for other apps it takes about at least a minimum of 25 – 30 mins to respond in action.

The Sentinel application has the highest survival rate in accordance with response time.

6. Conclusion and Future Work

The Sentinel App is developed for the safety concern of women and young children. The app ensures that the victims get help as soon as possible by alerting everyone in that particular area where the problem is. This app ensures that the details of the victim is shared to everyone in that area along with the live streamed location of the user with a in-built map so as to not to waste time with

redirecting to different apps while on rescue. The app also notifies the victim how many people are notified so that the victim is informed that the help is on their way and as soon as a sentinel reached the victim, their details is also collected for a proof that they were on scene. Thus, this app provides an easy to use interface and reliable platform for ensuring their safety. Therefore the women and children can walk alone even in the darkest nights without any fear.

Sentinel App can be further developed to have a livestreaming video option as soon as the victim presses the alert button so that we can enable sentinels to pre watch what the situation is about and come prepared. The live streamed video then saved in the database for investigation purpose.

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