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Using a map matching technique, real-time position tracking for security purposes

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Abstract

Initially I planned to make an app to track where the live location of Near East University buses were (by sharing their live location) but as I researched a bit about this implementation of the application .with my supervisor's guidance I came to know that it can be used in many different and more beneficial ways When I was doing my research for the different uses that this application can be applied to, out of all different scenarios and implementations of this Live Location Tracking Application the most prominent and useful scenario is without a doubt, for it to be used by emergency services such as the police, the medical facilities (ambulances) and the general safety departments (fire departments and zabita etc.).
Further explained in this research you shall find how this application is intended to work

Keywords: map matching technique, real-time position tracking, security purposes.

Introduction

In most cases of accidents, the number 1 cause of fatalities is the emergency Services arriving late. Now the most common reason that affect the estimated time of arrival can vary from things such as Traffic congestions to a lack of sense of directions. By using this application an added benefit to using GOOGLE map's libraries Is the fact that we use the facilities of GOOGLE MAPS that Give the real time forecast of things such as traffic. We will know which route has more traffic and which route can save

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time in order to get to the destination along with an estimated time of arrival. These features when combined can give us a broader sense of saving time even seconds which is crucial to save lives in such life-or-death situations In Britain alone, an estimated 2500 lives are being lost a year due to ambulances arriving late while responding to an emergency call. And this figure is only for the cases of patients with heart attacks, strokes and burn victims. The average response time in Britain for such emergency calls should be 18 minutes but, in most cases, patients have to wait for an hour or even more than that. The problem affects every 1 in 16 “emergency” cases in England. A substantial contributor to these “delays” is the uncertainty of how an area is populated with traffic and estimating the best route to get to the destination with the least traffic [1-5].

The aim of this research:

Each year thousands of lives are lost in accidents or medical emergencies while waiting for emergency services to arrive, may it be an ambulance, a police squad or even fire services. In most of these cases the biggest factor to these delays is usually the following reasons. A general lack of information about the location of the emergency can cause priceless minutes to be lost. Other reasons such as emergency Services being caught up in traffic or the survivor mistakenly gave them an Impartial or wrong address.

These simple yet life altering mistakes end up causing the lives of countless people to be lost. That’s where this proposed project aims to overcome these problems and wants the emergency services to have an advantage while trying to save lives by have a real time location of the patients marked on a map which will be accurate up to a few meters.

Even in the case of traffic which is a random factor and is uncontrollable these paramedics can actively see life traffic “forecasts” and see which route has the most traffic and which route has the least traffic and decide which route they want to take in order to get to their destination as soon as possible. These little advantages when combined together can prove to be a powerful tool in order to save lives.

1. SYSTEM ANALYSIS

Analysis can be described as partitioning a complete figure, to find out their nature and get a better point of view of the whole equation, function. It describes as designing to make fundamental sketches or to design a pattern for Devising to follow through, especially by a distinct arrangement or completing a task skillfully. System design or analysis and can be described as a set of processes and techniques, we will discuss how and what went behind the creation of this application. Analysis consists of the following steps:

- Devising.
- Appropriate Scheduling.
- Developing solution.
- Carrying trade studies.
- Carrying cost benefit comparison analysis.
- Comparing other solutions.

- Controlling, implementing and maintaining the system.

Such a system manages the analysis of the location tracking features in a mobile device intended to be used in life saving situations. The project will help determine the exact location of someone with a few easy clicks and transmit their live location to the emergency services while allowing the patient himself to see the live location of the emergency services coming to his rescue giving an estimated time while comparing routes to monitor traffic in a live feed provided by GOOGLE MAPS SERVICES.

1.2 EXISTING SYSTEM:

In a state of emergency, the existing system is outdated and impractical especially considering that we have such evolved and modern technological inventions we can use for this purpose. In the existing state, someone in need of help has to call and manually co-ordinate his exact location to the emergency dispatch. While this project wishes to eradicate wastage of time and false information being given such as an impartial address

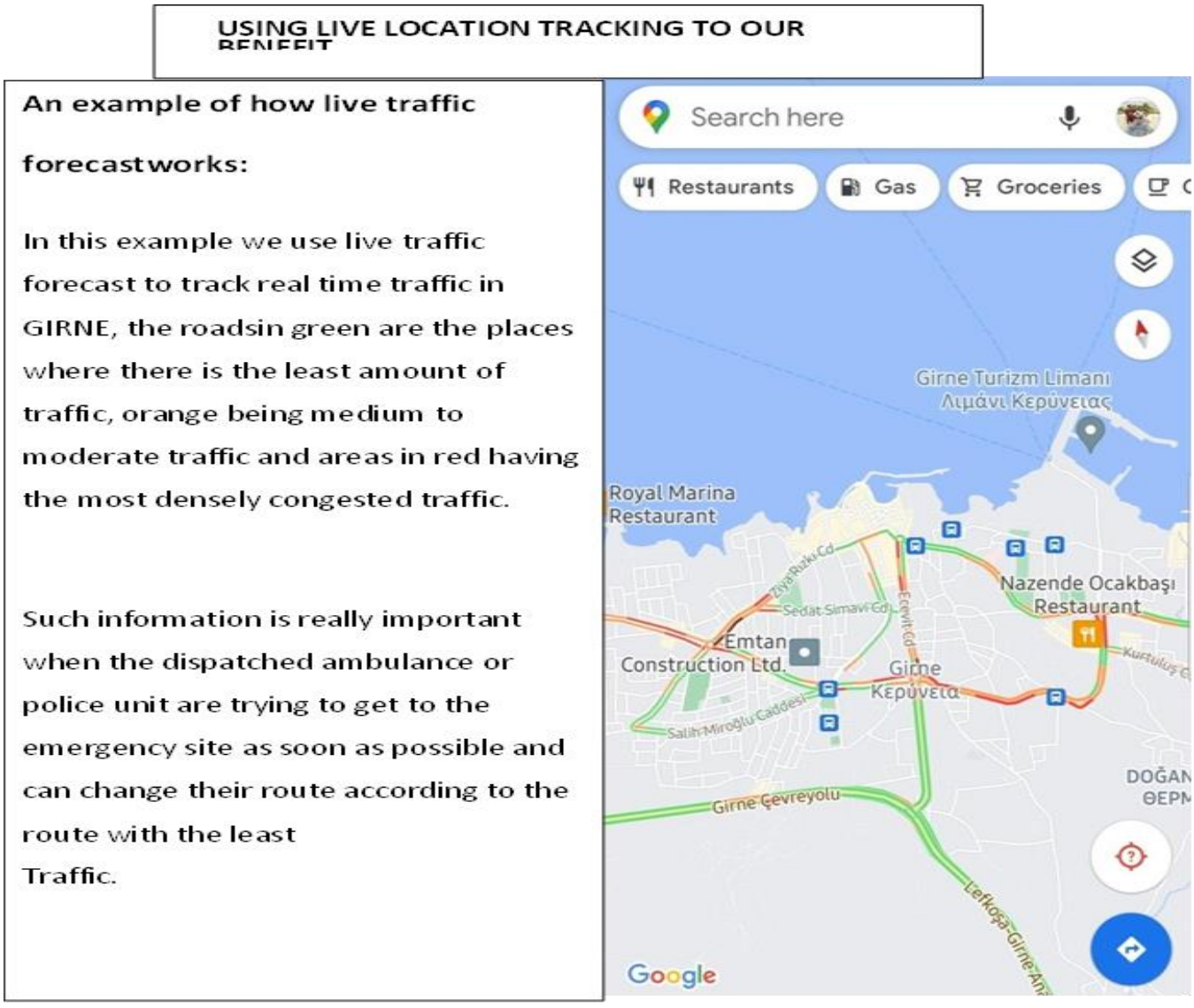
1.3 PROPOSED SYSTEM:

To overcome the drawbacks of the existing system, the proposed system has been evolved. This project aims to reduce the time taken for emergency services to arrive at the place of emergency by guiding them to the exact location, while providing them with useful information such as the name, blood type, allergies, age of the patient while the dispatch is on the way to help them prepare better and save crucial time. All of this useful information is provided along with the live location of both patient and dispatch to each other. Also providing live traffic updates to manage the best route to the scene.

1.4 How this project aims to solve the issue with the random factor of traffic

All smartphones these days come pre-equipped with sensors and features, the most prominent one which we will be using to our advantage is the GPS (Global Positioning System) receiver/transmitter. This receiver/transmitter uses radio waves to communicate with satellites orbiting the Earth and approximates your location with accuracy. To make things simpler we have grown accustomed to using graphical interfaces, as an example of such graphical interfaces we will be using Google Maps Libraries as the benefits of using it are substantial and another benefit to using Google map is that it is already maintained and updated regularly.

As an added feature to using Google maps as the mapping library is the fact that Google maps already has the means to monitor real time traffic. How that works is, almost all devices that are turned on are actively being tracked by Google maps services and the Global Positioning system satellites. And all the location data that is being transmitted by these mobile phones is then compared to each other to approximate their locations and how far these devices (mobile phones) are from each other, and in doing so we can approximate how much traffic there is in a particular area and which routes are best to take in order to save time



USING LIVE LOCATION TRAFFIC CORECAST TO OUR BENEFIT IN EMERGENCIES.

2.THE STRUCTURE AND OPERATION OF LIVE LOCATION TRACKING

2.1 HOW THE TECHNOLOGY WORKS:

This research paper Is about creating an application that we use in emergencies to tract and transmit live location of 2 devices (1 the user, 2 the emergency dispatch). To achieve this feat, we have to use the technology of Global Positioning System To our advantage, but first we need to have a keen understanding of how the Global Positioning System works.

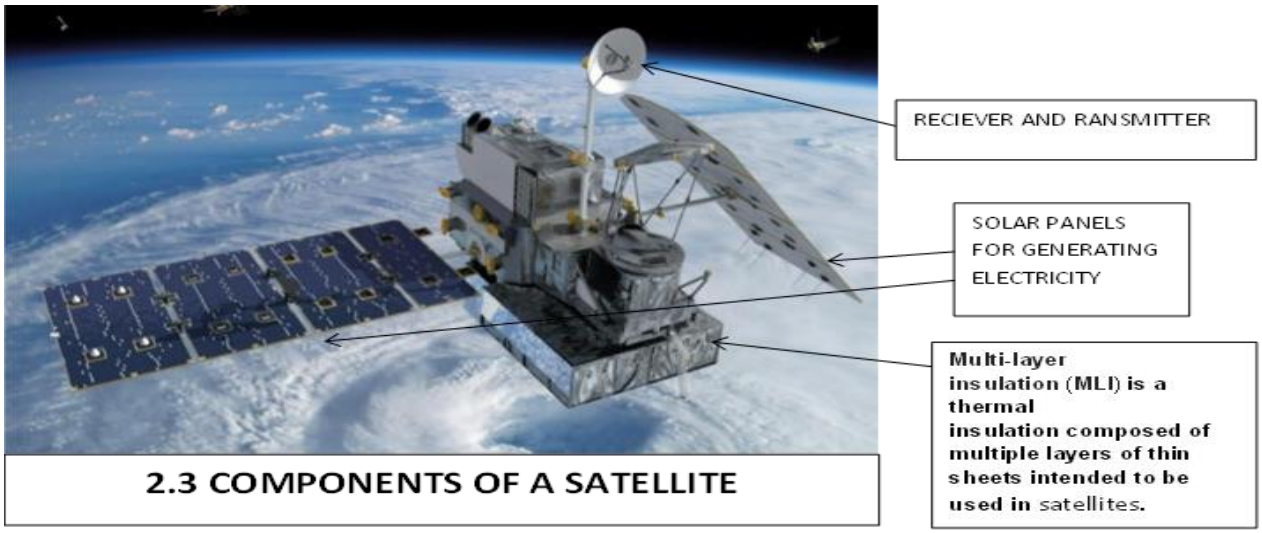
HOW THE G-P-S (GLOBAL POSITIONING SYSTEM) WORKS:
First, we need to understand how we sent satellites up into the orbit of Earth. In the past there were government monitored departments like NASA (USA), CNES (FRANCE), CNSA (CHINA) ESA (EUROPE), ISRO (INDIA), JAXA (JAPAN) ETC. But recently, private companies like SPACE X, BOEING, BLUE ORIGIN have been successful at creating their dominance in the "SPACE RACE". These companies develop the rockets that transport these satellites from the surface of the Earth to their intended trajectory in Space. Embedded in these rockets are the satellites and supplies for the astronauts that are orbiting earth. These companies meticulously calculate the date, time, weather, humidity and all natural factors before deciding the trajectory of each rocket launch. When the time is right these rockets lift off on a certain trajectory to earth so that the satellites once in position, stay at their intended track and along the way detach in segments to send these satellites off to their trajectory (path) [6-10].

2.2 HOW THE GPS SATELLITES ARE SENT TO SPACE

We use rockets to deliver these satellites into the earth's orbit. These satellites have a lot of engineering that goes into making them. They are designed to deflect cosmic radiations; the vacuum of space (lack of atmospheric pressure), temperature shocks up till −270.45 °C, and these satellites use a combination of solar power and batteries to meet all their electrical necessities.

2.3 Components of A Satellite

The global positioning system (GPS) is an interconnected network of around 31 constantly working satellites that are consistently orbiting the Earth. As of now, anybody with a GPS gadget (either a cell phone or a handheld GPS unit) can get wireless signals from those satellites. Wherever you are in the world, at any instance at least four GPS satellites are



2.3 COMPONENTS OF A SATELLITE

'visible'(connectable) and transmit signals about their position. At any time and place, you are within the reach of at least 3 to 4 satellites no matter where you are on earth or when you are there. The GPS chip from your cell phone receives those signals. At that point, it figures how far these three satellites stay from your current location. by using this data, your GPS chip provides the specific directions of your actual location by using a process called 'trilateration'

Contrary to popular belief Global Positioning System does not track your location but you track its Location and relative to it you can calculate your location. It consists of 30 satellites, receiver and an accurate clock. Without having a super accurate notation of time, we cannot achieve Global Positioning System. So, the satellite network also needs to know the precise time relative to one or all satellites to operate so we needed an absolutely precise clock. The clock that has such accuracy is known as an atomic clock. And how it works is further discussed:

2.4 ATOMIC CLOCK

All of these satellites operate by using atomic clocks to monitor the time. The atomic clock operates by sensors powerful enough to map the vibrations of the electron of a single atom in a second. And in doing so these clocks generate precise number of oscillations per each second. The atomic clock is so precise that it can measure up to billionths of a second by consistently monitoring the electron-vibration of an element called Cesium-133 in a second. Cesium-133's electron vibration is equal to 9,192,631770 (9 billion, 192 million, 631 thousand and 770) in a second virtually enabling the atomic clocks accuracy is precise up to Nano seconds.

By April 2008 there were 24 Global Positioning System satellites, each having 4 atomic clocks onboard. As well as transmitters to send microwave signals down to the planet below. The network of satellites is physically travelling at 7,000 Mph (7 thousand miles per hour) Or 11,000 K/H (11 thousand kilometers per hour) with an altitude (height from the surface of Earth) of roughly 12,500 miles or 20,000 kilometers above the earth's surface. Their decided course of trajectory and maintenance is done by the United States Air Force.

Global Positioning System's microwave signals are transmitted and received at exact intervals (every few seconds). Embedded into the microwave signals that is being transmitted, is the identification data of the satellite sending it also the health status of the satellite and the location of all the satellites of the entire Global Positioning System along with the very precise date and time.

2.5 THE ELECTROMAGNETIC SPECTRUM

The precision of time is of huge importance that defines the accuracy of the signal because microwave signals travel at the speed of light roughly 300,000 km per second, Microwaves are electromagnetic rays with a frequency range of
0.3GHz to 300 Ghz.

So, in a fraction of a second the signal travels from each satellite to you, this is why we need the accuracy of atomic clocks, because a small 20 to 30 Nano seconds can make the entire satellite system worthless. The receiver can tell where each satellite is by calculating the difference in time lag from the signal by using a mathematical process called "trilateration", the Global Positioning System unit can determine your exact location. Basically, a sphere is drawn around each satellite, indicating the time lag from each overlapping point where they all intersect and this intersecting point is your current location.

There is not an atomic clock in our smartphones! As long as the smartphone's clock is pretty good and is regularly updated by the data observed from the United States Naval Observatory, it is precise. The more satellites that our phone can connect to, the more accurate our location will be. For example, if

we are connected to 3 satellites, we can locate our longitude and latitude (coordinated location) but if we connect to 4 Global Positioning System satellites, we can also determine our altitude (height).
Even after all this, there are a lot of other complications such as:

2.6 COMPENSATION FOR TIME LAG:

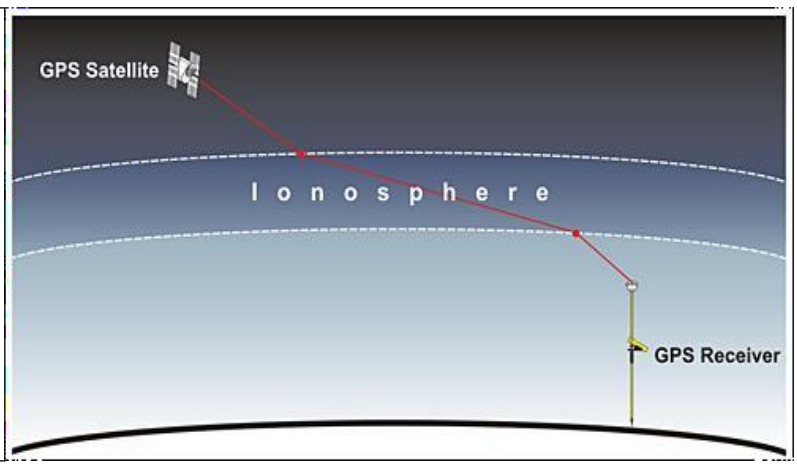
As we change our location, the time lag from the satellites reach our device's Antenna differently and constantly will update with the math of trilateration, causing our location to be updated on the map, hence locating us in real time.

2.7 THE OPERATIONAL LIFE SPAN OF SATELLITES:

can range from 7 to 15 years of service, so the satellites need to be replaced.so we have to keep launching new ones. Currently we have the 5th generation of satellites in use [11].

2.8 THE IONOSPHERE

In most cases of inaccuracy, the signalbeing transmitted from the satellite bounces off an ionic layer in the atmosphere called the ***"Ionosphere*** "while being transmitted causing a delayed or even inaccurate reading oftime lag. The ionosphere is the same thing where AM radio frequency regularly bounces off of.



On top of all that these satellites travel really fast (11,000 K/H) and are really far (20,000 kilometers) away meaning we need to use Einstein's theory of general relativity and special relativity due to compensate for the difference of relative time and velocity between these satellites which requires a lot of processing capabilities.

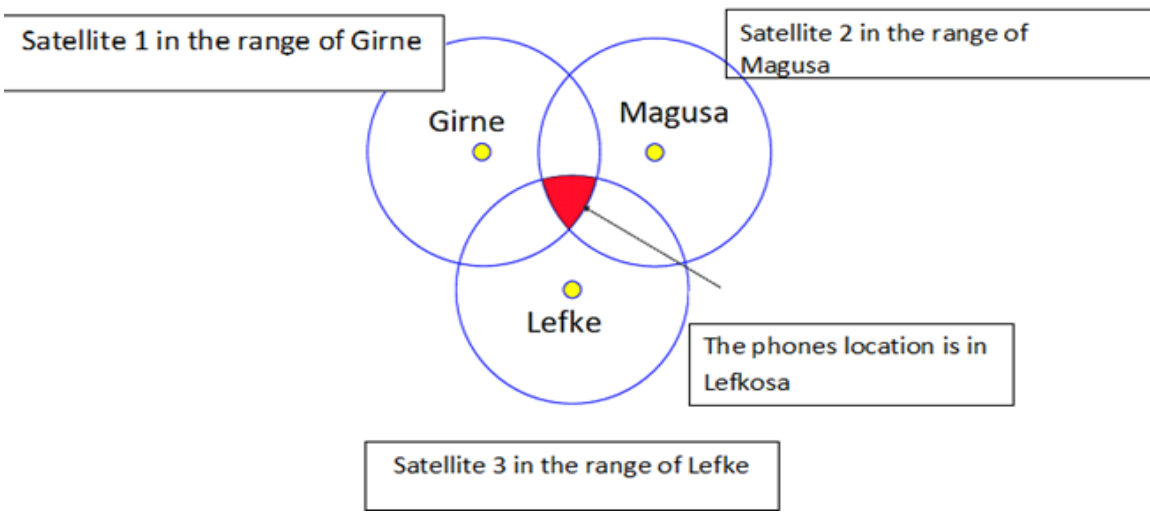
A strange fact is that even the atomic clocks in the satellites are ticking faster than the one's down here because of the stronger gravity down here because time is relative, so the Global Positioning System has to mathematically calculate and adjust its time for 45,000 Nano seconds each day to compensate for the time difference between earth and the location of the satellites which is thousands of miles away.

So, in general to locate someone's co-ordinates in real time we have to use the facilities of the international space program, Einstein's relativistic physics, an atomic clock, a network of satellites, and a smartphone equipped with a Global Positioning System receiver operating on the right software.

2.9 THE DETAILS OF LIVE LOCATION TRACKING:

2.9.1 TRILATERATION:

For active location tracking or live location tracking we need to understand a few things that make it all possible. The You can always accurately track the location of someone who has a GPS-enabled smartphone. Therefore, GPS tracking on mobile phones will be a useful feature. But to achieve that we have to use a process called Tri-alteration which basically means 3 different ranges of locations inter-lapping each other and the location that has all three ranges interacting to a pin point is the location we are looking for. This technology is used to track cellphones by using active satellites.
3 orbiting satellites send and receive signals to a phone and calculate the time lag that the phone emits to each satellite. By doing so the approximate location of the mobile phone is found out.
Explaining the process of TRILATERATION



2.9.2 THE GPS OPERATING BANDWITH(FREQUENCY):

G-P-S (Global Positioning System) is a satellite-based navigation system. It is made up of more than 23 active satellites. G-P-S continues to works in all weather conditions, at any place in the world, 24 hours every single day, with no subscription fees or setup charges. This service was made available for civilian use in the 1980s.which means that the number of users increased drastically. GPS relies on microwaves to communicate but other technologies like long range radio, AM, FM also use the method to of Electromagnetic waves transmit data. This raised a question. If the frequencies were to somehow match or interfere, that could put this multi-billion-dollar facility to jeopardy. Some restrictions were made to ensure that never happens. Such as restricting the GPS system to operate with a specific frequency to prevent overlapping of the signals or to prevent interference.
GPS Technology operates in the following frequency bands (frequency range):

- GPS Level 2 Band: 1227.6 MHz with a bandwidth of 11 MHz
- GPS Level 5 Band: 1176.45 MHz with a bandwidth of 12.5 MHz
- GPS Level 1 Band: 1575.42 MHz with a bandwidth of 15.345 MHz

Global Positioning System (GPS) is a satellite-based navigation system where the correctness of the navigation solution is more essential than the average BER The GPS signal now has a protected bandwidth of 24 MHz, despite the fact that the GPS signal itself covers a substantially larger bandwidth. Current GPS, like other digital communication systems, is based on spreading codes and data formatting, with the signal power peaking at the carrier frequency and following a function away from the epi-center.

The upgraded GPS employs a binary offset carrier formatting scheme (BOC). Peaks (there are two primary peaks) for BOC signals exist distant from the center and over any bandwidth, given that GPS currently has a protected bandwidth of 24 MHz.

Signals and Which criterion should be utilized to define such a bandwidth for signals? a European version of the GPS and a member of the GNSS (Global Navigation Satellite System) Since Galileo, uses BOC signals in the same frequency range as the GPS, a suitable specification of bandwidth for navigation is Signals to be Protected signals are desperately needed [12-13].

2.9.3 TYPES OF LOCATION TRACKING SYSTEMS:

As far as classification goes, location tracking applications can be distributed into two basic categories which are 'real time' and 'non real time'. A 'real time' location tracking application continually tracks a user's co-ordinates whereas 'non-real time' location tracking applications, in actuality.

GPS tracking systems work in a variety of ways. From a general point of view, GPS devices are commonly used to track a user's location as they travel. Active GPS tracking systems are well known as real-time systems. This is because this method automatically sends information about the GPS system to a central tracking portal or system in real time.

2.9.4 REAL TIME LOCATION TRACKING:

The term "real-time" is often used, it doesn't actually mean real-time, but rather regular updates at specific time intervals, it could be minutes or seconds or even Nano-seconds depending on the nature of the use of the application. For the use of our purpose in emergency services we have to look after a few details such as low battery consumption and the ability to track devices constantly. And for that I had initially decided to make the algorithm refresh the users' locations every half a second when mobile and every 3 seconds when stationary. But seeing how that would be inefficient for the battery due to the constant processing requirements.

2.9.5 PASSIVE (INTERMITTENT) GPS TRACKING SYSTEM:

Passive GPS tracking systems process locations and store travel data in response to certain types of events. For example, these types of GPS systems can store data. B. Where the device has been driven in the last few hours. Information stored in such geolocation tracking systems is typically stored in internal or external memory cards and can be uploaded to your computer for later analysis. In most cases, the data will be sent automatically wirelessly at a pre-determined date and time, or it can be tracked at a specific point in time during during the journey.

2.9.6 USING GSM TECHNOLOGY TO TRACK MOBILE PHONES:

G-S-M localization considers the usage of multi-alteration to define the location of G-S-M mobile phones, with the need to locate its user.

Localization-based Systems can be broadly divided into:

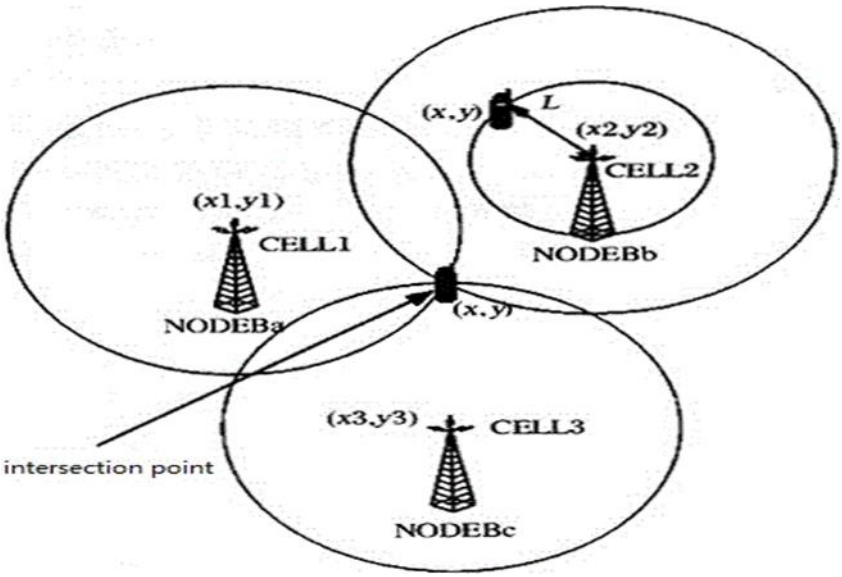
- Hybrid
- Handset based
- Network based

2.9.7 Network- Based Tracking

Network based technology uses the service provider's networking infrastructure to describe the exact location of a handheld device. The pros of network-based technology (by the mobile user's perspective) are that it cannot be used intrusively without affecting the mobile phone. The accuracy of the network-based method varies, with cell identification being the least accurate and triangulation being the most accurate. The accuracy of network-based technology is highly dependent on the concentration of cells in the base station, achieving the highest possible accuracy in an urban environment. Apart from GPS, a smartphone's location can also be determined by several other means:

2.9.8 CP-ID (CELLPHONE ID TRACKING) TRACKING:

Cellular id better known as CELL ID works By signals of the phone's base stations where a cell phone is connected (the 'Cellular ID'); we can triangulate where the device is located but this method is not so precise because it can only accurately provide the estimation of the phones location in a 300 meters radius.



It has the same working procedure as trilateration of satellites but instead of satellites, base stations check their range for the phone's location

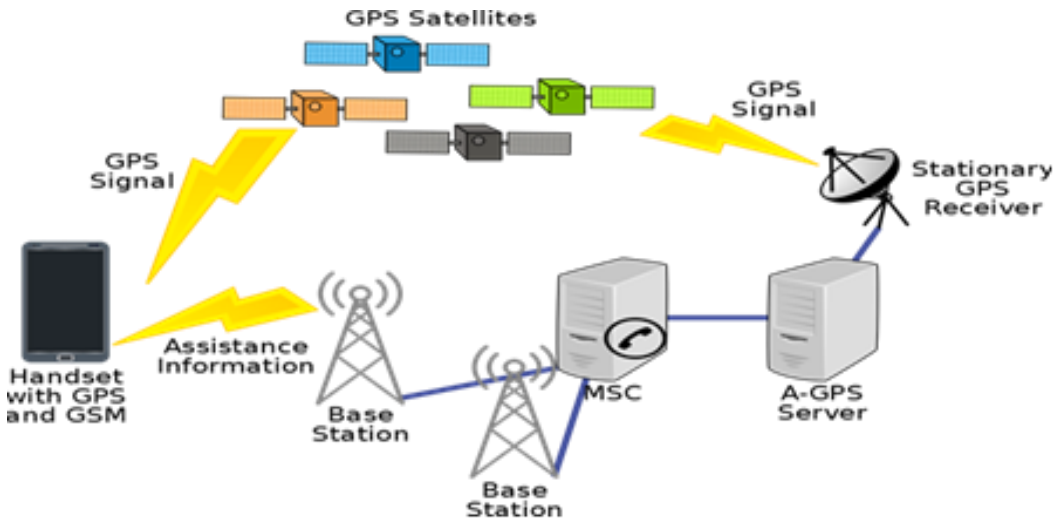
2.9.9 Handset Based Tracking

Handset-based technology requires the installation of client software on the handset to determine its location for E-911 purposes. This technique determines the location of the handset by computing its

location by cell identification, signal strengths of the home and neighboring cells, which is continuously sent to the carrier. In addition, if the handset is also equipped with GPS, then significantly more precise location information is then sent from the handset to the carrier.
This technology requires client software such as ATNT and VERISON standard bloatware to be installed on the mobile phone. This is a major drawback as it is difficult to install software on mobile phones without the user's consent.
The software needs to be compatible with various operating systems such as ANDROID or IOS. Active cooperation between mobile subscribers and software that need to be able to handle the various operating systems of the end device is required. Generally, smartphones based on B. Symbian (old Nokia operating system), Windows Mobile, iPhone / iPhone, or Android can run such software.

2.10 HYBRID TRACKING SYSTEM

Like the name suggests, for location determination, hybrid positioning systems combine network-based and handset-based technology. An example is Assisted G-P-S, which computes the location using both Global positioning system and network data. Hybrid based solutions provide the highest accuracy of the three, but they also inherit the constraints and problems of network- and handset-based technologies.



The phone in the figure above is actively receiving / transmitting the location data to the GPS satellites and the cellular base stations at the same time. The satellites also use resources of the cellular network to triangulate the location of the phone and send the data to the cellular network's stationary receivers and then the MSC servers, A-GPS servers and transmit it to the phone using the base stations to shorten the connectivity time and to increase the accuracy.

2.11 B-L-E (Bluetooth Low Energy):

Bluetooth-low-energy is a wireless communication radio-frequency (RF) technology that may be used to identify and monitor the location of people, devices, and assets for a variety of indoor positioning applications, such as asset tracking, indoor navigation, proximity services, and more. Bluetooth is a technology that is quite common and accessible, and it is supported by a large number of modern gadgets.

2.12 GPS (global positioning system) tracking:

GPS is initially slower in general if all requirements are completed by the device, it has the best accuracy, measuring roughly 10 meters. When the GPS sensor is turned on for the first time after a lengthy period of inactivity, it must first receive data from the satellite before triangulating it. As a result, obtaining location data might take up to two minutes. GPS sensors can acquire data about a new place considerably faster once they've established a link with satellites. This is a major pillar that defines the time factor for an application like this because time is crucial when it comes to creating an application that is intended for the use of emergencies

2.13 Wifi (wireless fidelity) tracking:

Wi-Fi is initially faster but inaccurate when compared to GPS Wireless fidelity technology provides an accuracy level of about 300 to 500 meters. If the connection has already been activated, the location data can be received faster than GPS alone. The GPS system will require more time to establish a connection with satellites [14-15].

2.14 IP tracking:

Is initially faster as compared to the others but it is virtually inaccurate. The level of accuracy when using an IP address can sometimes be precise up to 30 meters or have an error of up to 1 kilometer depending on the connectivity making it nearly useless for our intended purpose. As you can see, each of these providers has its strengths and weaknesses, and each one is good for GPS tracking application development in its own way. Naturally we get to the conclusion that there are a lot of different kinds of technology that we can use to track the cellphones but which one is the most beneficial one in which conditions? The following table explains the pros and cons of all the technologies.

- **Comparasion Of Geolocation Technologies**

	GPS	WIFI	BLE	NETWORK BASED
Indoor/outdoor	Outdoor only	Indoor/outdoor	Indoor/outdoor	Indoor/outdoor
Energy consumption	high	Medium	Low	Very low
Accuracy	5 M	<25m	<25m	3-5 km
Required infrastructure	no	No	Minimal	No
Ideal environment	Outdoor	In/out uncontrolled	In/out uncontrolled	In/out everywhere

2.15 EMBEDDING GOOGLE MAP'S LIBRARIES IN THE APPLICATION FOR ACCURACY:

Even by looking up directions on Google Maps or hailing a taxi via applications, geo-location applications have become an important factor for many successful businesses and almost all of these successful applications rely on Google's mapping libraries because of the regular and free updating.
To match our needs for a geo-location app, we need two APIs (Application Programming Interface) that are a software bridge that allows numerous applications to communicate with each other. The first API is dedicated to learning a user's location and second one is used to implement the coordinates on maps. Those A-P-I's provide the tools that the application s needs to integrate location-based services (LBS) into the application.

2.16 Requirements for development a Geo-location application:

To locate an apple device, we can use: (optional, our project will be based on android devices)
Offline maps are unavailable in the Google map's SDK libraries which are a disadvantage but our use of the application requires being connected (online) so it does not matter to us anyway. For the projection of the location on the map, we will use Google Maps SDK libraries. Data quality is still one of the biggest benefits of using Google's SDK. libraries as it is already regularly updated by Google on a global basis and will require almost no maintenance when the application is complete and operational. The maps show construction outlines, in tiny villages or metropolis cities, along with a street view mode for mega cities across Earth (except countries like China and North Korea, where Google Maps is not available)

2.17 IMPLEMENTATION OF GOOGLE MAPS API SERVICES:

Google map service is the most commonly used map service on Earth. It is provided in most if not all languages and is absolutely easy to implement. We can modify the map's colors to fit our applications image, remove labels or modify road density from the map. This makes it totally customizable and updatable for future references. And since we will be developing the application in an android environment, we will be using the following services:

Android location package which is embedded into the source code of android operating systems. Along with Google Maps API for additional accuracy.

Google Location Services API which is easier to work with, provides more accurate results and has lower power consumption. It allows us to:
To detect user movement and react to these changes
To locate the user's position via GPS, Wi-Fi, Cell ID, or A-GPS.
To visualize our location on the map, the application will use:

Google-Map's A-P-I and Map-View. We must patch the proper Google-App repositories before integrating the map's functions; or the API will not be executable by Android devices.
By using G-P-S, the process of location tracking has to be easier where we can relatively easily find where the location of something is. Our mobile phones have all the technological requirements to show us the particular place our emergency dispatch (ambulance or police squad) are and tell them the exact place we are. The main purpose of our location tracking app is to get information about the user's current place and pinpoint the exact position and to transmit it to the search party (ambulance or police).

LocationManager.GPS_PROVIDER identifies and connects to the location processing satellites and takes some time to deliver the information.

LocationManager.NETWORK_PROVIDER identifies the location depending on the connect-ability of a cell reception tower (cellular transmission or GSM base tower) and Wi-Fi access networks to provide accurate data.

LocationManager.PASSIVE_PROVIDER which returns the location data produced by all different providers and combines them to get the most precisely accurate location of the phone.

Further we will be discussing about the factors that define the accuracy of Global Positioning System and how we can use those factors to benefit us.

2.18 USING GOOGLE PLAY SERVICE'S LOCATION APIS:

For the purpose of our application, we will be using Google's play service location APIs my recommendation is implementing this service to create a G-P-S application since this method is relatively efficient and depletes the battery slower. it by its self decides how to get the proper locations' data.

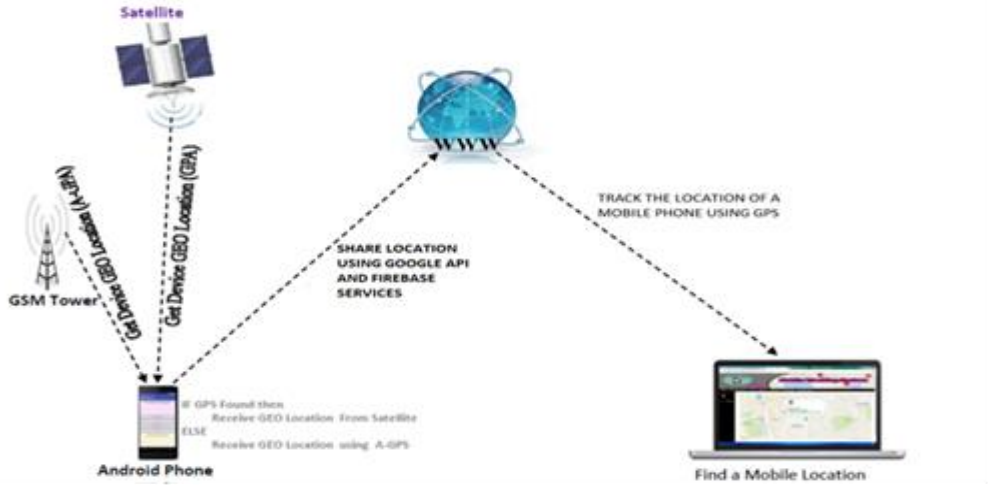
This feature is provided in the Google-Play-Services and provides a modifiable feature package. Live-tracking-system which basically means a GPS tracking device that provides its own location to the other user at a high frequency. It provides users with real time (continuous) and precise location updates after a few seconds. G-P-S locating devices send and receive their co-ordinates by taking the signals. Such a feature can be used for security and safety purpose by tracking the live location of inbound ambulances or police squad units and show the co-ordinates of the survivor the dispatch and also display the incoming dispatch's location to the survivor.

APP DEVELOPMENT

3.0 DEVELOPMENT OF THE APPLICATION

To develop a Live Location Tracking Application there were many things that need to be done. We will see how each and every step is implied while discussing the details leading to how we end up with the finished product.

First, I came up with the concept design of the application to research and learn how to make it simpler to create such an application.



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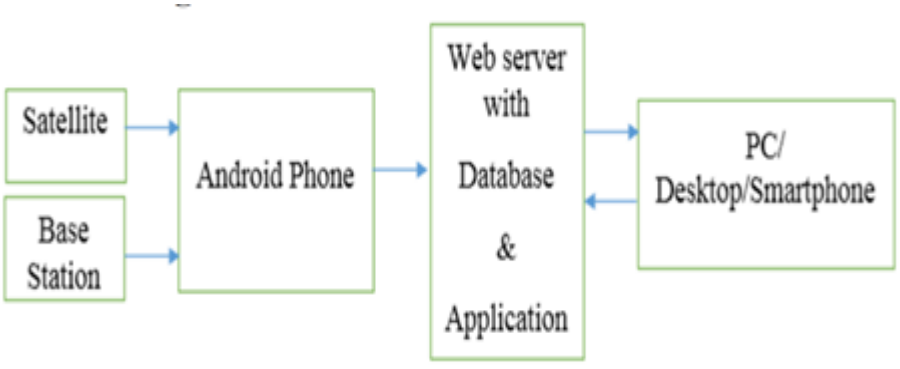
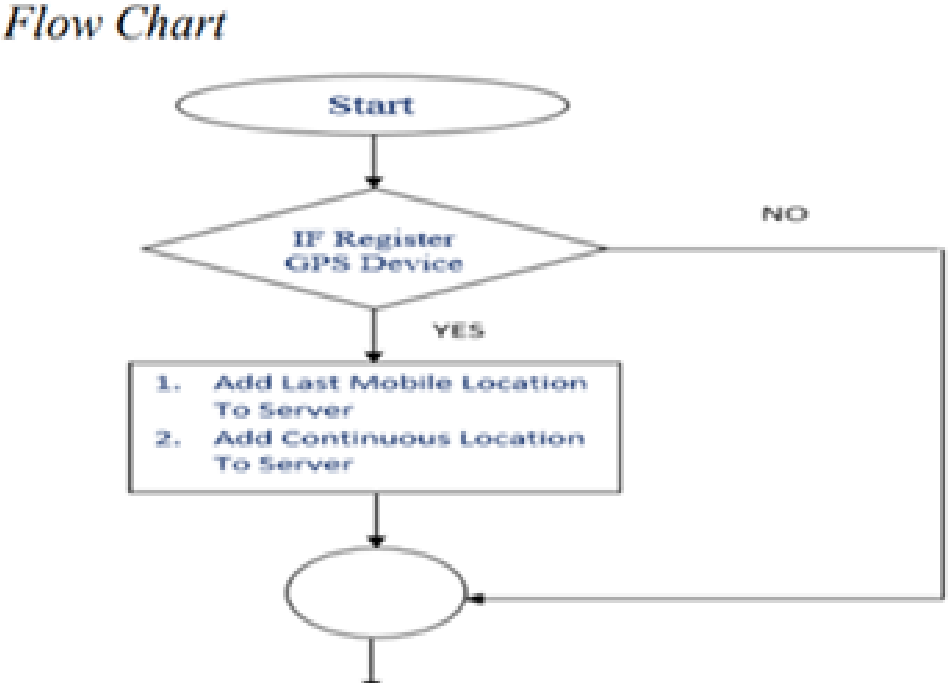
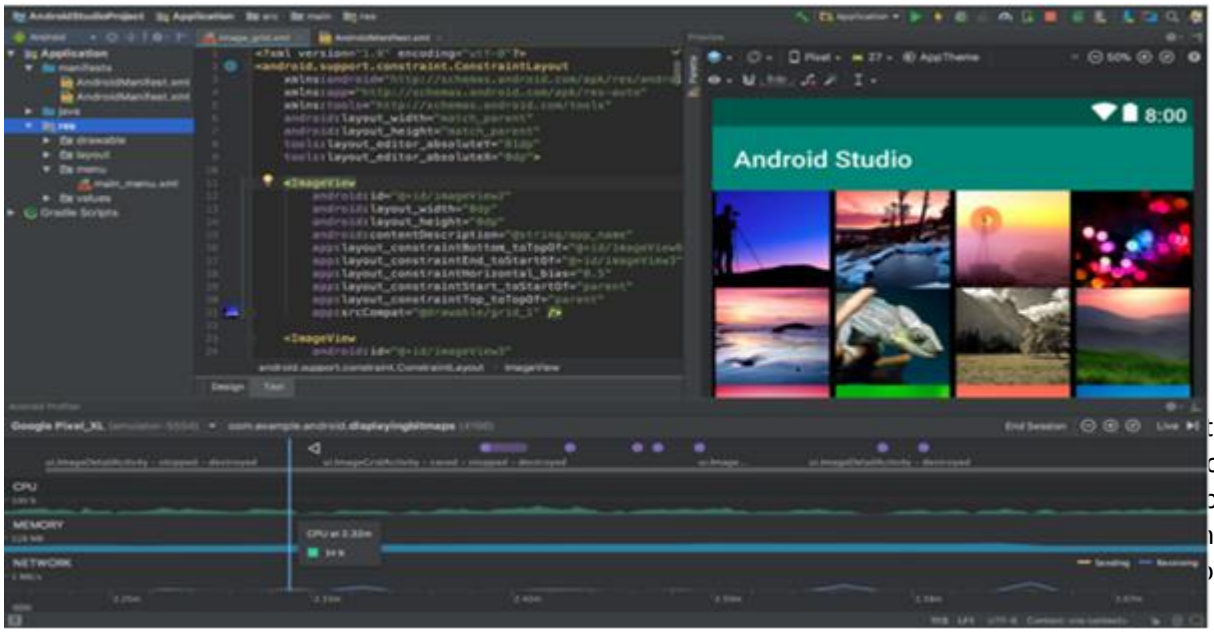
3.1 BLOCK DIAGRAM



FLOW DIAGRAM FOR THE APPLICATION LAYOUT



3.2 Android Studio.



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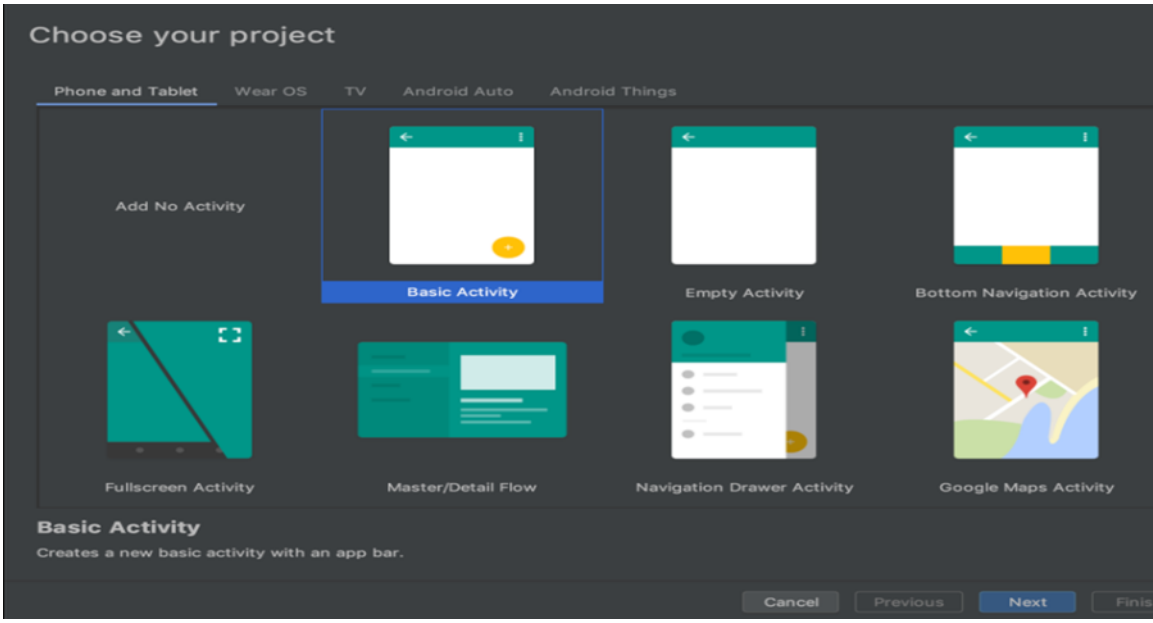
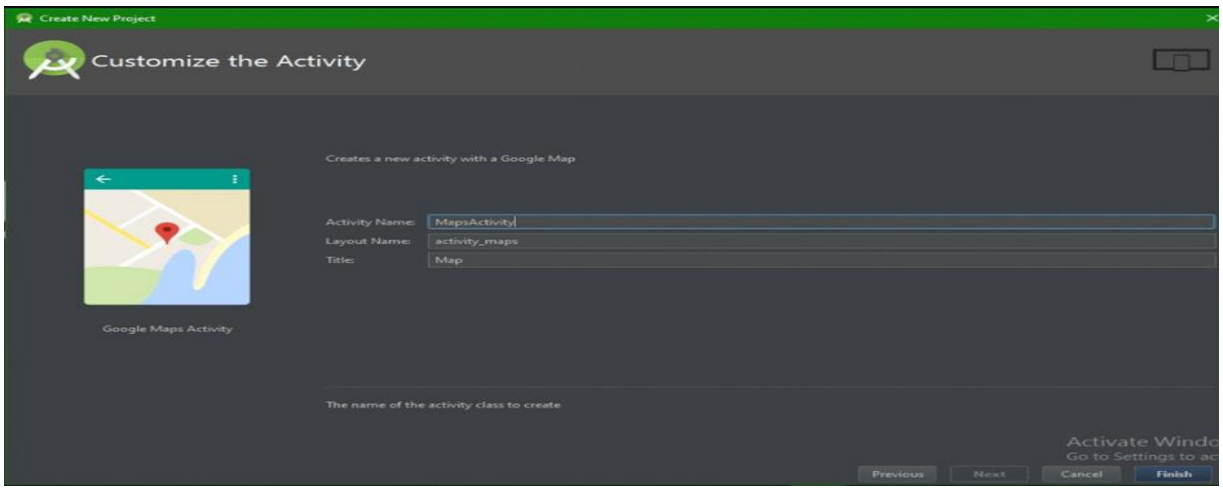
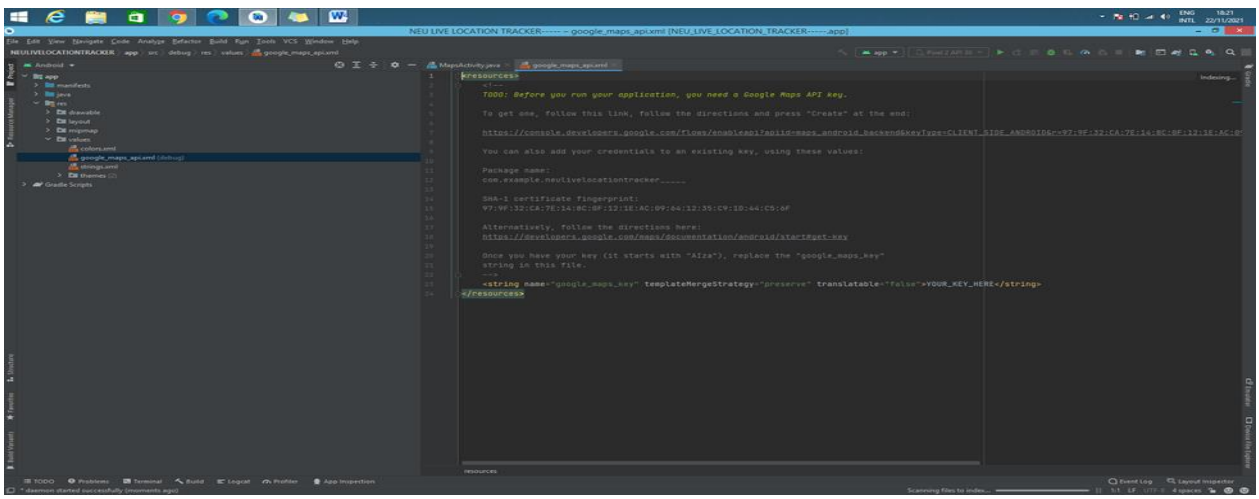


3.3 GOOGLE MAPS ACTIVITY:

For our intended use we selected a Google Maps Activity and continued to the next step by clicking next. We are then asked to provide a name for the activity





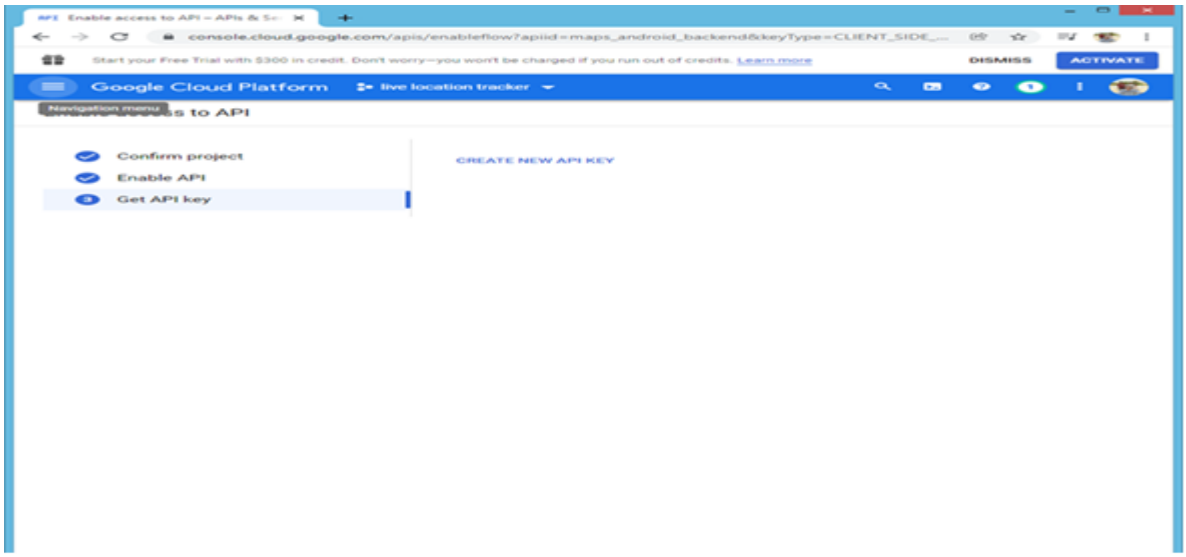
After providing a name for the project you are taken to the next screen where you will find that the basic Gradel file for the application already provided and named.

Now we are provided with a unique project key. Every application ever built has a unique project key that gives it a unique signature to be differentiated from other applications.
Since we are using Google Maps Plugins and repositories, we have to pair our project key with a unique API key provided to us by Google Maps APIs.

3.4 API

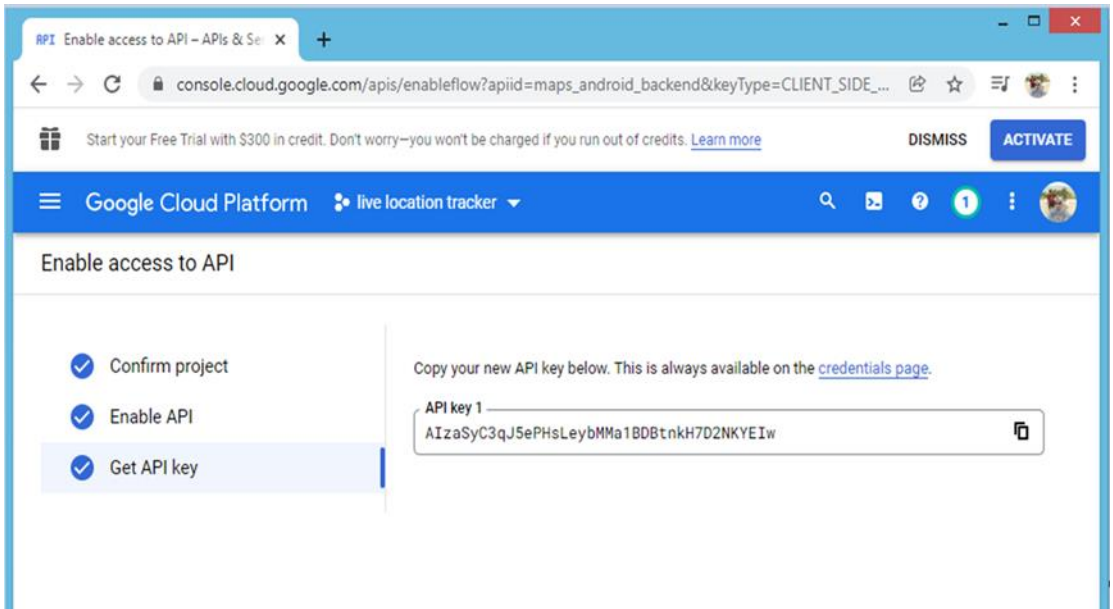
A-P-I Is described as (procedures and functions which allow the production of applications which provide the data or feature of an O-S (operating system), applications etc.)

To get a unique API from Google clouds we have to register our application and sign in to our google account. After following the steps, we get the option to create a new API key as shown below.



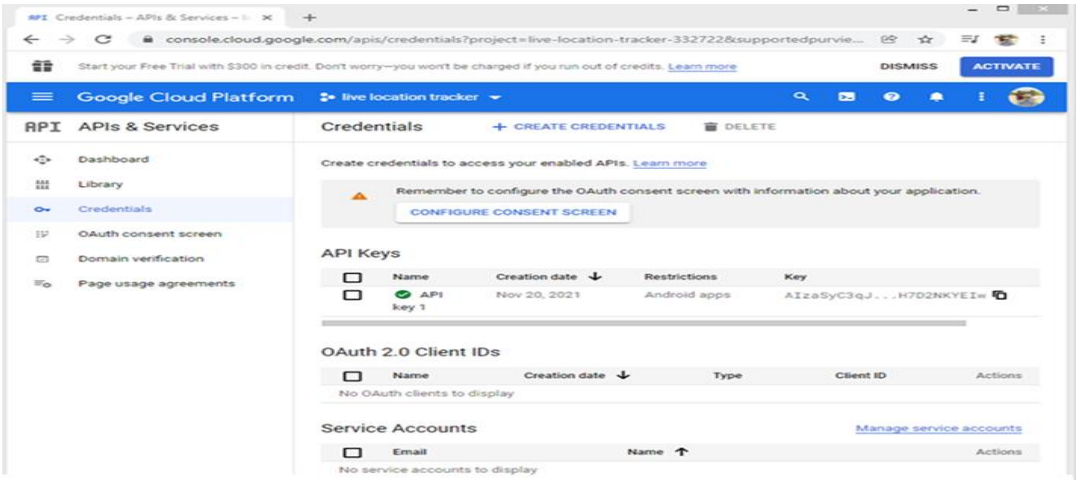
We are provided with a unique API key to merge with our application so that Google maps can identify it and not mix data from countless other applications that are also using Google Maps Repositories.
An easier explanation would be to consider all the mobile and computer devices which are connected to the google maps api services.

Such as:
People who are looking for directions, people who are looking at their food delivery locations or order tracking. All these people and their devices are unique and carry a unique API to identify them. These API keys differentiate each device, application so that their data is not mixed or sent to someone else causing an error.

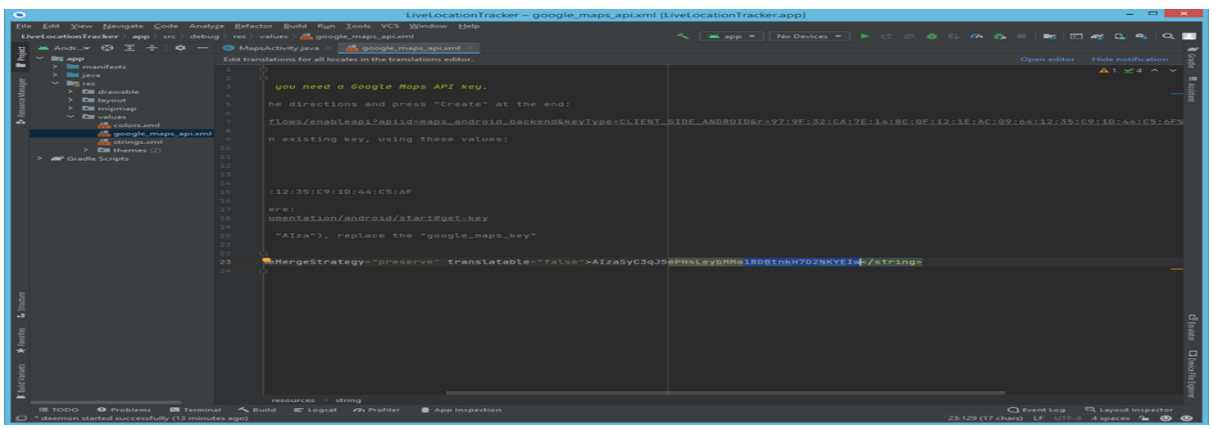


Our applications unique API key is:
AIzaSyC3qJ5ePHsLeybMMa1BDBtnkH7D2NKYEIw

The next step is to restrict the key to our host application. So that other users do not have admin privileges. By creating credentials, we secure our restrictions to be only used by android devices as shown in the image below.



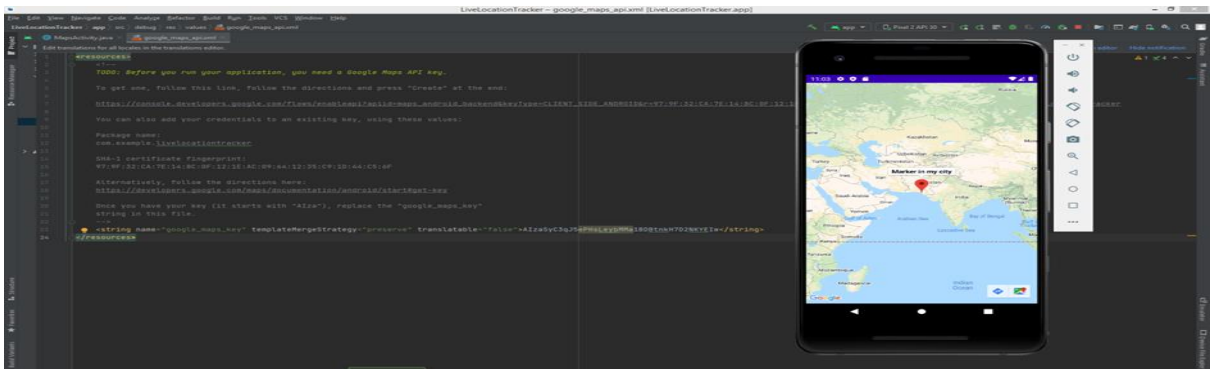
We then implement this key within our application's root.xml file for the unique identification



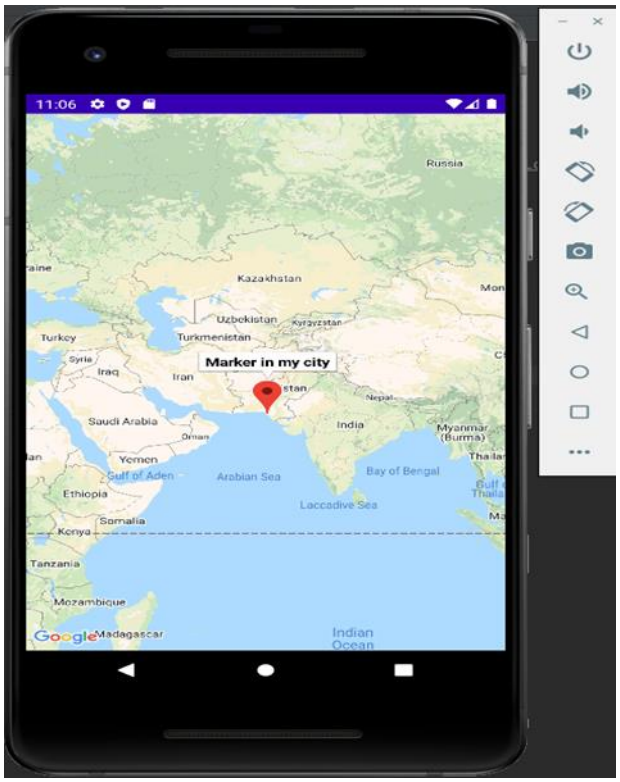
- In the highlighted text above, we copied over the unique signature known as the Google Maps API key.
- And in following these steps we have successfully achieved the basic application that is merged with Google maps repositories.
- Then I designed the basic user interface for the application while running into a lot of bugs and finally was able to debug the application enough that it now runs stable in simulations**.**

3.5 BASIC SIMULATION

And to ensure that we didn't run into any errors we will simulate it in a virtual environment.

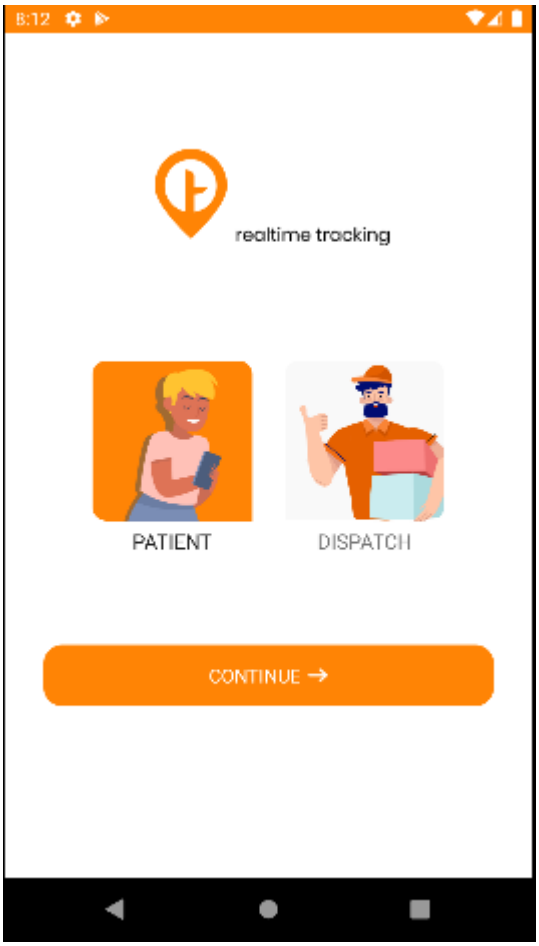


As seen in the simulation, the virtual device is running as a mobile device. This simulation proves that the Google Maps Repositories and the application are working perfectly. And as a result it is showing the exact location of the device running the simulation (Karachi , Pakistan).

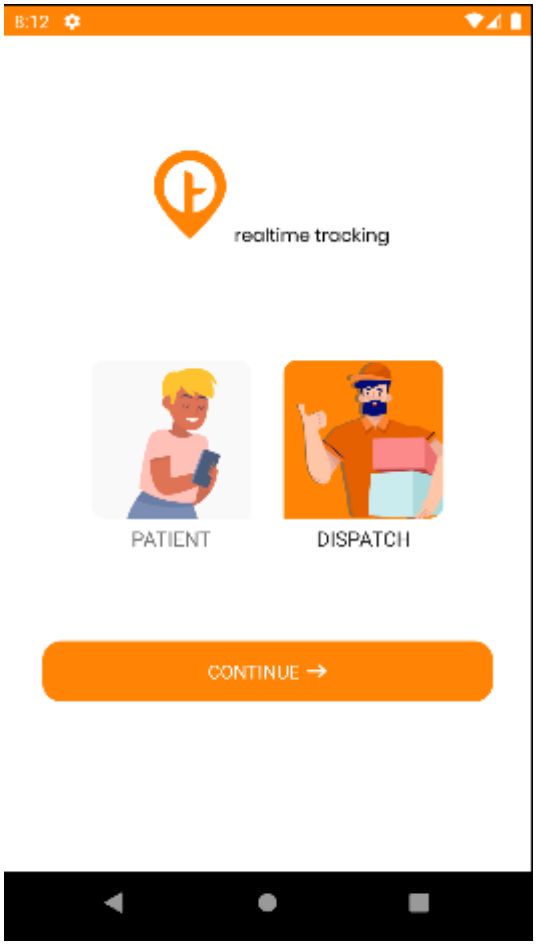


3.6 USER INTERFACE SCREENSHOTS WITH SIMULATION

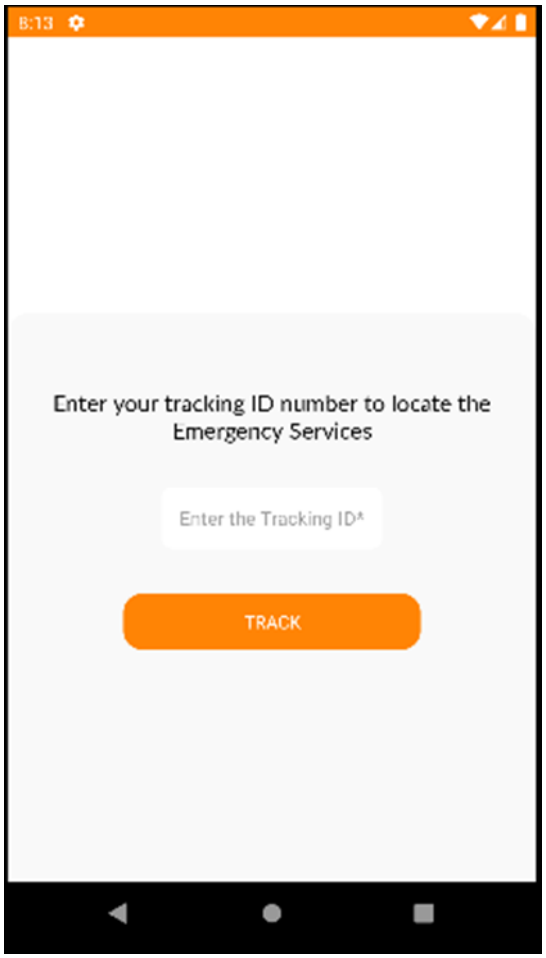
Home screen access panels

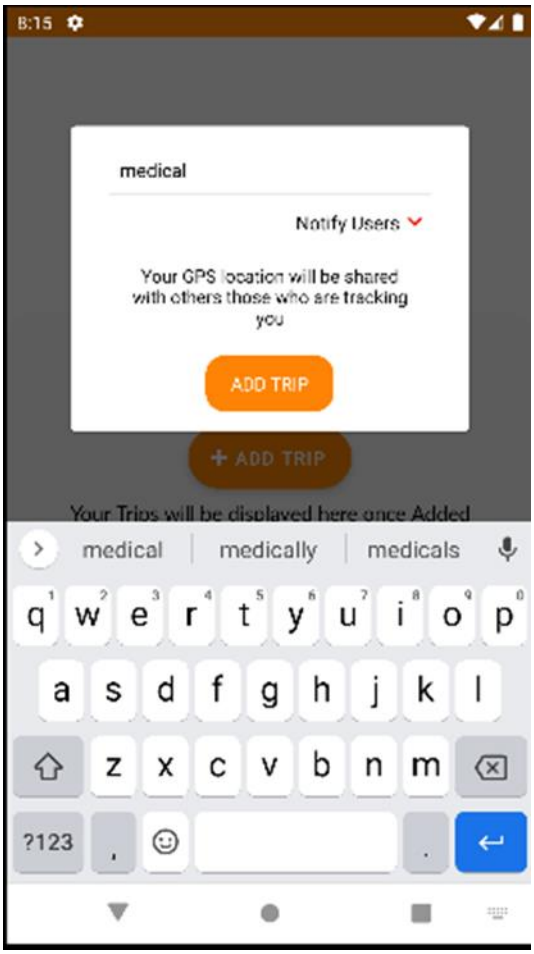


Patient's panel with selection animations



Medical dispatch's panel with selection animations

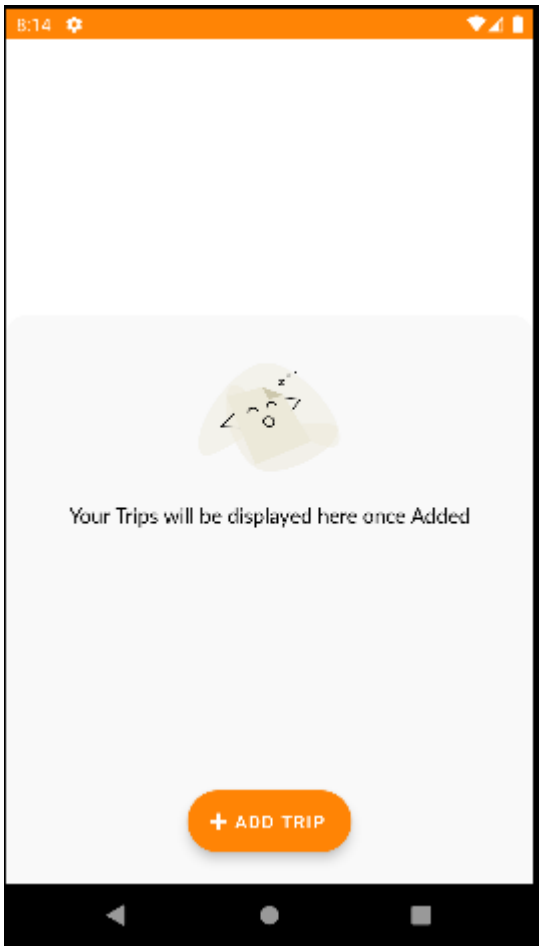




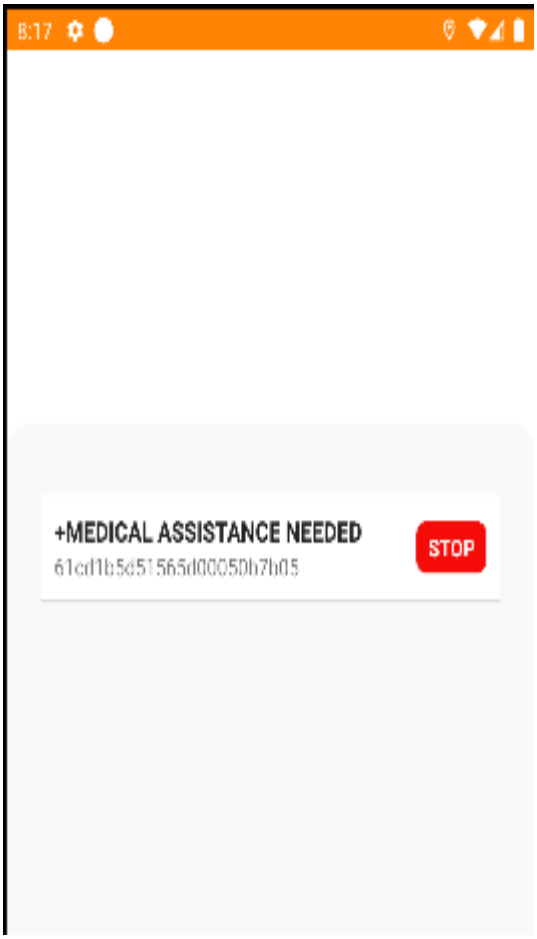
Patient tracking pin identification

Patient tracking confirmation screen

- Every user needs to register 1 time and has to get access by the admin
- The term “Medical” is used as an example, if fire or police services are needed the person in an emergency can type that
- If time is limited and there is an urgent emergency simply leave it empty for just ambulance services and confirm by tapping “add trip” button.



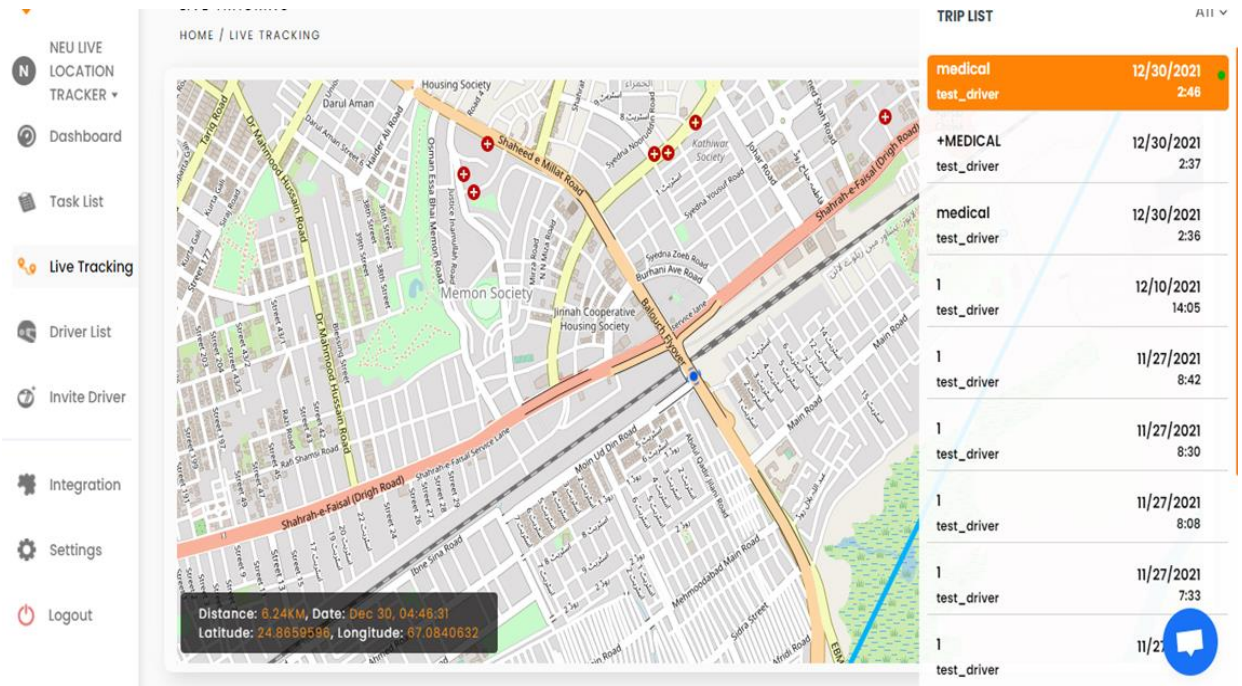
Emergency services idle screen



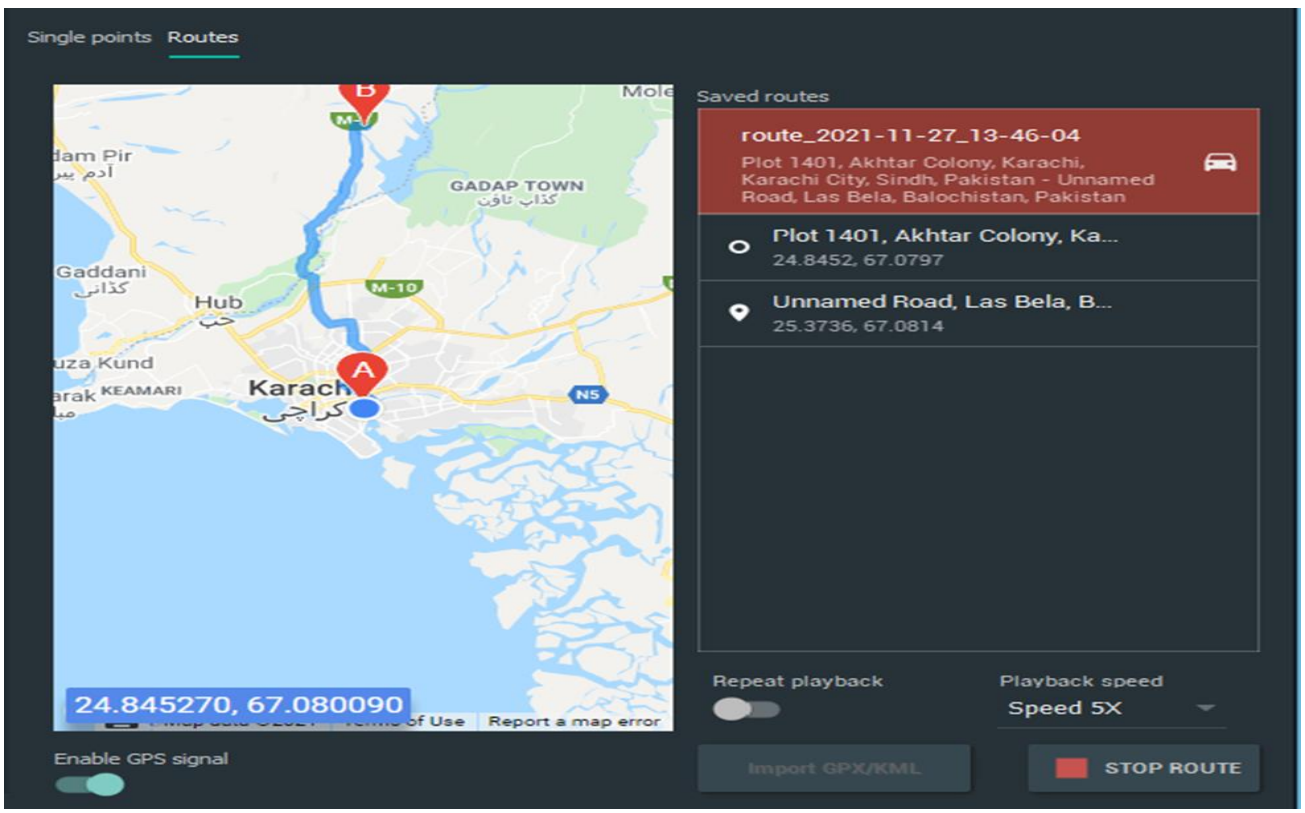
Emergency services active request screen

The feature to stop a request is also added on both ends of the users for the application if the request is made by mistake.

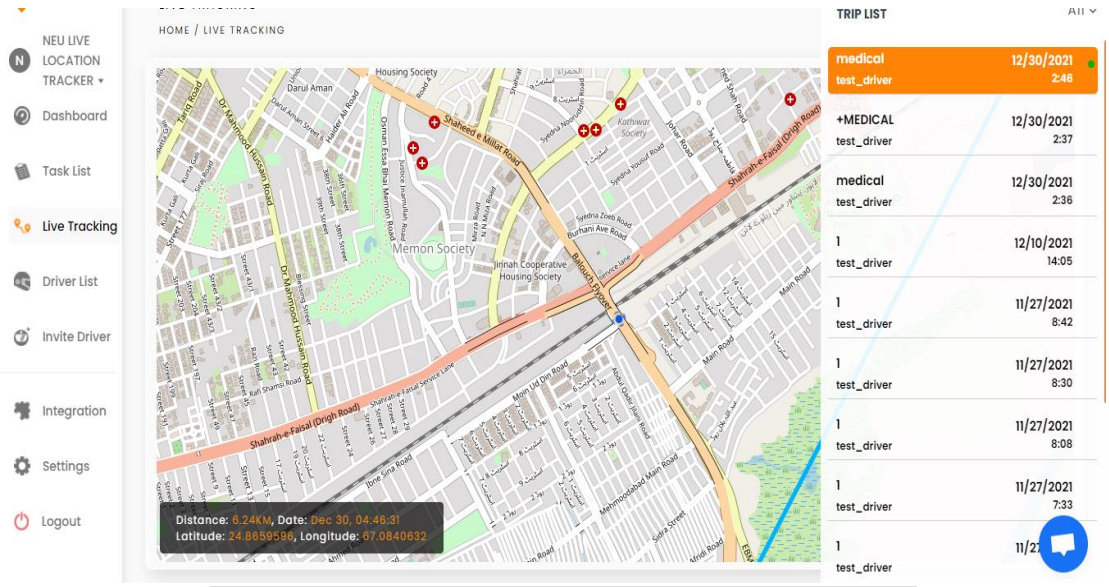
Admins panel where the admin can add new users, and monitor all requests mentioned on the right or track a specific request.

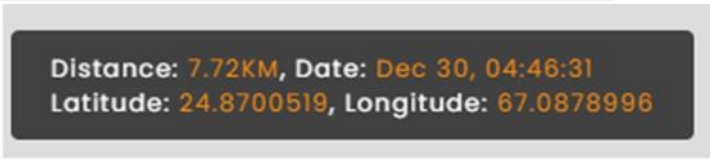


For our intended use we used the android studios built in route simulation tool to simulate a real-life situation

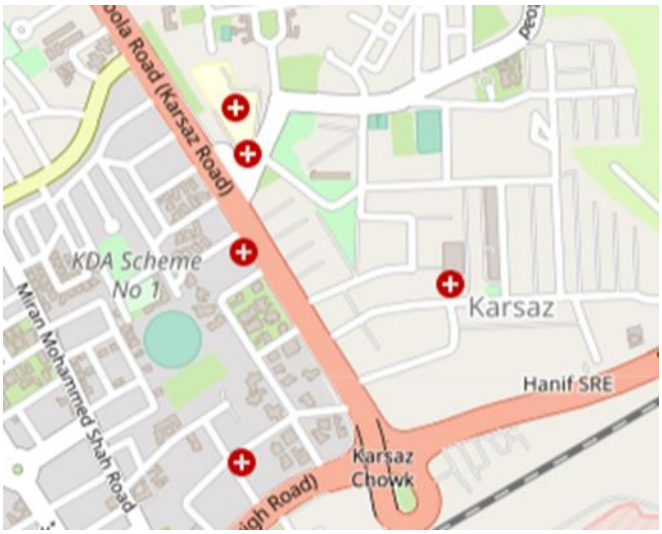


On the left side is the actual map simulation that will display the emergency service's location to the user. Admins panel showing the best route with live location and remaining distance to the person in an emergency





Estimated time remaining for the journey to end, request's starting time, real time latitude and longitude



Real time traffic updates being forecasted, marked as small red dots where there's a lot of traffic to avoid and take the best route.

```
<application
    android:name=".MApplication"
    android:allowBackup="false"
    android:icon="@mipmap/ic_launcher"
    android:label="LIVE LOCATION TRACKING-20156719"
    android:supportsRtl="true"
    android:theme="@style/AppTheme"
    tools:ignore="LockedOrientationActivity"
    tools:replace="android:allowBackup">
    <activity android:name=".ActSplash">

    </activity>

    <meta-data
        android:name="com.google.android.geo.API_KEY"
        android:value="AIzaSyC3qJ5ePHsLeybMMa1BDBtnkH7D2NKYEIw" />

    <activity
        android:name=".activities.ActivityLauncher"
```

Taxi industry: due to the geo-location tracking feature, we will be able to track the location of the driver any time. The person hailing a taxi will also have the opportunity to compare all the cars that are nearby or how far away each driver is before making decision.

School buses: students can monitor where the buses are in order to get to the bus stations on time

Locating the elderly: If they are going outside, they can be monitored to make sure they are safe.

Shipping, courier delivery: allows us to being capable to see delivery of goods, cargo transportation, or track the speed and location of courier services in real-time.

Emergencies: our intended use for medical assistance or police assistance whenever there may be an emergency in order to save time.
Employee location tracking: the application can be used to determine your employees' performance and efficiency.

Cargo location tracking: the application can be modified to monitor cargo or shipping operations. Users can communicate with their captains to ask for location status or estimated time of arrival

Transportation: This technology can be implemented in local buses to help travelers be aware of when they need to be at the bus station in order to get on their rides (also applies to taxis)

Child monitoring system: this app can easily be modified in such a way that can actively track their child's location allowing the parents to look after their kids.

Result and Discussion

The Problem criteria this application will be beneficial for:

- Availability of safety devices that everyone already has. Meaning that the phones will act as an emergency beacon for free and the user will not have to buy another beacon for the same purpose.
- Survivors of accidents can send their location to the police with the touch of a button and don't even need to waste time calling and explaining to them the exact location (that is considering if survivor or user already knows their exact location)
- With the help of this application the emergency services can instantly track and decide the best route to get to the emergency location ultimately saving life altering moments for the user.
- The user can monitor how far the emergency dispatch is in real time location tracking.

Conclusion

Although we cannot foresee or anticipate what will happen to us in the future, we may nevertheless exercise prudence. My top priorities while submitting this application are public safety and ensuring that those in need of immediate assistance receive it in the shortest period of time possible. Today, there are various technologies that we may use in our everyday lives to improve our quality of life.

References

[1] Quddus, M. A., Ochieng, W. Y., & Noland, R. B. (2007). Current map-matching algorithms for transport applications: State-of-the art and future research directions. Transportation research part c: *Emerging technologies, 15*(5), 312-328.

[2] Plangi, S., Hadachi, A., Lind, A., & Bensrhair, A. (2018). Real-time vehicles tracking based on mobile multi-sensor fusion. *IEEE Sensors Journal, 18*(24), 10077-10084.

[3] Mohamed, R., Aly, H., & Youssef, M. (2016). Accurate real-time map matching for challenging environments. *IEEE Transactions on Intelligent Transportation Systems, 18*(4), 847-857.

[4] Aggarwal, P., Thomas, D., Ojeda, L., & Borenstein, J. (2011). Map matching and heuristic elimination of gyro drift for personal navigation systems in GPS-denied conditions. *Measurement Science and Technology, 22*(2), 025205.

[5] Boukerche, A., Oliveira, H. A., Nakamura, E. F., & Loureiro, A. A. (2008). Vehicular ad hoc networks: A new challenge for localization-based systems. *Computer communications, 31(*12), 2838-2849.

[6] Behzadan, A. H., Aziz, Z., Anumba, C. J., & Kamat, V. R. (2008). Ubiquitous location tracking for context-specific information delivery on construction sites. *Automation in construction, 17(*6), 737-748.

[7] Vahdatikhaki, F., & Hammad, A. (2014). Framework for near real-time simulation of earthmoving projects using location tracking technologies. *Automation in Construction, 42,* 50-67.

[8] Zhao, Z., Zhang, M., Yang, C., Fang, J., & Huang, G. Q. (2018). Distributed and collaborative proactive tandem location tracking of vehicle products for warehouse operations. Computers & *Industrial Engineering, 125,* 637-648.

[9] Zhang, F. (2014, May). Research of Solar Tracking Controller based on the STC12C5A32S2. In 2014 IEEE Workshop on Electronics, Computer and Applications (pp. 1049-1051). IEEE.

[10] Kim, J. S., Lee, H. J., & Oh, R. D. (2015). Smart integrated multiple tracking system development for IoT based target-oriented logistics location and resource service. *International Journal of Smart Home, 9*(5), 195-204.

[11] Sarkar, S., & Bose, A. (2017). Lifetime performances of modernized GLONASS satellites: a review. *Artificial Satellites, 52*(4), 85.

[12] Sreelekshmi, S., & Sankar, S. P. (2021, November). A 2.5 GHz Compact Wearable Microstrip Patch Antenna for off body Wireless Communication in WBANs. In 2021 Fifth International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud)(I-SMAC) (pp. 1751-1756). IEEE.

[13] Mansour, G., Nugoolcharoenlap, E., Mahmud, R. H., Tippo, T., Akkaraekthalin, P., & Torrungrueng, D. (2021, September). Circularly Polarized Elliptical Patch Array Antennas for GPS. In 2021 Research, Invention, and Innovation Congress: Innovation Electricals and Electronics (RI2C) (pp. 92-96). IEEE.

[14] Namee, K., Srikamta, N., Kittisitthipong, S., & Polpinij, J. (2021, February). Applying CMX Tracking for Identifying the Indoor Positioning of Wireless Devices. In 2021 International Symposium on Electrical, Electronics and Information Engineering (pp. 202-207).

[15] Yu, H. K., Oh, S. H., & Kim, J. G. (2020, February). AI based location tracking in WiFi indoor positioning application. In 2020 International Conference on Artificial Intelligence in Information and Communication (ICAIIC) (pp. 199-202). IEEE.