INCOGNIZANCE- AN ANDROID APP

Project report submitted in partial fulfilment of the requirement for the degree of Bachelor of Technology

in

Computer Science and Engineering/Information Technology

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To

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Certificate

Candidate's Declaration

I hereby declare that the work presented in this report entitled " Incognizance" in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Computer Science and Engineering/Information Technology submitted in the department of Computer Science & Engineering and Information Technology, Jaypee University of Information Technology Waknaghat is an authentic record of my own work carried out over a period from August 2015 to June 2016 under the supervision of (Ms Annie Singla) (Assistant Professor (Grade-I)).
The matter embodied in the report has not been submitted for the award of any other degree or diploma.

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This is to certify that the above statement made by the candidate is true to the best of my knowledge.

(Supervisor Signature)
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Information Technology
Dated:

Acknowledgement

I gratefully acknowledge the Management and Administration of Jaypee University of Information Technology for providing me the opportunity and hence the environment to initiate and complete my project.
I would like to express my gratitude to Prof. Dr. RMK Sinha, Dean and Head of Department, Information Technology JUIT and Brig. (Retd) S.P.Ghrera Head of Department, Computer Science, JUIT Waknaghat for guiding, encouraging and inspiring by giving me valuable thoughts to carry out the project and also like to thank my project guide, Ms. Annie Singla, Assistant Professor, Dept. of Information Technology for his expert guidance, encouragement and valuable suggestions at every step.

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Abstract

Location tracking is becoming an increasingly important statistical operation in the modern days. The idea of this project is implementing location-tracking services and further increasing its scope with the use of an android based an application. Even if this is a much-explored concept, then major issue that we would like to address at this point is the accuracy that the location tracking services can offer. This application can be used for a variety of statistical and other tracking services.

In the past decades, the GPS (Global Positioning System) tracking systems play an import role in the position-aware applications. For the cost issue, most of these systems use the Google MAP to display the track.

In this project we chose to use the Google Maps API as a lot of information is not generally available through satellite. For example, if a mobile user is at his own home or his relatives place, the application tells us his approximate location.

Chapter 1 Introduction

1.1.1 Introduction: Android Application

An application developed for use on mobile devices, which is powered by Google's Android platform. These applications can be downloaded from the Play Store or supported websites.

1.1.2 Introduction: Location Based Tracking

For location-based tracking we make use of technologies like GPRS, GSM, GIS. Here we discuss in details about these technologies.

1.1.2.1 Techniques for location tracking

As we mentioned earlier, the location-based services can be used for things like GPRS, Cell Identification, GPS and other related technologies. Here is a brief introduction to each of these.

1.1.2.1.1 Cell Identification

This technology has the easiest and the cheapest implementation of all the above-mentioned technologies. The implementation involves GSM and WCDMA technologies. The location is determined by finding the location of the tower cell of the device, which is basically the location of the user's mobile.

To get the most accurate data, the cells play an important role, that is, larger the cell, the better will be the accuracy. The precision of cell identification is 200m to 20 km, which is inaccurate. This can however be increased by adding time and distance values to the given estimate.

1.1.2.1.2 GPS

GPS is a navigation system, which is widely used around the globe. Through this technology we are able to get more precise data of the location of the users. The system consist of networks of 24 satellites in six different 12 hour orbital paths spaced so that at least five are in view from every point on the globe and their ground stations. Trilateration is the base of GPS. One can determine the Longitude, Latitude and altitude of device. One of the major issues with GPS is the fact that it takes 5 seconds for the system to update itself. It is also important that we know the exact location of the satellites at all times. Lastly, the major drawback of the GPS system is that it can only be used while the user is outdoors, for indoor use, you will have to look at other technologies.

1.1.2.1.3 Assisted GPS

Like we mentioned earlier, GPS can't determine the location of the device when it is located indoors. Assisted GPS is the answer to this problem. It can make use of the weaker signals that can give accurate readings to the GPS systems.

1.1.2.2 Various Radiolocation systems

These are the systems that measure radio signals, which are exchanged between mobile device transceivers and various set of fixed stations. These technologies try to get the Location but gives inaccurate results. Few of them are landmarks, Dead Reckoning, Celestial and Loran. These technologies have limited precision because of environmental factors.

1.1.2.3 Accelerometers and Electronic Compass

Although GPS is good method for Location Tracking but it has a drawback of poor indoor accuracy, long acquisition time and low accuracy in densely populated area [6]. Therefore in Today's world the alternative solution is use of Accelerometers and Compasses in addition to GPS. It gives better accuracy in indoors and has better energy utilization. They have accuracy of less then 30 meters.

1.1.3 Introduction: Google APIs

Google APIs is a set of application programming interfaces (APIs) developed by Google, which allow communication with Google Services and their integration to other services. Examples of these include Search, Gmail, Translate or Google Maps. Third-party apps can use these APIs to take advantage of or extend the functionality of the existing services. The APIs provide functionality like analytics, machine learning as a service (the Prediction API) or access to user data (when permission to read the data is given).

1.1.3.1 Authentication and authorization of an API

Usage of some of the APIs requires authentication and authorization using the OAuth 2.0 protocol. OAuth 2.0 is a simple protocol. To start, it is necessary to obtain credentials from the Developers Console. Then the client app can request an access token from the Google Authorization Server, and uses that token for authorization when accessing a Google API service.

1.1.3.2 Client Libraries

There are client libraries in various languages, which allow developers to use Google APIs from within their code, including Java, JavaScript, .NET, Objective-C, PHP and Python.

1.1.3.3 Google Apps Script

Google Apps Script is a cloud-based JavaScript platform, which allows developers to write scripts that can manipulate APIs of services such as Calendar, Docs, Drive, Gmail, and Sheets and easily create Add-Ons for these services with chromium-based applications.

1.1.3.4 Common use cases

User registration is commonly done via Google+ sign in, which allows users to securely log in to 3rd party services with their Google+ account using the Google+ API. This is currently available from within Android, iOS or JavaScript.

It is popular to include a “Sign in with Google” button in Android apps, as typing login credentials manually is time-consuming due to limited screen size. As the user is usually signed into their Google account on their mobile device, signing-in/signing-up for a new service with a Google is usually a matter of a few button clicks.

1.1.4 Introduction: Google Maps API

1.1.4.1 Google Maps

Google Maps is a desktop web mapping service developed by Google. It offers satellite imagery, street maps, 360° panoramic views of streets (Street View), real-time traffic conditions (Google Traffic), and route planning for traveling by foot, car, bicycle (in beta), or public transportation.

Google Maps offers an API that allows maps to be embedded on third-party websites, and offers a locator for urban businesses and other organizations in numerous countries around the world. Google Map Maker allows users to collaboratively expand and update the service's mapping worldwide. Google Maps' satellite view is a "top-down" view; most of the high-resolution imagery of cities is aerial photography taken from aircraft flying at 800 to 1,500 feet (240 to 460 m), while most other imagery is from satellites. Much of the available satellite imagery is no more than three years old and is updated on a regular basis.

1.1.4.2 Google Maps API

By using the Google Maps API, it is possible to embed Google Maps site into an external website, on to which site specific data can be overlaid. Although initially only a JavaScript API, the Maps API was expanded to include an API for Adobe Flash applications (but this has been deprecated), a service for retrieving static map images, and web services for performing geocoding, generating driving directions, and obtaining elevation profiles. The Google Maps API is free for commercial use, provided that the site on which it is being used is publicly accessible and does not charge for access, and is not generating more than 25 000 map accesses a day.

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1.1.5 Introduction to SDK and the Development Environment

A software development kit (SDK or "devkit") is typically a set of software development tools that allows the creation of applications for a certain software package, software framework, hardware platform, computer system, video game console, operating system, or similar development platform.

It may be something as simple as the implementation of one or more application programming interfaces (APIs) in the form of some libraries to interface to a particular programming language or to include sophisticated hardware that can communicate with a particular embedded system. Common tools include debugging facilities and other utilities, often presented in an integrated development environment (IDE). SDKs also frequently include sample code and supporting technical notes or other supporting documentation to help clarify points made by the primary reference material.

1.1.5.1 Java Development Kit (JDK)

The Java Development Kit (JDK) is an implementation of either one of the Java SE, Java EE or Java ME platforms released by Oracle Corporation in the form of a binary product aimed at Java developers on Solaris, Linux, Mac OS X or Windows. The JDK includes a private JVM and a few other resources to finish the development of a Java Application. Since the introduction of the Java platform, it has been by far the most widely used Software Development Kit (SDK).

1.1.5.2 Eclipse

In computer programming, Eclipse is an integrated development environment (IDE). It contains a base workspace and an extensible plug-in system for customizing the environment.

Android Development Tools (ADT) is a Google-provided plugin for the Eclipse IDE that is designed to provide an integrated environment in which to build Android applications.

1.1.5.3 Android Studio

Android Studio is an integrated development environment (IDE) for developing for the Android platform.

Based on JetBrain’s IntelliJ IDEA software, Android Studio is designed specifically for Android development. It is available for download on Windows, Mac OS X and Linux, and replaced Eclipse Android Development Tools (ADT) as Google's primary IDE for native Android application development.

1.1.5.3.1 Android Studio Features

New features are expected to be rolled out with each release of Android Studio. The following features are provided in the current version:

- Gradle-based build support.
- Android-specific refactoring and quick fixes.
- Lint tools to catch performance, usability, version compatibility and other problems.
- ProGuard integration and app-signing capabilities.
- Template-based wizards to create common Android designs and components.
- Support for building Android Wear apps
- Built-in support for Google Cloud Platform, enabling integration with Google Cloud Messaging and App Engine.

1.1.5.3.2 System Requirements

Table 1-System Requirements for Android Studio

	Windows	Mac OS X	Linux
OS version	**Microsoft Windows 10/8.1/8/7/Vista/2003/XP (32 or 64 bit)**	Mac OS X 10.8.5 or higher, up to 10.10 to up 10.10.2 up 10.10.3 on 10.10.5 (Yosemite)	GNOME or KDE or Unity desktop on Ubuntu or Fedora or GNU/Linux Debian
RAM	2 GB RAM minimum, 4 GB RAM recommended		
Disk space	500 MB disk space		
Space for Android SDK	At least 1 GB for Android SDK, emulator system images, and caches		
JDK version	Java Development Kit (JDK) 7 or higher		
Screen resolution	1280x800 minimum screen resolution		

1.1.5.3.3 Android Studio vs. Eclipse ADT comparison

Table 2-Android studio Vs Eclipse ADT

Feature	Android Studio	Eclipse ADT
Build system	Gradle	Apache Ant
Maven-based build dependencies	Yes	No
Build variants and multiple-APK generation	Yes	No
Advanced Android code completion and refactoring	Yes	No
Graphical layout editor	Yes	Yes
APK signing and keystore management	Yes	Yes
NDK support	Yes	Yes

1.2 Problem Statement

Creating an application that is able to track the location of the user without his knowledge.

1.3 Objective of study

This project is centred on finding new ways and algorithms to better the existing location based services. As defined by the problem statement, the main intention is to make an application that tracks the location of the user without his/her knowledge, so a major part of this project has been making services that run continuously and is able to bypass the security that is offered by the device operating system.

1.4 Methodology

Detailed methodology is described in the Gantt chart below.

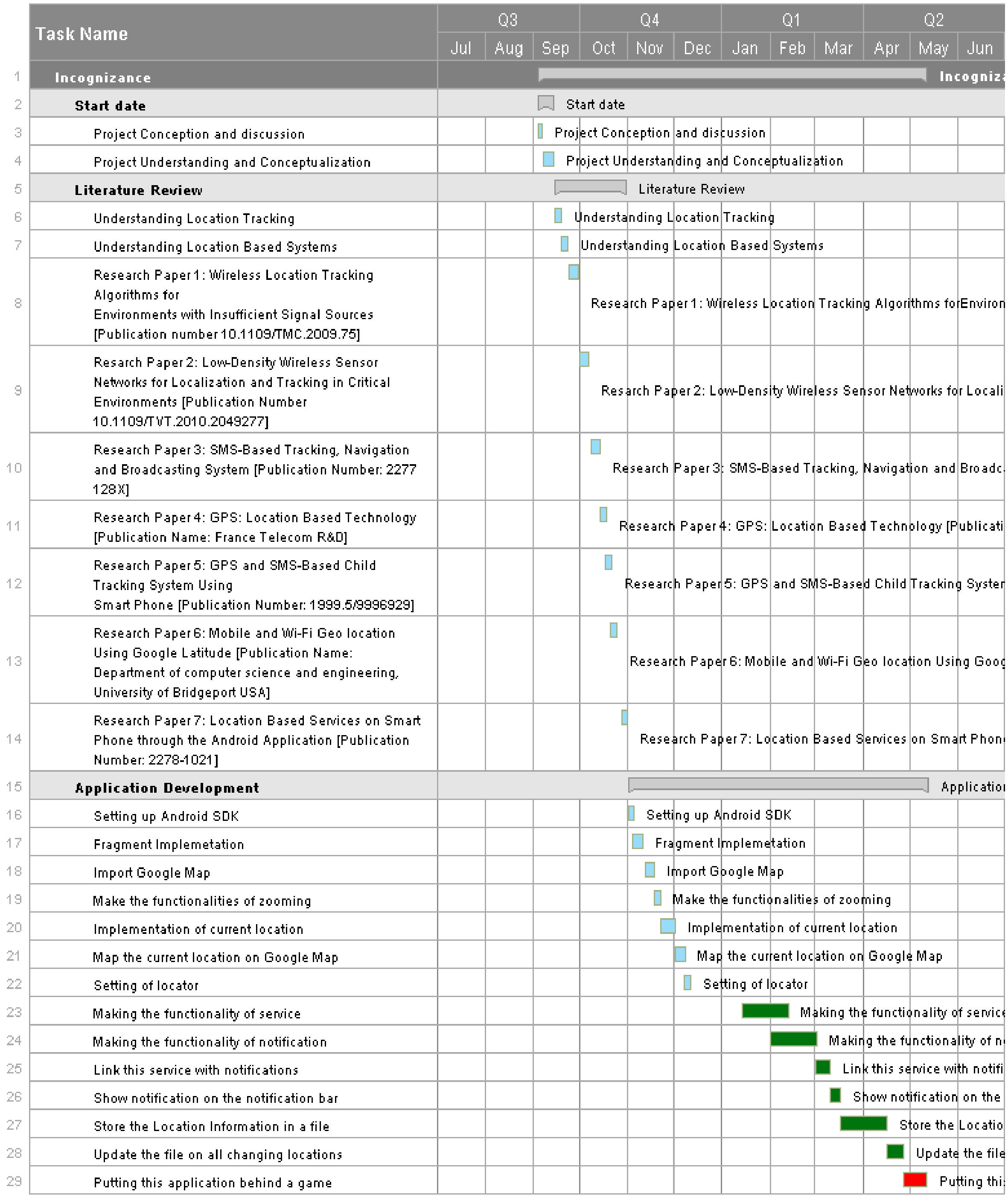

Figure 1-Gantt Char

1.5 Organization

The organization of the application is detailed below via a flow diagram.

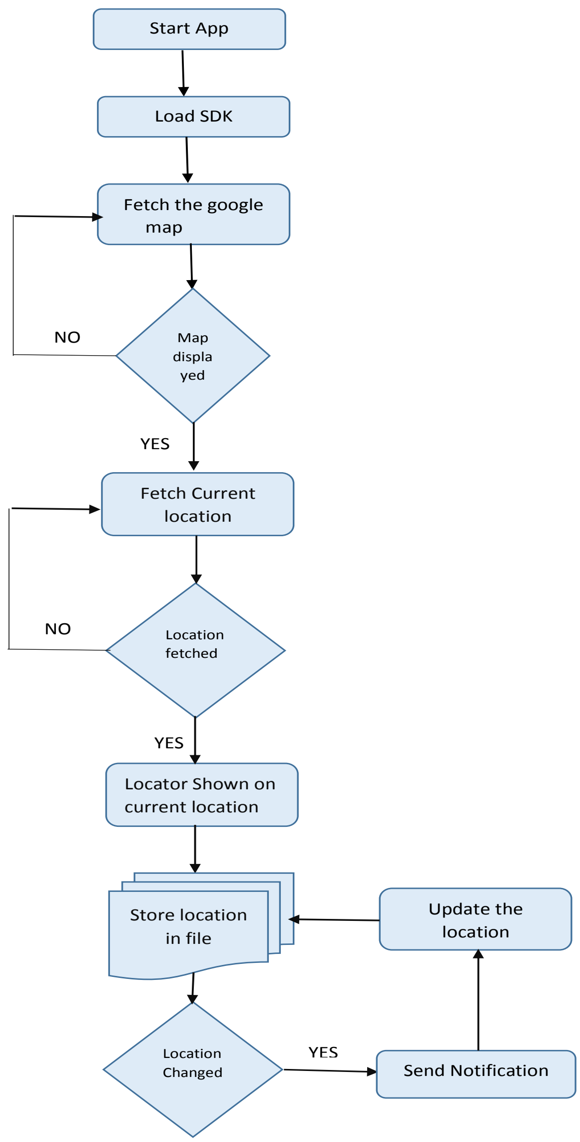

Figure 2-Flow Diagram

Chapter 2 Literature Survey

2.1 Wireless Location Tracking Algorithms for Environments with Insufficient Signal Sources

In this project the main emphasis is on searching for ways to improve the overall location-based services that we can get using Google Maps API. This paper is one of the publications that focused on algorithms for location tracking services in the places that has insufficient signal sources.

Wireless location technologies, which are designated to estimate the position of a Mobile Station (MS), have drawn a lot of attention over the past few decades. The Quality-of-Service (QoS) of the positioning accuracy has been announced after the issue of the emergency 911 (E-911) subscriber safety service [1]. With the assistance of the information derived from the positioning system, the required performance and objectives for the targeting MS can be achieved with augmented robustness. In recent years, there are increasing demands for commercial applications to adopt the location information within their system design, such as the navigation systems, the location based billing, the health care systems, the Wireless Sensor Networks (WSNs) [2], [3], [4], and the Intelligent Transportation Systems (ITSs) [5], [6]. With the emergent interests in the Location-Based Services (LBSs), the location estimation algorithms with enhanced precision become necessary for the applications under different circumstances. A variety of wireless location techniques have been investigated [7], [8], [9], [10]. The network-based location estimation schemes have been widely proposed and employed in the wireless communication system. These

Schemes locate the position of an MS based on the measured radio signals from its neighbourhood Base Stations (BSs). The representative algorithms for the network-based location estimation techniques are the Time-of-Arrival (TOA), the Time Difference-of-Arrival (TDOA), and the Angle-of Arrival (AOA). The TOA scheme measures the arrival time of the radio signals coming from different wireless BSs; while the TDOA scheme measures the time difference between the radio signals. The AOA technique is conducted within the BS by observing the arriving angle of the signals coming from the MS. It is recognized that the equations associated with the network-based location estimation schemes are inherently nonlinear. The uncertainties induced by the measurement noises make it more difficult to acquire the estimated MS position with tolerable precision. The Taylor Series Expansion (TSE) method was utilized in [11] to acquire the location estimation of the MS from the TOA measurements. The method requires iterative processes to obtain the location estimate from a linearized system. The major drawback of the TSE scheme is that it may suffer from the convergence problem due to an incorrect initial guess of the MS's position. The two-step Least-Square (LS) method was adopted to solve the location estimation problem from the TOA [12], the TDOA [13], and the TDOA/AOA measurements [14]. It is an approximate realization of the Maximum Likelihood (ML) estimator and does not require iterative processes. The two-step LS scheme is advantageous in its computational efficiency with adequate accuracy for location estimation. Instead of utilizing the Circular Line of Position (CLOP) methods (e.g., the TSE and the two-step LS schemes), the Linear Line of Position (LLOP) approach is presented as a different interpretation for the cell geometry from the TOA measurements. Since the pairwise intersections of N TOA measurements will establish (N 1) independent linear lines, the LS method can, therefore, be applied to estimate the position of the MS. In addition to the estimation of an MS's position, trajectory tracking of a moving MS has been studied [17], [18], [19], [20], [21], [22], [23], [24]. The Extended Kalman Filter (EKF) scheme [17], [18], [19] is considered the well-adopted method for location tracking. The EKF algorithm estimates the MS's position, speed, and acceleration via the linearization of measurement inputs. The technique by combining the Kalman filter with the Weighted Least Square (WLS) method is exploited in [20]. The Kalman Tracking (KT) scheme [21], [22] distinguishes the linear part from the originally nonlinear equations for location estimation. The linear aspect is exploited within the Kalman filtering formulation; while the nonlinear term is served as an external measurement input to the Kalman filter. The technique utilized in [23] adopted the Kalman filters for both pre-processing and post processing in order to both mitigate the Non line-of-Sight (NLOS) noises and track the MS's trajectory. The Cascade Location Tracking (CLT) scheme as proposed in [24] utilizes the two-step LS method for initial location estimation of the MS. The Kalman filtering technique is employed to smooth out and trace the position of the MS based on its previously estimated data. The Geometric Dilution of Precision (GDOP) [25], [26] and the Crame´r-Rao Lower Bound (CRLB) [27] are the well-adopted metrics for justifying the accuracy of location estimation based on the geometric layouts between the MS and its associated BSs. It has been indicated in [28] that the environments with ill-conditioned layouts will result in relatively larger GDOP and CRLB values. In general, the ill conditioned situations can be classified into two categories:

1) Insufficient number of available neighbourhood BSs around the MS.

2) The occurrence of co-linearity or co-planarity between the BSs and the MS. It is noticed that the problem caused by case 2 can be resolved with well-planned locations of the BSs. Nevertheless, the scenarios with insufficient signal sources (i.e., case 1) can happen in real circumstances, e.g., under rural environments or city valley with blocking buildings. It will be beneficial to provide consistent accuracy for location tracking under various environments. However, the wireless location-tracking problem with deficient signal sources has not been extensively addressed in previous studies. In the cellular based networks, three BSs are required in order to provide three signal sources for the TOA-based location estimation. The scheme as proposed in [29] considers the location-tracking problem under the circumstances with short periods of signal deficiency, i.e., occasionally with only two signal sources available. The linear predictive information obtained from the Kalman filter is injected into its original LS scheme while one of the BSs is not observable. However, this algorithm is regarded as a preliminary design for signal-deficient scenarios, which does not consider the cases while only one BS is available for location estimation.

Insufficient accuracy for location estimation and tracking of the MS is, therefore, perceived. In this paper, a Predictive Location Tracking (PLT) algorithm is proposed to improve the problem with insufficient measurement inputs, i.e., with only two BSs or a single BS available to be exploited. The predictive information obtained from the Kalman filter is adopted as the virtual signal source, which is incorporated into the two-step LS method for location estimation and tracking. It is also noted that the preliminary design of the PLT scheme was first presented in our previous work in [30]. A more comprehensive design and performance comparison with other schemes will be conducted in this paper. Moreover, a Geometric-assisted Predictive Location Tracking (GPLT) scheme is proposed by adopting the GDOP concept into its formulation in order to further enhance the performance of the original PLT algorithm. The position of the virtual signal source is relocated for the purpose of achieving the minimum GDOP value with respect to the MS's position. Consistent precision for location tracking of an MS is observed by exploiting the GPLT algorithm. Comparing with the existing techniques, the simulation results show that the proposed GPLT scheme can acquire higher accuracy for location estimation and tracking even under the situations with inadequate signal sources.

2.2 Low-Density Wireless Sensor Networks for Localization and Tracking in Critical Environments

Through this paper, the limitations of application of low-density wireless networks for this project were explored. This however was only a brief study that gave some future insights into our project.

Wireless sensor networks (WSNs), which are large networks of spatially distributed electronic devices (nodes) capable of sensing, computation, and wireless communication, are becoming very popular not only within the academic community as a prototype for multi agent systems but in industry as well. In fact, they can offer access to unprecedented quality and quantity of information that can revolutionize our ability to control the environment: Typical applications include building environmental control [31], vehicular networks [32], surveillance [33], habitat monitoring [34], [35], and manufacturing automation [36]. In particular, location-based applications are among the first and most popular applications of WSNs since they can be employed to track people in wide outdoor areas or enemies in the battlefield or in extending to indoor environments the GPS approach for locating people and tracking mobile objects in large buildings (e.g., warehouses, hospitals). The work in this paper is motivated by one of these applications, i.e., the design of a real-time system that can support fire rescue squads to locate them and to navigate through a building during emergency scenarios. Moreover, to improve coordinated searching strategies, there might also be a need to communicate a fireman's position to an external unit supervising operations.

To achieve these objectives, we propose deploying a static WSN whose nodes are placed in known positions. Each mobile subject is then provided with a compact smart device [personal digital assistant (PDA)-like] that can communicate with the static network and compute and transmit the estimated current position. In detail, the position of the node is obtained using only the radio signals [received signal strength (RSS)] that are provided by a standard IEEE 802.15.4 radio chip, without resorting to any other special sensors or devices such as infrared (IR) motion sensors, ultrasound, or directional antennas. The entire network of both fixed and mobile nodes (MNs) then realizes a distributed intelligence system, relying on the computational capabilities of the nodes. In this framework, however, local position computation is performed by the mobile unit, allowing inherent robustness to static node failure and scalability of the system since the static network simply keeps on transmitting its own location, regardless of the number of MNs in the area. Each PDA computes its own position and displays it on a screen with a map of the environment similarly to commercial GPS-based navigation systems. The position is also transmitted to the static network, which routes it back to a gateway and, finally, to the outer coordination centre. In addition, the localization system must also comply with a number of constraints that are common to WSNs. In fact, it needs to be power-efficient if the nodes of the static network are battery-powered, to be robust to packet drop, and to run in real time, and finally, it should maintain acceptable localization accuracy, even in the event of some static node failure. To avoid confusion, some definitions are in order before proceeding: We define localization as the process of estimating the position of a node, whereas tracking is the process of estimating the trajectory of a moving node, possibly adopting a model of the object dynamics to reduce localization error. In recent years, the problems of localization and tracking have been widely explored with particular emphasis on the accuracy issue: On the other hand, however, the localization error is not the only important factor that needs to be considered when designing an appropriate system. Other aspects are important such as the number of nodes to achieve a desired localization error, the computational requirements that are necessary to run the proposed algorithms in real time, the installation and maintenance costs, the system lifetime, the robustness to packet drop and node failures, and the system scalability. In this spirit, the contribution of this paper is twofold. On the theoretical side, the proposed approach belongs to RSS map based localization systems and makes use of a stochastic model relying on empirical RSS measurements that are collected in the real environment, similarly to that proposed in [37], but adopting, in addition, a novel interpolation for the RSS map. Also, packet loss channel modelling has been studied and integrated into the system. On a more practical ground, the system has been evaluated both in simulation and real-world experiments, with particular attention to issues such as the extension of the static network coverage without excessive increase in the number of nodes and the communication loss in the network. The architecture is implemented in a real-world test bed using commercial off-the-shelf wireless sensor nodes, hardware, and software, and the static network deployment procedure undergoes a connectivity analysis step and a heuristic optimal placement of sensors. Finally, real-time tracking experiments are performed in a rather hostile and large-scale indoor environment that is characterized by massive concrete walls, high electromagnetic interference, and metallic structures.

2.3 SMS-Based Tracking, Navigation and Broadcasting System

This research paper proved beneficial in research for ways to foray into other methods of tracking the location of devices. Short Message Service (SMS) is a text based messaging service available in cell phone or a mobile communication system, which uses standard communication protocol that allow the exchange of limited size text messages (e.g. 160 7- bit characters in GSM mobile handsets). This technology is widely used in day-to-day applications throughout the world. For example Text message services generated by users - include financial, news, sports, language and location based services, mobile commerce such as shopping, stocks and share prices, mobile banking facilities, remainders about programs and booking services.

The GSM is originally Group Special Mobile, which is a standard developed by the ETSI (European Telecommunications Standards Institute) to describe the protocols for digital cellular networks used by mobile phones i.e. Second Generation (2G) networks. Later it became the global standard for mobile communications. The GSM standard was developed as a substitute for first generation (1G) analog cellular networks. This standard initially described a digital, circuit-switched network, which was optimized for full duplex voice telephony. This is later extended to include data communications, by circuit-switched transport and then subsequently by packet data transport via General Packet Radio Services (GPRS) and Enhanced Data rates for GSM Evolution (EDGE or EGPRS). Later, the third generation (3G) UMTS standards where developed by the 3GPP, followed by fourth generation (4G) LTE Advanced standards, and they are not a part of ETSI GSM standard.

Smartphone is a mobile phone with many advanced computing capabilities, features and connectivity than the basic features available in normal mobile phones. The early generation smartphones typically included the features of a mobile phone with those of other popular consumer devices, such as PDAs, a digital camera, a multimedia player and a GPS navigation unit (optional). Modern smartphones along with all the features, they also include the features of a touch screen system, including browsers for web browsing, Wi-Fi, and some 3rd-party applications and accessories. The most popular smartphones available today in the worldwide market are powered by Android from Google and iOS from Apple, mobile operating systems. In the present study a Android based Smartphone with GPS receiver is used showing the versatility of Android SDK for developing a client based application for sending GPS data of client location via SMS.

The Global Positioning System (GPS) is a satellite navigation system that provides information about location and time in all weather conditions, spatially anywhere on Earth. Four or more GPS satellites are used to provide GPS information when there is unobstructed line of sight from earth. The GPS system provides important capabilities to military, commercial and civil users around the world. The United States government maintains this, and is freely accessible to anyone, anywhere with a GPS receiver.

The GPS receiver calculates its position using precision timing of the signals sent by satellites above the Earth. The GPS satellite transmits messages continuously that include: the time at which the message was transmitted and the satellite's position at that particular time of message transmission. To determine the transit time of each message the receiver uses the messages it receive and then the distance to each satellite is computed using the speed of light. The distance calculated and locations of the satellites are used to compute the receiver's location using navigation equations assuming the GPS receiver is located on a sphere. This location is displayed as latitude and longitude; elevation or altitude information based on height above the geoid.

2.4 GPS: Location Based Technology [Publication Name: France Telecom R&D]

This paper helped us in research of AGPS and DGPS technologies, their limitations and also which one of those will we be using in our project. Relevant limitations of each are also mentioned here.

Radiolocation tracking systems are an area of growing significance in the field of wire- less communications. In particular, the satellite-based

Global Positioning System initiated by the US Department of Defence in 1978 promises to revolutionize location- tracking technology as commercial usage increases. Offered free of charge and accessible worldwide, GPS is rapidly becoming a universal utility as the cost of integrating the technology into vehicles, machinery, computers, and cellular phones decreases.

Location tracking has been of great importance since World War II, when military planners realized its usefulness for targeting, fleet management, positioning, and navigation. Today, GPS has a wide range of other applications including tracking package delivery, mobile commerce, emergency response, exploration, surveying, law enforcement, recreation, wildlife tracking, search and rescue, roadside assistance, stolen vehicle recovery, satellite data processing, and resource management.

Tracking methods are generally based on a moving object’s distance, direction, or both. Dead reckoning is a primitive location estimation technique that involves computing an object’s direction and distance from a known starting position. Beacon systems, also known as proximity or signpost systems, use an object’s acceleration to calculate its location and are well suited for fixed-route.

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on a vehicle or carried by hand—uses to estimate the satellite's location as well as the distance between satellite and receiver.

With four or more satellites in view, the receiver can determine the user's latitude, longitude, and altitude. Once it has calculated the user's 3D position, the receiver can calculate other useful information such as speed, bearing,

Operations in small areas

Radiolocation systems including GPS and more limited systems such as Loran—a long- range, accurate navigational system used by ships and aircraft—measure the radio signals exchanged between a mobile unit's transceivers and a set of fixed stations.

GPS consists of a network of 24 satellites in six different 12-hour orbital paths spaced so that at least five are in view from every point on the globe. The satellites continuously transmit military and civilian navigation data on two L-band frequencies. Five monitor stations and four ground antennas located around the world passively gather range data on each satellite's exact position. The system relays this information to the master control station at Schreiber Air Force Base in Colorado, which provides overall coordination of the network and transmits correction data to the satellites.

Each satellite emits radio signals that a receiver—a miniature device installed track, trip distance, distance to destination, and sunrise and sunset time.

To obtain an accurate fix on a moving object or person, GPS determines how long it takes a satellite signal to reach a receiver, which generates its own signal. Assuming that the signals are synchronous, GPS compares the satellite signal's pseudorandom number code—a digital signature unique to each satellite—with the receiver's PNC to determine the signal's travel time. The system multiplies this value by the speed of light to compute the satellite's distance from the receiver.

Because the satellites are nearly 11,000 miles away, miscalculating signal travel time by even a few milliseconds can cause a location error measuring as much as

200 miles. Satellites therefore use extremely precise—and expensive—atomic clocks. A receiver's clock doesn't need to be as accurate because it measures the distance to a fourth satellite to synchronize its PNC with the satellites and correct for any timing offset.

Because the satellites serve as reference points, accurate location tracking requires knowing exactly where they are at all times. In addition to pseudo- random code, satellite signals include navigation data. The monitoring stations and ground antennas, which constantly check satellites' speed, position, and altitude, look for ephemeris (orbital) errors caused by gravitational pulls from the moon and sun as well as solar radiation pressure. The monitors relay this information back to the satellites, which incorporate it into the timing signals.

Limitations

Several factors limit GPS accuracy. A major source of error arises from the fact that radio signal speed is constant only in a vacuum. Water vapour and other particles in the atmosphere can slow signals down, resulting in propagation delay. Errors due to multipath fading, which occurs when a signal bounces off a building or terrain before reaching the receiver's antenna, also can reduce accuracy. In addition, distance measurements are less reliable when the satellites a receiver locks on to are closely oriented with respect to each other. Atomic clock discrepancies, receiver noise, and interruptions to ephemeris monitoring can result in minor errors.

The largest source of potential error is selective availability, an intentional degradation of L1, the civilian GPS signal. SA was originally intended to prevent a hostile force or terrorist group from exploiting the technology. However, the enormous benefits to the world community of increasing GPS accuracy led the US government to turn SA off in 2000. Although it has no intention of reactivating it, the government could do so in a crisis or war.

Improving Accuracy

The typical GPS receiver is accurate from 60 to 300 feet—suitable for most, but not all, applications. Sophisticated models that compare the relative speeds of two timing signals can pro- vide location accuracy within half an

inch, but they are too expensive for the average user. Two cost-effective alter-natives, however, can eliminate most of the errors associated with GPS.

2.5 GPS and SMS-Based Child Tracking System Using Smart Phone

This research paper future uses for our project. In the project the researches were also used that were done here to improve the service and the overall accuracy of our application.

In today's world, over 80% of the world population, including children around the age of eight or seven, owns smart phones [38]. This is due to many reasons. One of them is the remarkable features and capabilities that new smart phones offer especially Android based smart phones. With that many features, the need for resourceful applications rises. In our opinion, GPS offers outstanding capabilities in locating position and this can be used to develop resourceful application that helps in locating missing or lost children. Studies conducted by Cyber Travel Tips [39] showed that in Malaysia, missing children are basically classified into two categories. The first category is disappearance, which includes running away from home. The other category is abduction or kidnapping. Statistics reveal that since 2004, a total of 5,996 children under the age of 18 went missing from their homes. Fortunately, around 4092 children returned home or found by the police. However, the other 1,904 children are still missing. Those children are boys and girls with ages between 14 years and 17 years. Moreover, when parents want to go family trip, they always concern about their children's safety. This worrying may affects negatively on the parent to enjoy their family trip. Even worst, parents can lose sight of their children and fear the possibly of kidnaping or worst for them. Consequently, this project is designed to be used by parents and aimed to help locating missing or lost children. It takes advantage of the fact that many of today's children bring smartphones, which is convenient for this kind of situation. In this work, GPS is combined with one of the basic service of a smart phone, which is GSM, more specifically SMS, in one system. An application at the parent side will allow parents to send a location request to a child side then retrieve the location from the request reply and shows it on a map. On the other hand, the application at the child's side gathers the necessary information of the smart phone that will be used to locate the smart phone. Information such as GPS coordinates and time are gathered and sent to the parent smart phone that's pre-registered on the application. The communication between the parent and the child applications is done using Short Message Service (SMS). SMS offers the system unique features. It will allow the system to work without the need of internet connection thus allows the application to be implemented on smart phones that don't support GPRS, 2G or 3G internet connectivity. The system sends the location of child's smart phone to parent's smart phone when the parent wishes to check on the child.

A. Application Development

This work is designed for parents and children. Both must have a smart phone that supports GPS and SMS as a minimum. SMS is a basic service on any smart phones but GPS can be found on new smart phones. The application is mostly to be used by parents to track down the child's location. In a later phase for implementation purposes, the system will be developed using Android SDK tools [40] and Eclipse [41] supporting Android. The main reason why the Android OS was chosen for the implementation of this work is to target more users. Statistics shows that the market share for the Android OS is 48.8 [42]. This makes it the highest over others smartphones operating systems currently in the market.

B. Application Architecture

We propose a solution to solve the problem based mainly on GPS and GSM technologies. It takes advantage of the two main rich features that is offered in advanced smart mobile platforms nowadays. Those features are location services, mainly GPS, and basic telephony services, mainly SMS. The solution proposed will be implemented to support Android platforms in a later work. The system proposed is based on a simple idea that is the use of SMS for communicating between the parties involved, parent and child. It is designed in a simple way so that it will involve few elements and less user interaction. This way it will result in a system that is simple and easy to implement and use, making it more user-friendly.

The architecture of the system proposed, consists of two sides. First is the parent side, which acts as a server for the system though it is not actually a server. It is basically an Android phone owned by the parent of the child to be located. The parent's side uses SMS for communicating with the child and maps to view the location of the child on a map. Thus, it requires telephony and Internet services to be enabled in the parent's phone for the system to function. The Second is the child side, which acts as a client for the system. The child side is also another Android smart phone but owned by the child to be located. The child side uses SMS for communicating with the parent side and location services, GPS or Network, to get the location of the child in form of coordinates. On the child side, telephony and location services must be enabled and up running on the child side for the system to work. Where else the parent side might need Internet connectivity only for the map to show.

On the parent side, the application by minimum runs the user interface, mostly for map tracking, as well as a service (Listener) that runs in the background of the smart phone. On the child side, the application is mostly a service or Listener that runs in the background of the smart phone. A user, parent, will use the interface to send a location request SMS to child. The Listener at the parent side employs one main function and that is to listen for the child's reply for the location request. However, the Listener at child side employs two main functions. One of these functions is periodically listens and gets location coordinates updates from GPS satellite or Network provider whichever more accurate. The other main function is listening and waiting for a location request from the parent side.

A Listener is a service runs in the background and keeps listening to all SMS incoming but only will only reply to location requests or update coming from the other side of the system. So, when a parent sends a location request via SMS to the child side, the Listener at the child side will automatically reply to a location request SMS with the latest location update received from the location service. Afterwards, the parent's Listener will receive the location details from the child via SMS and processes it for viewing on a convenient map on the UI.

For The Listener to work, it listens for a specific string of characters that is predetermined between the parent and child sides. If an SMS message received starting with that predetermined string then the application will handle event. In this work, the string "$getUpdate$" will be used by the SMS sent by parent side for location request. Where else, the string "$update$Coord" will be used by SMS sent by the child side for updating the location. Note that the "Coordinate" in the string refers to the location coordinates decimals in the actual system.

The design of this proposed solution offers many advantages over many exiting solutions. First, the application operates automatically upon parent location request without the need for user interaction at the child side. This is considered as a big advantage for the system because usually a child cannot handle a complex mobile application and too many user interactions. Another advantage is that the system uses SMS for data transfer thus eliminating the need for Internet connectivity. The system will only require location services and telephony connectivity. This is suitable for situations where the users might not have Internet access. The third advantage this solution offers is that it can perfectly function indoor as well. Using both GPS and Network provider for location determination does it. The application will always get coordinates from both, compare them and use the most accurate. In cases where there is no GPS satellite signal received, for example indoors, the application will use the only other source available, which is the Network provider. It should be noted that Network provider location detection is based on the Cellular ID. Lastly, the system uses a master- slave relation between parent and child sides where the parent controls all the functions of the system and the child has very little control over the system.

2.6 Mobile and Wi-Fi Geo location Using Google Latitude

The development of Geographical location standards has opened the doors for new strategies and ideas for location based services, specifically for wireless mobile devices. With the help of Geo location, it has become easy to get information of specific location or find the current locations on our mobile devices. Using networks like Wi-Fi, Cellular networks or GPS positions, it has become a function of second nature for letting our wireless mobile devices know our locations. However, if a wireless mobile device does not support GPS service, we cannot access Wi-Fi data. This research paper presents an application as a proof of concept (POC), with the help of Google Latitude to define the location of a specific Wi-Fi tower that in turn enables us to locate the approximate location of the wireless mobile devices without GPS support.

The most commonly used location based service application for the wireless mobile devices is the Google latitude, which is provided by Google. With the use of a Google account, the user can set his location on the Google map, view location of other people or businesses and have control over his privacy of location. The privacy option enables a user to hide his location for specific users or even specify the city or the country where his information can or cannot be seen.

In order to get any wireless mobile devices (mobile phones or laptops in our example) location; we need to have GPS position of that wireless mobile device. This information is based on calculating the mobile devices' position out of the GSM's geographic location data [43]. Hence, the infrastructure is already provided in the current world using GPS satellites for location- based services throughout the world. Though this method revolutionized the location-based services, the downfall is that we still need access to GPS data every time we are looking for our location. Also, the synchronization between the satellites and our application fails sometimes; thus, taking more time to define a location (happens mostly in car based GPS systems). If we don’t have wireless network, we cannot get the location data.

Also, to access the GPS or search for GPS satellites, we need a lot of precious power resources that is the most challenging issue with wireless mobile devices. In other words, many of us must use Google location services using mobile phones to display our location. For example the Facebook application could be used to check in our location using the Google location services. On an observational standpoint, we cannot use this application on our desktop system or laptops that are connected to a LAN or wired connection for defining our locations. In this case, we have to re-enter our location that is the address every time we need just in order to define our location or find an address. But if we access the Internet or the application on a laptop or desktop via a wireless signal, we should able to define the location. This is quite extraordinary but the reason behind this is that the IP address cannot alone determine the location of our device.

Thus, to understand the concepts presented in this paper we will need to explain in this introduction what an IP address is, how the IP address is assigned and finally how can the IP address be used in defining the location of wireless mobile devices. After this overview, we are going to explain how Google Gears Geo location technique works.

A. Overview of IP Address:

IP address is the address of the Internet protocol. Each device on a specific network has its own IP address, for example: laptop, PC or printer within a network [44].

The IP address of any device identifies two parts: the identification of the network and addressing the location as shown in Figure 1. So, from the IP address we can know the name of the host or the network, its location and the router to being there [45]. IANA has the responsibility of managing the address spaces that are distributed globally in accordance with the hierarchical structure shown in Figure 2. First, the IPv4 address was assigned as 32bits number [44]. But due to the rapid growth of the Internet, the Internet Engineering Task Force (IETF) proposed IPv6 in 1995 [45]. An IPv6 address consists of a 128bits. Then 1998, IPv6 became RFC 2460 standard. Furthermore, this IP address usually appears in readable text file. It contains binary numbers and each part of these bits meets a specific need as explained above.

B. Position Calculation:

There are three basic methods that are used to calculate the position of the device [46].

1. **Triangulation**: We consider this method exactly as the triangle in the mathematical rule. So, the query is to find the location that is between two angles of two positions. If we know the distance of the two sites, then easily we can calculate the location by using the two angles.
2. **Lateration**: This method can be used if we have more than one site that surrounds the query location. Then we need to measure the distance between those positions. First, we need to get from each position the minimum of its three signals. Then, either we calculate the difference in the time of the signals or the difference of signal runtime. However, if the surrounding positions are three we call this method Trilateration. Furthermore, if we have more positions that are pinpointed for the queried location, we call **it Multi-lateration**.
3. **Centroid Localization**: This method also considers the triangle shape. The query location should be centralized and the important function is to know the received signaled sites. Based on this sited we can get the measurement or the desired position.

2.7 Location Based Services on Smart Phone through the Android Application

This research paper helped in our research for the application that we are going to make. This is a similar project to what we are looking to achieve. The motivation for every location based information system is ‘To assist with the exact information, at right place in real time with personalized setup and location sensitiveness’. In this era we are dealing with smartphones, which are going to replace the bulky desktops even for computational purposes. Such needs can only be catered with the help of LBS. But these applications are limited to desktops only. We need to import them on mobile devices all the information must be available in his mobile device and also in user customized format. The project ‘Android application for location based service on mobile‘is based on the mobile operating system Android‘, GPS technology & Java technology (J2EE). Android operating system & Java technology emerges as one of the hottest topic in field of information technology.

The idea of using the mobile handsets and phones is to deliver the valuable services.

Chapter 3 System Development

3.1 Algorithms

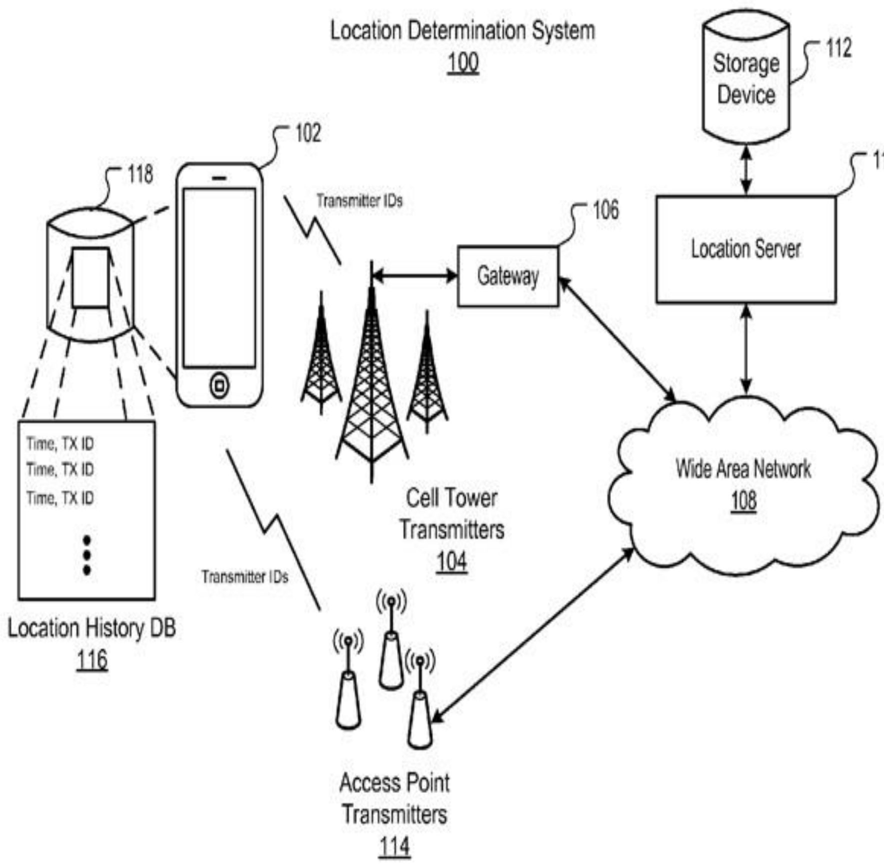

Figure 3-Location Determination System

Location is tracked using a method called triangulation. It is a three-step process that is defined below.

- Step One:
  Suppose we measure our distance from a satellite and find it to be 11,000 miles. Knowing that we're 11,000 miles from a particular satellite narrows down all the possible locations we could be in the whole universe to the surface of a sphere that is centred on this satellite and has a radius of 11,000 miles.
- Step Two:
  Next, say we measure our distance to a second satellite and find out that it's 12,000 miles away.
  That tells us that we're not only on the first sphere but we're also on a sphere that's 12,000 miles from the second satellite. Or in other words, we're somewhere on the circle where these two spheres intersected.
- Step Three:
  If we then make a measurement from a third satellite and find that we're 13,000 miles from that one that narrows our position down even further, to the two points where the 13,000 mile sphere cuts through the circle that's the intersection of the first two spheres.
  So by ranging from three satellites we can narrow our position to just two points in space.

We could have also used another method called lateration. This method can be used if we have more than one site that surrounds the query location. Then we need to measure the distance between those positions as shown in Figure 4. First, we need to get from each position the minimum of its three signals. Then, either we calculate the difference in the time of the signals or the difference of signal runtime. However, if the surrounding positions are three we call this method Trilateration. Furthermore, if we have more positions that are pinpointed for the queried location, we call it Multi-lateration.

3.2 Project Design

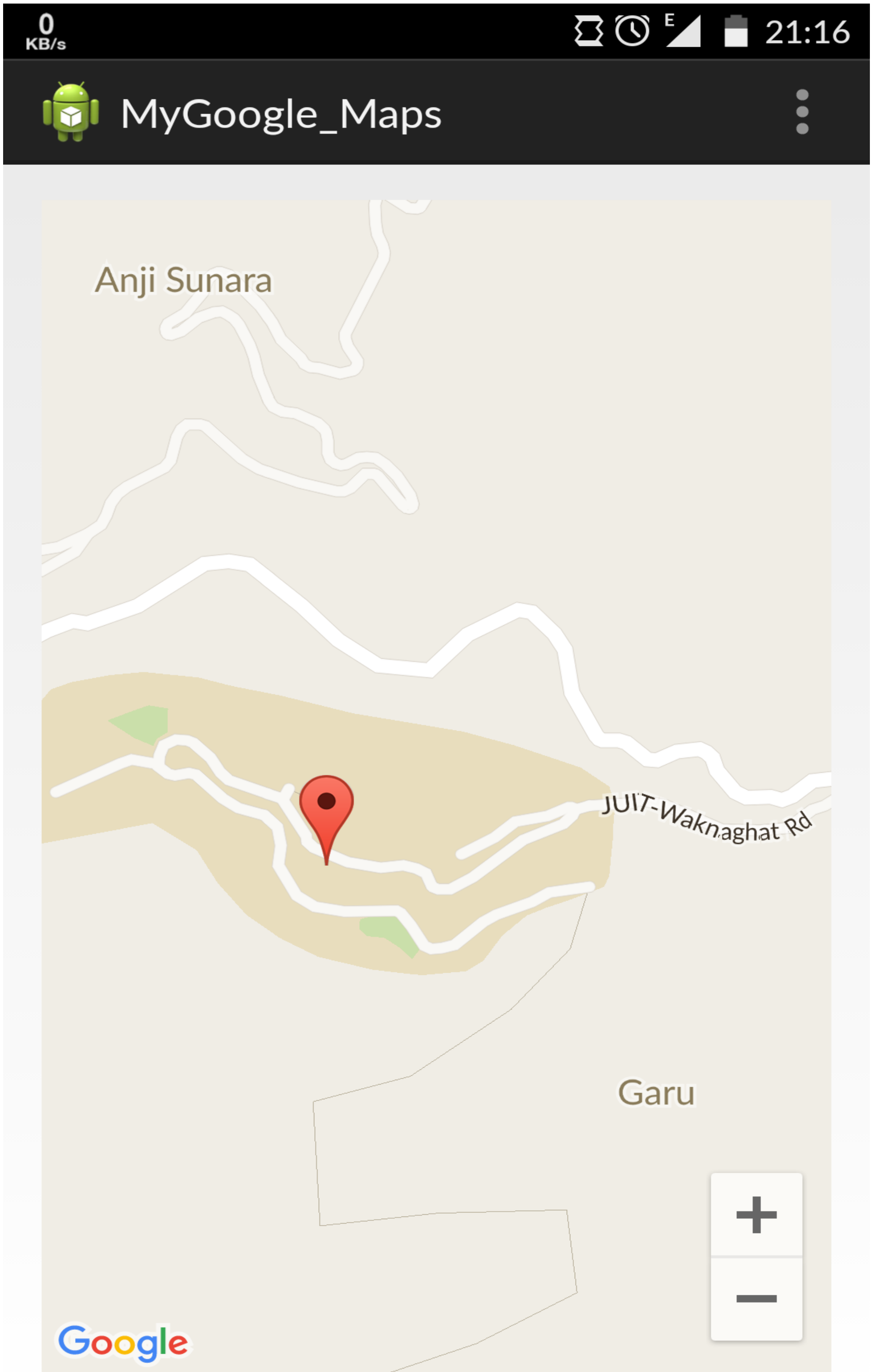

Figure 4-Zoomed out Screenshot of the current location

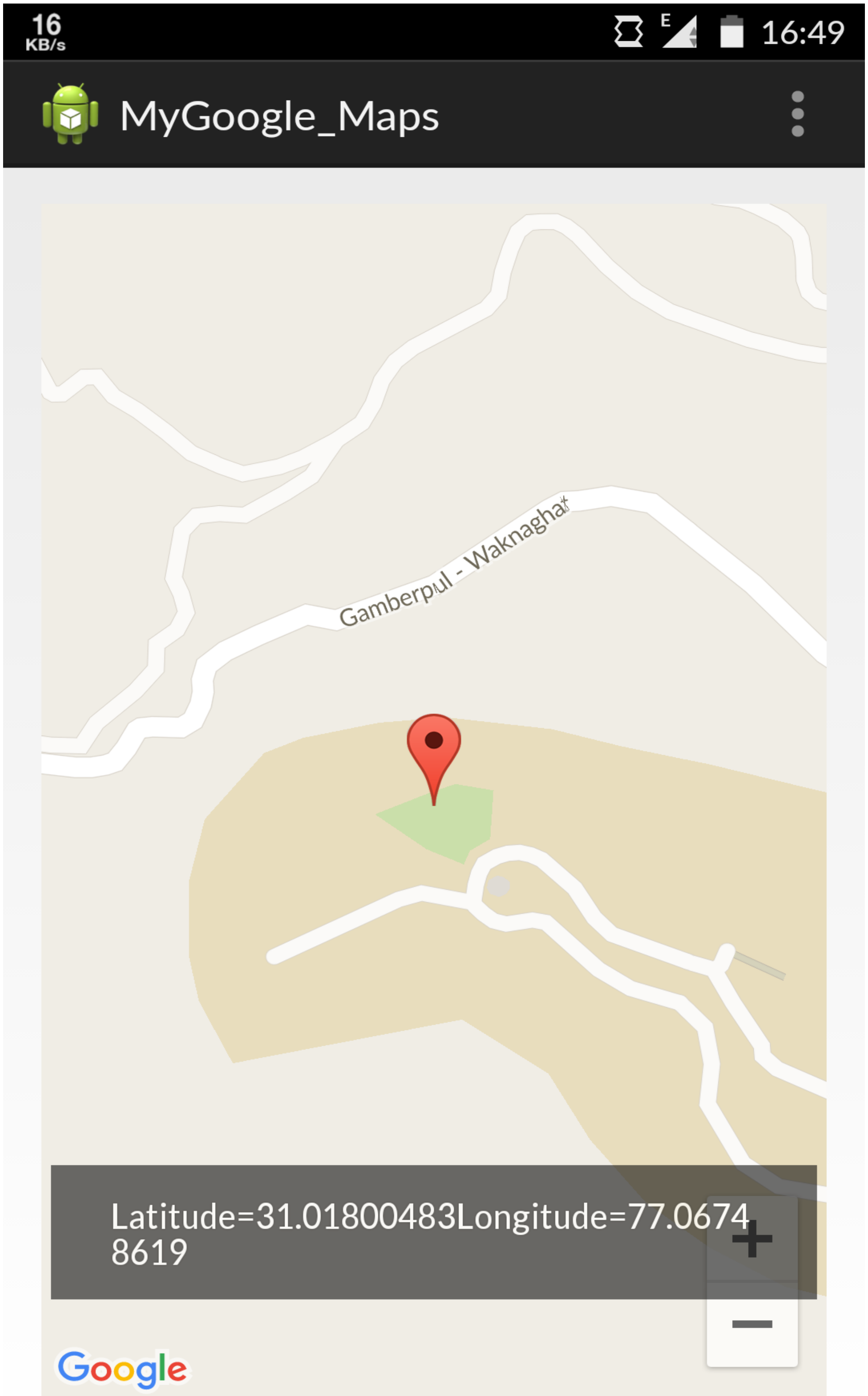

Figure 5-Toast showing latitude and longitude of the current location

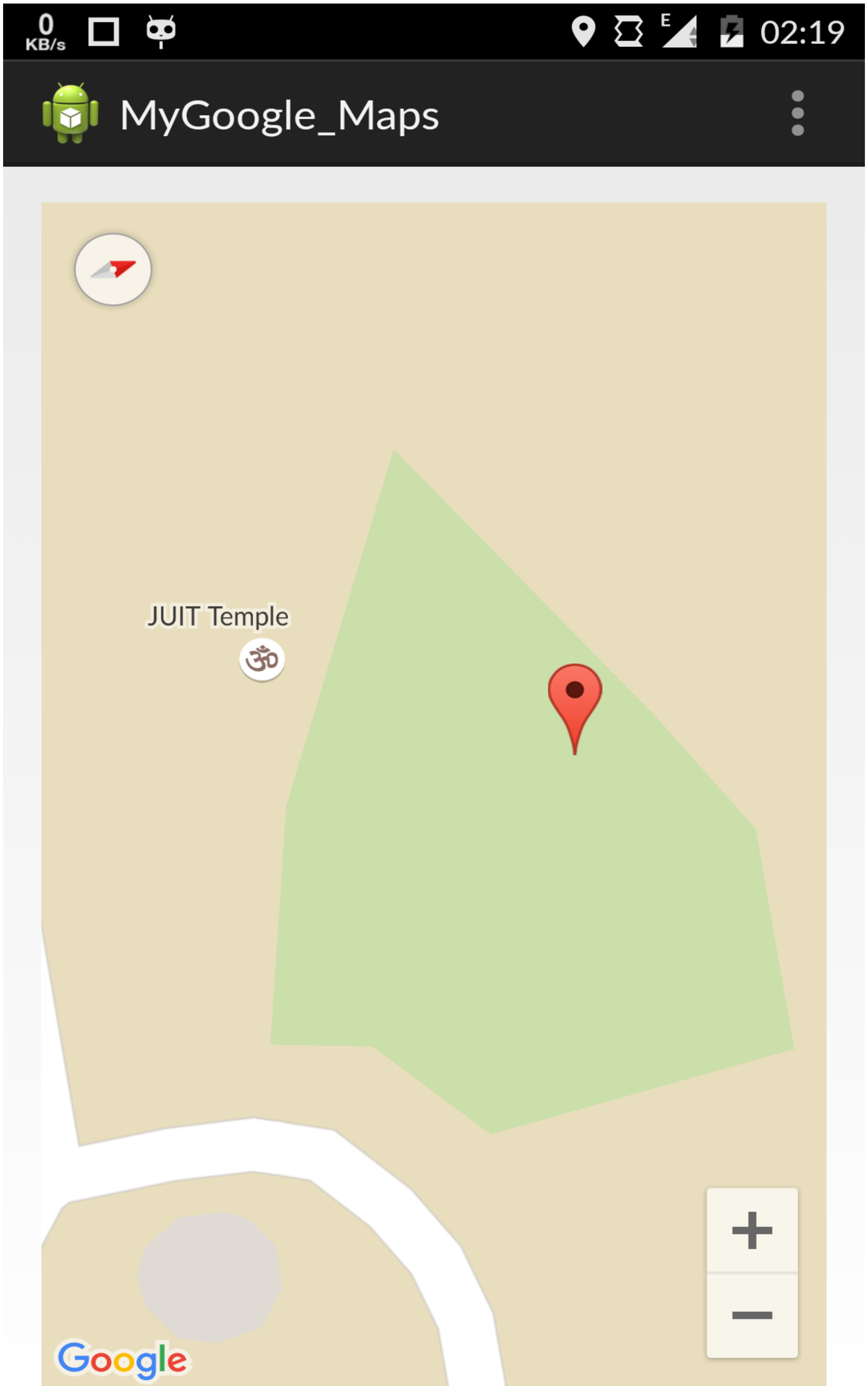

Figure 6-Zoomed In view in current Location

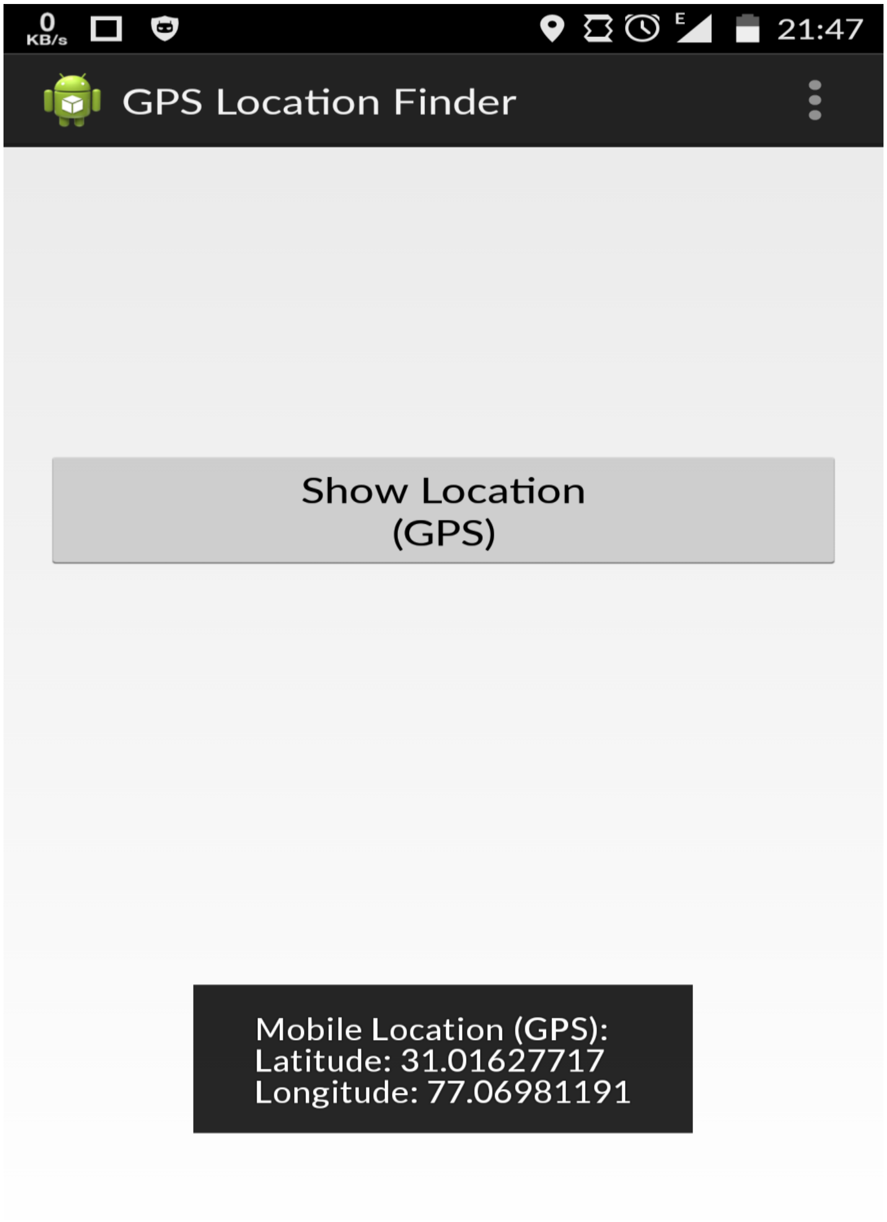

Figure 7-Toast Showing Latitude and Longitude in the other platform

Figure 8- Admin Notification

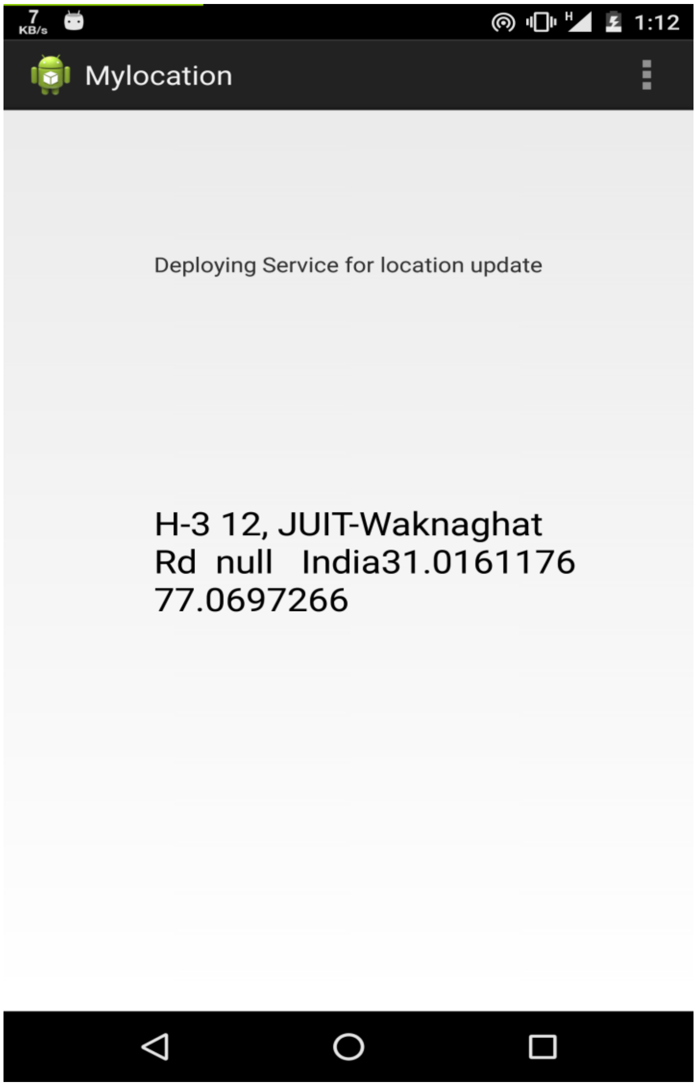

Figure 9-Admin notification on location change

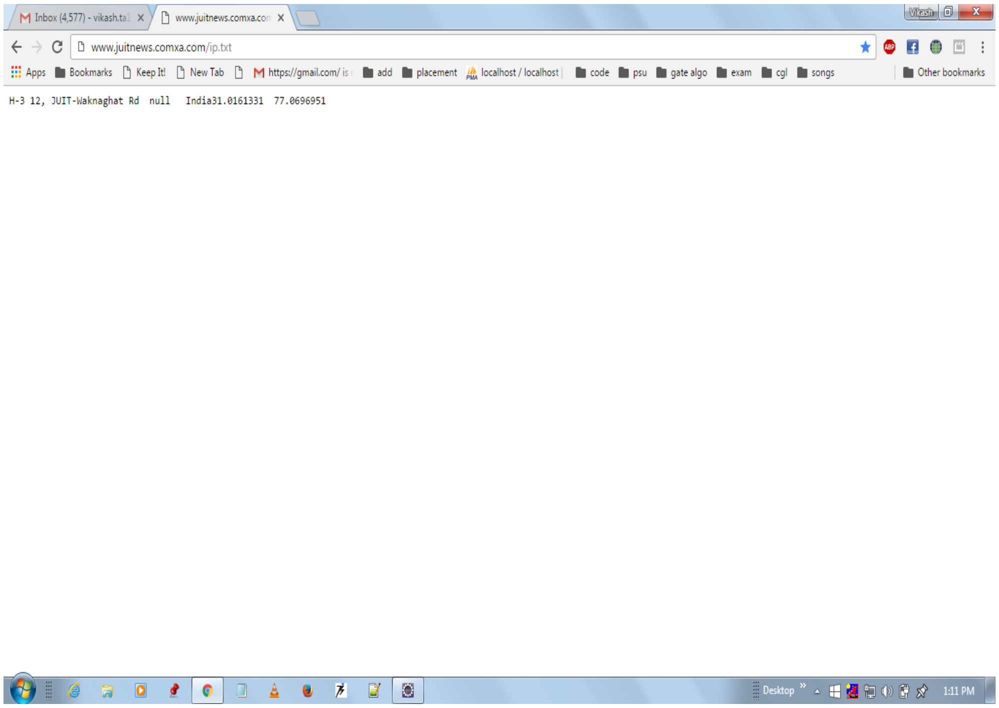

Figure 10-Current Location (Server)

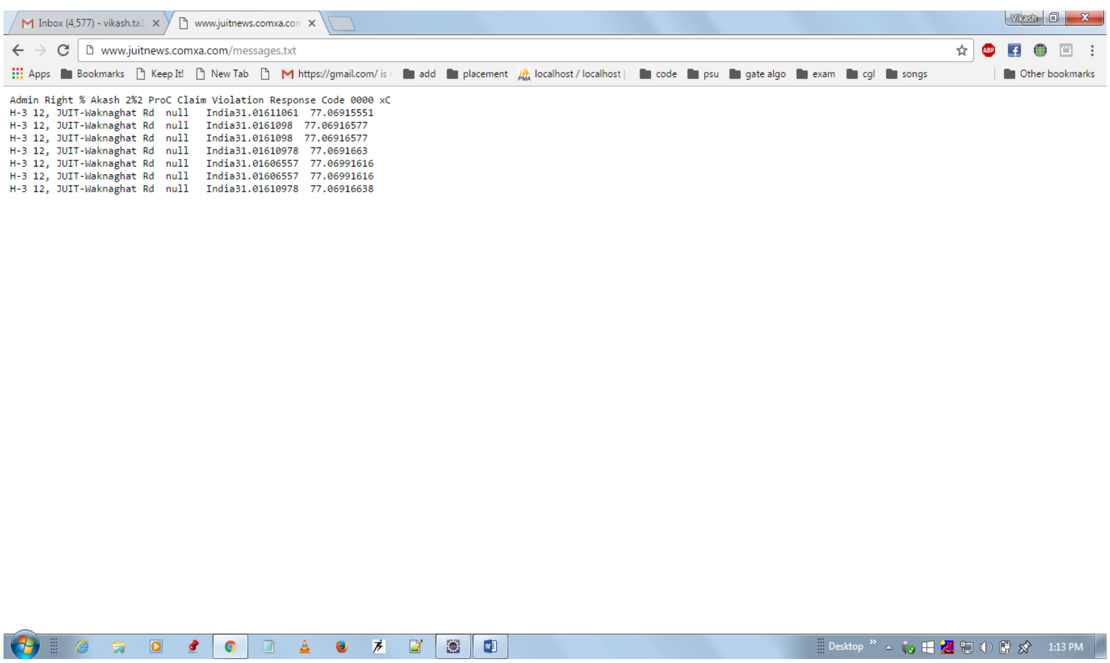

Figure 11-List of locations (Server)

Chapter 4: Performance Analysis

4.1 Experiments and Analysis

Here is a bullet representation of all the experiments that happened in this project.

- **Choosing the right Android Development Tool (ADT)**

  Eclipse and Android Studio are both widely used development platforms for making android applications. So, in this project the application that used Google Maps API is developed in Eclipse whereas in the location listener application, android studio has been used. Different operating systems have also been used in the development, namely MAC OS X and Windows 7.

- **Issues in setting up the SDK**

  As already mentioned above, this project is developed over various platforms and operating systems, so while setting up the SDK, the process was quite varying.

- **Choosing the proper location-tracking channel**

  Wi-Fi and GPS were the two channels that were considered to track the location of the device in this project. Ultimately, to check the efficiency and other functionalities, at once, only Wi-Fi, only GPS and Wi-Fi and GPS were used.

- **Setting up and importing the Google Maps API**

  Constant crashing of the Eclipse ADT was observed when importing the Google Maps API.

- **Using Location Manager classes**

  Gradle dependencies and interlinking proved to be an issue while using location manager classes in the project.

- **Using different emulator**

  Using Android virtual device (AVD) that is included in Eclipse and Android Studio for debugging proved to be an entirely different experience as using an actual android device for debugging. AVD provided with the SDK could not be used for tracking location, so in this project to track the location, GenyMotion was used as a virtual device. For an actual device, an android device running on android Lolllipop version 5.1.1 was used.

Chapter 5 Conclusions

5.1 Conclusion

This project delves into the details of what Location based services actually are, their architecture and why it is important for the generation of today. This project also was a witness to the development a basic support application ‘GPS Location Tracker’ implementing Location based services, Google Maps and Coordinate. This application basically deals with enabling the users to track their coordinates and store them as they change. Developing the app required the use of many internal as well as external technologies. Various classes from packages such as ‘com.google.android’ and Android Location were used. Location management classes, display classes and storage were used for communication, storage and display. The complexity of every implemented class is a good indication of the development efforts. All in all, implementation of LBS for mobile involves an interesting combination of basic native Android development as well as the working and integration of external Google API’s.

5.2 Future Work

1) Photo Tagging

This application can be paired with a camera app to tag the photos with the location at which the photo was taken.

2) Real time application

The logistics companies can use this application as a real-time application by connecting it to a database and tracking the movement of the delivery vehicles.

3) Security

This application can be used to track the location of the device in case it gets stolen.

4) **Tracking Children and students**

This application can be used as a way to safeguard children and students and also at the same time tracking their location and movement.

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