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Location Based Services on Smart Phone through the Android Application

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Abstract— 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. Our 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 Android operating system is comprised of a virtual machine that runs on the Linux kernel, plus APIs, and a collection of built-in applications. A location-based service (LBS) is a mobile application that is dependent on the location of a mobile device. A positioning component is usually needed in a LBS application to determine the location of user's mobile device. Most of the current LBS services do not require users to input location manually, like giving zip code or street name.

Keywords— Android operating system, LBS, GPS, Google Maps.Reputation based security

I. INTRODUCTION

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

Location-based services or LBS refer to 'a set of applications that exploit the knowledge of the geographical position of a mobile device in order to provide services based on that information.' Location-based services (LBS) provide the mobile clients personalized services according to their current location. They also open a new area for developers, cellular service network operators, and service providers to develop and provide value-added services: advising clients of current traffic conditions, providing routing information, helping the users to find nearby shopping malls. Location-based services offer many merits to the mobile clients. For the mobile user, the examples of location based services [2] are:

- **Profile changer based on place or area**
- **Person Location tracking by Family Member(SMS)**
- **Nearest Friends notification reminder**

Location based Services can be classified in 3 categories
a) Public Safety / Emergency Services

The location of the client can be determined by the mobile carrier hence it finds great use during Emergency since it can be used during the emergency/health hazard to locate the mobile clients.

b) Consumer Services
Now days, smart phones like (Android, Blackberry and iPhone) provide a set of location based applications and services which helps the users to access the multiple services based on the user location.

☐ *Maps Navigation*- The users can use the Google Maps to get to the particular location or to trace the route between any two locations.

☐ *Marketing /Advertising*- Many corporate companies advertise their items based on the location of the clients.
For Example – Sale in Shopping Mall near to your location.

☐ *Location based Reminders*- The phones can be used to set as the reminder based on the location.

2. LBS COMPONENTS

All In order to make LBS services possible, some infrastructure elements are necessary, including mobile devices, applications, communication network, positioning component, and service servers Mobile devices are tools used by users to access LBS services, to send requests and retrieve results. Such devices can be portable navigation devices (PNDs), Personal Data Assistants (PDAs), laptops, mobile phones, and so on. Application is the interface for users to access the LBS service. It is usually software developed by an application provider, downloaded and installed on user's mobile device. A specific application is usually developed for a specific LBS service. Due to the restrictions of mobile devices (small screen size, limited processor power and memory, battery capacity), LBS applications need to be lightweight and battery saving. Communication network refers to the mobile network which transfers service request from user to service

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provider, and requested information back to the user.A positioning component is usually needed in a LBS application to determine the location of user's mobile device. Service providers maintain service servers which offer different kinds of LBS services to users and are responsible for processing service requests and sending back request results. Servers calculate positions, search for a route, or search specific information based on user's position. Service providers usually do not store and maintain all the information requested by users. Instead, content providers are responsible for collecting and storing geographic data, location-based information, and other related data. These data will be requested and processed by service servers and then returned to users. Figure 1 shows the interactions among these components, and the process of a LBS service. First, user sends a service request using the application running on mobile device (Step 1). The service request, with user's current location information obtained from the positioning component (in this example, GPS data), is sent to service server via the mobile communication network (Step 2). The service server requests geographic database and other related database to get required information (Step 3, 4). At last, the requested information is sent back to user's mobile phone via mobile communication network paragraphs must be indented.

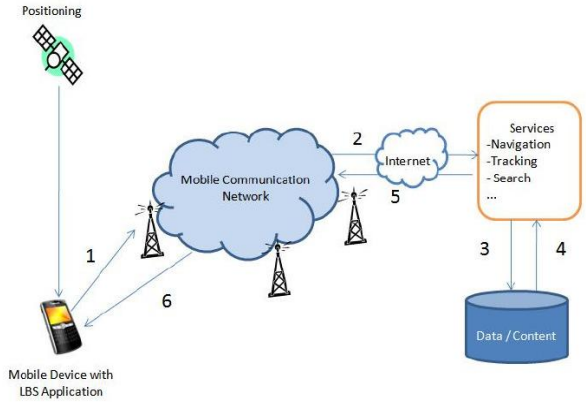

Figure 1 LBS components and Service Process

Every LBSs contain a number of components including maps and Geographic Information System (GIS) information, location collection services, and LBS application-specific subcomponents. The architecture of LBS can be generalized as shown in Figure 2.

LBS Application

This represents a specific application such as a "find my friends" application. This consists of a Smartphone component, which has a number of sensors, and potentially a server component that includes application-specific data (such as location-tagged information

LBS Middleware

This wraps access to Core LBS Features (Location Tracking, GIS Provider and Location Collection Services) to provide a consistent interface to LBS applications.

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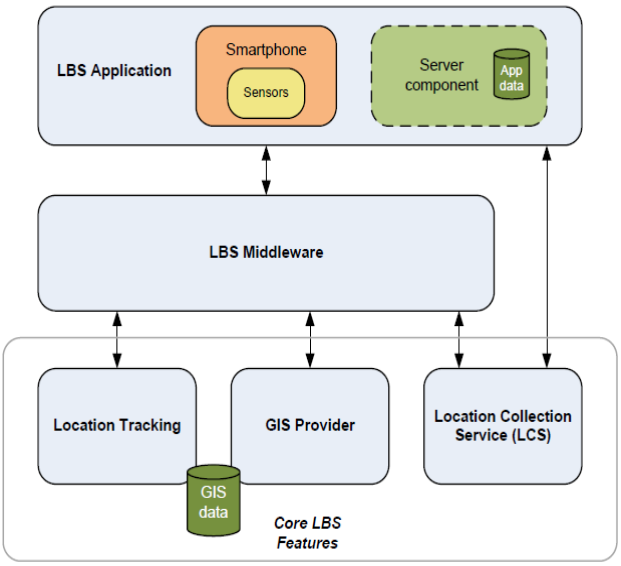

Figure 2 Components of LBS

Location Tracking

This component stores the location trace of individual users. This represents a fundamental component in next-generation LBS as it contains the data that allows a user's route to be determined and potentially predicted. In particular, this component would typically support the following functionality:

1. Keep records on user's current and past locations.
2. Notify other components when a specific user has moved, or when they move in or out of an area.

This supports location-based notifications being sent to users.

3. Determine which users are within a defined location this supports geo-casting features.
4. Queries of location trace to generate user movement models

GIS Provider

This component provides geospatial functionality for many LBSs including map information, map visualization and directory services. Google Maps with its API can be considered a GIS provider.

Location Collection Service

This component performs location collection to get a latitude and longitude for a specific user. Depending on the technology, this component may be accessed via the LBS Middleware (e.g., mobile network triangulation via a service provider) or directly (e.g., via GPS receiver in the Smartphone). Android provides access to the above components to facilitate the implementation of LBS services

through the help of following classes;

1. Location Manager
2. Location Provider
3. Geo-coding
4. Google-Map

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Location Manager

Location Manager Class of android is present to manage all other components needed to establish a LBS system.

Location provider

Location provider represents the technology to determine the physical location i.e. to handle GIS. Location Provider component of Android application is a present to facilitate the determination of available provider and selection of suitable one.

There are two methodologies to implement LBS [3]-

- To process location data in a server and to forward the generated response to the clients.
- To find location data for a mobile device-based application that can use it directly.

To discover the position of the mobile, LBS must use positioning methods in real time. The accuracy of the methodology depends on the approach used. Locations can be represented in spatial terms or as text descriptions. A spatial location can be represented in the used latitude-longitude-altitude coordinate system. Latitude is defined as 0-90 degrees north or south of the equator and longitude as 0-180 degrees east or west of the prime meridian, that passes through the Greenwich, England. Altitude is represented in meters above sea level. A text description is usually defined as a street location, including city, pin code.

The location of the device can be retrieved by-

i) Mobile Phone Service Provider Network-

The current cell ID is used to locate the Base Transceiver Station (BTS) that the mobile phone is interacting with and the location of that BTS. It is the most basic and cheapest method for this purpose as it uses the location of the radio base station that the cell phone is connected to. A GSM cell may be anywhere from 2 to 20 kilometers in diameter. Other approaches used along with cell ID can achieve location granularity within 150 meters. The granularity of location information is poor due to Wide Cell Range. The advantage is that no additional cost is attached to the handset or to the network to enable this service.

ii) Satellites

The Global Positioning System (GPS) uses a constellation of 24 satellites orbiting the earth. GPS finds the user position by calculating differences in the times the signals, from different satellites, take to reach the receiver. GPS signals are decoded, so the smart phone must have in-built GPS receiver. Assisted GPS (A-GPS) is the new technology for smart phones that integrates the mobile network with the GPS to give a better accuracy of 5 to 10 meters. This fixes the position within seconds, has better coverage and can, in some cases, be used inside the buildings, consumes less battery power and requires fewer satellites. The granularity of location information is most accurate (Latitudes and Longitudes).The disadvantage is cost of AGPS enabled handsets for the user.

3. USE OF LBS IN ANDROID APP

1.Profile changer based on place or area

In this module of project we are going to implement automatic profile changing facility means using this feature of our android app, the profile of user's mobile device will automatically change from normal mode to silent mode & vice versa. According to places where person goes. The user needs to register the particular places/location for which he wants to change the profile. And accordingly the profile changer will work in that particular registered perimeter only. Here first the user's mobile device will locate using GPS technology then according to place the profile of mobile will change. Sometimes the person forgets to change the profile of mobile phone at certain places, so this app will help which automatically change profile.

2.Person Location tracking by Family Member(SMS)

This feature of our android app will help the family members to locate their other family member. In this module we are going to implement person's location tracking with mobile device using Google map & GPS technology. Here when family members e.g. parents wants to find location of son/daughter then they have to just send a particular message on son/daughter's mobile then the app will send location to Google map service & then Google cloud's SMS service will this send location SMS to parents. So parents can easily get location of their son/daughter with help of this feature.

3.Nearest Friends notification reminder

This is another location based service provided by our android app, in which we are going to implement nearest friends notification reminder. In this feature the user will get reminder message when his/her friend locate in the same area, so that the user can meet him/her. Here according to the friends list provided by user, user will get the notification reminder when the GPS tracks the location of the person from list in same area where the user is currently present. In this scenario, the area is based on the geographic cell.

4.GLOBAL POSITIONING SYSTEM(GPS)

The **Global Positioning System** (**GPS**) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil and commercial users

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around the world. It is maintained by the United States government and is freely accessible to anyone with a GPS receiver.

GPS is often used by civilians as a navigation system. On the ground, any GPS receiver contains a computer that "triangulates" its own position by getting bearings from at least three satellites. The result is provided in the form of a geographic position - longitude and latitude - to, for most receivers, within an accuracy of 10 to 100 meters. Software applications can then use those coordinates to provide driving or walking instructions. Getting a lock on by the GPS receivers on the ground usually takes some time especially where the receiver is in a moving vehicle or in dense urban areas. The initial time needed for a GPS lock is usually dependent on how the GPS receiver starts.

The receiver has a general idea of which satellites to look for because it knows its last position and the almanac data helps identify which satellites are visible in the sky. This takes longer than a hot start but not as long as a cold start.The GPS receiver has to attempt to lock onto a satellite signal from any available satellites, basically like polling, which takes a lot longer than knowing which satellites to look for. This GPS lock takes the longest.

In an attempt to improve lock times, cellphone manufacturers and operators have introduced the Assisted GPS technology, which downloads the current ephemeris for a few days ahead via the wireless networks and helps triangulate the general user's position with the cell towers thus allowing the GPS receiver to get a faster lock at the expense of several (kilo)bytes.

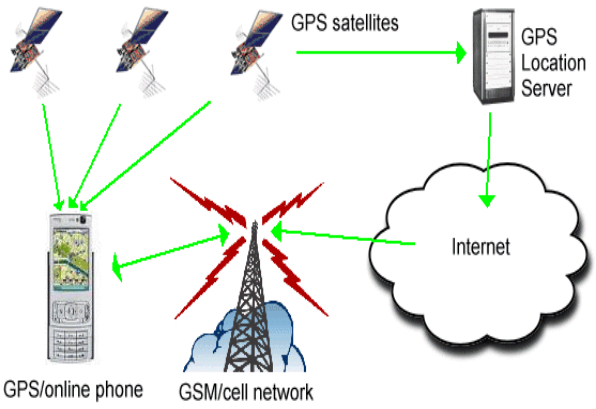

Figure 3 Architecture of GPS System

5.ANDROID :MOBILE OPERATING SYSTEM

Android delivers a complete set of software for mobile devices: an operating system, middleware and key mobile applications. Android was built from the ground-up to enable developers to create compelling mobile applications that take full advantage of all a handset has to offer. It was built to be truly open. Android is built on the open Linux Kernel. Android support LBS Application Programming Interfaces (APIs) . Location service allows finding out the device current location. The application can request for periodic update of the device location information. The application can also register a intent receiver for proximity alerts like when the device is entering and existing from an area of given longitude, latitude and radius.

On a basic level, Android is a distribution of Linux that includes a Java Virtual Machine (JVM), with Java being the preferred programming language for most Android applications. The Android Software Development Kit (SDK) includes a debugger, libraries, a handset emulator, documentation, sample code and tutorials. Android's official integrated development environment is Eclipse using the Android Development Tools (ADT) plug-in. SQLite database support is integrated into the Android platform. The ADT plugin includes an Android emulator that allows for the simulation of GPS and Wi-Fi. The Android emulator is depicted

- **Android Location API**

These are the different classes present under Location API package to retrieve the Location information of the user.

☐ *LocationManager*- The class provides access to the location service. It also provides facility to get the best Location Provider as per the criteria.

☐ *LocationProvider*- It's an abstract super class for location providers. A location provider provides periodic reports on the geographical location of the device.

☐ *LocationListener*- This class provides callback methods which are called when location gets changed. The listener object has to be registered with the

☐ *location manager* - The class provides the application to choose suitable Location Provider by providing access to set of required properties of the Location Provider. Android also provide an API to access the Google maps. So with the help of the Google maps and the location APIs the application can show required places to the user on the map.

- **Google Places API**

On 10 May, 2011, at the Google I/O developer Conference in San Francisco, Google announced the opening up and general availability of the Google Places API. The Google Places API is a service that returns data about Places — defined within this Web Service as, spatial locations, or preferred points of interest — using HTTP requests. Place response specifies locations as latitude/longitude coordinates. The four types of requests are available with the Google Places API

There are 4 fundamental Place services available:

☐ *Place Searches* - It returns an array of nearby Places based on a location defined by the user.

☐ *Place Details* - It returns more specific data about a user defined Place.

☐ *Place Check-ins* - It allows the request that a person has checked in to a Place.

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☐ *Place Reports* - It allows the users to add new locations to the Place service, and to delete Places that the application has added to the database.

6.ANDROID APPLICATION: WORKING WITH USE OF GPS, GOOGLE MAPS API

It is the biggest and most important part of the entire application. It uses Android SDK API to manage the GPS Sensor, Google Maps API to show the Map powered by Google Maps, to display the markers about events on the Map.

The first and most important part is acquiring the User's Location. It's important to manage it properly because the aim is to get the most accurate location and use the least battery possible. Android utilizes GPS and Android's Network Location Provider to acquire the user location. Although GPS is most accurate, it only works outdoors, it quickly consumes battery power, and doesn't return the location as quickly as users want. Android's Network Location Provider determines user location using cell tower and Wi-Fi signals, providing location information in a way that works indoors and outdoors, responds faster, and uses less battery power. Obtaining user location from a mobile device can contain errors and be inaccurate due to:

- Multitude of location sources: determining which to use and trust between GPS, Cell- ID, and Wi-Fi;
- User movement: location changes and we need to re-estimating user location every so often;
- Varying accuracy: a location obtained 10 seconds ago from one source might be more accurate than the newest location from another or same source.

Android provides a best performance model to obtain user location:

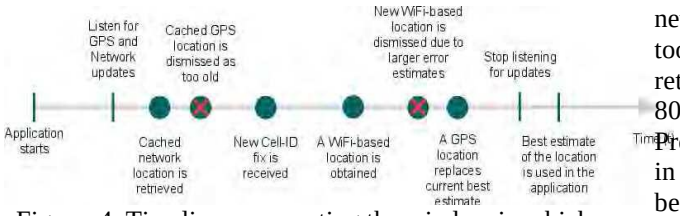

Figure. 4. Timeline representing the window in which an application listens for location updates

The application will start listen to location updates just after it started. After a certain amount of time the application will come back to listen to updates and will estimate the best location between the old one and the one just retrieved.

The best way to get the most accurate location is to use the API method *getAccuracy()*. This method returns the accuracy of the fix in meters. If for example this method returns an *Accuracy* value of 50, it means that user is in a 50 meters radius from the position that is shown on the map.

However if we want a location to be the most accurate possible, we have to use a lot of battery, so we should save some of our battery and have a less accurate location.

There are several tricks we can use to save device battery which is fundamental in this application:

1. Reduce the size of the window above in which we listen to location updates, less time the GPS sensor will be on the less battery will be used;
2. Using a last known location to increase the speed the location is shown on the map (every first time the application is launched, it takes a while to get a fix of the current location, because the GPS sensor must connect to several satellites);
3. Requesting location updates less frequently;
4. Use just one of the two providers (GPS and Network).

Obviously these tricks have a con: they don't help us to get a very accurate location. But the objective is to have the application works for a long time.

To achieve the most valuable result this application uses the following algorithm to save device's battery:

1. Check if the retrieved location is more recent than the one we are using by *getTime()*;
2. Check if the retrieved location has a better Accuracy than the one we are using by *getAccuracy();*
3. Check which provider is more dependable and use a location retrieved by that provider.

The problem is when the GPS sensor is off or when there is no GPS signal (i.e. when we are in buildings). The Android Network Provider will first get the Cell ID and then will send it to google server, which maps such Cell IDs and the server will return a latitude and longitude. In this case accuracy is usually very low, for example 1000 meters. By this time Android will also try to see all WiFi networks in the area and will send information about them too to the google server and if possible google server will return a new location with higher accuracy for an example 800 meters. It is very important to notice that the Network Provider requires an internet connection. So if the user is in a building and there is no data connection, he will never be able to get a location. Once the application has the user's location, it will connect to the server and download the list of events and their location and it will show a map centered in the user's location and will display the markers of the events that are around him

7. Reputation based security model for Android Application

Privacy issues are common in all OSes. However with Android's Global Positioning System (GPS) and Locations Based Services (LBS), hackers may be able to track the movements and location of the Android phone owner.

Our solution stores the reputation of Android applications in an anti-malware providers' cloud (AM Cloud). The experimental results witness that the proposed model

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could well identify the reputation index of a given application and hence its potential of being risky or not.

8. CONCLUSIONS

There are various constraints to implement Location Based Services. The different kinds of constraints include :

☐ Technology Constraints

The most important factor in enabling the growth of LBS is wide availability of cheap GPS enabled handsets. GPS enabled handsets are being manufactured now days.

☐ Infrastructure Constraints

One of the main problems is the lack of spread of the wireless network into the countryside. In developing country like India, the wireless technology is in very nascent stage. In metro cities and areas, the problem of network congestion is also an important issue. The percentage of service operators not meeting the congestion rate benchmarks has risen subsequently.

This paper proposes a developing an Android Application which is based on LBS & provides different location based services like profile changing of mobile from normal mode to silent mode & vice versa for certain places that user registered. Again nearest friend locator, family member location finder. Here for finding location the GPS technology with Google Map API can used. As android is an open source, this application can be used for further improvements in many Smartphones. Also in concern the security aspect of this application , the Reputation based security model can apply. After going through the surveying, it can be gathered that there is a huge scope of application development in mobile domain. Following the same notion, we can also develop application that can tackle following issues:

1) Location positioning technologies
2) Query processing
3) Cache management

Applications can be developed on Android platform of Open Handset Alliance led by Google. Google provides simulated environment and standard development kit for developing Android applications. We chose Android as it is parallel to iOS (supported by Apple) in terms of facilities it provide and is also open source. The LBS application can help user to find hospitals, school, gas filling station or any other facility of interest indicated by user within certain range. Just like a GPS device its location will also be updated as soon as user changes his/her position.

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