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Location-Based Services Using Autonomous GPS

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Abstract— In a mobile era, people need to know about everything at any place and any time. To achieve this need, Location Based Services (LBS) can be the solution for their search. Normally, LBS are achieved with the help of signals of the service provider of that particular mobile. But it is not appropriate if there is poor/no availability of signal strength. Therefore it might be less efficient or even completely useless in some circumstances. Most of the existed LBS consume more battery power, long time to make connection to the server and cost. To overcome this problem, the proposed Android App developed with the Autonomous GPS to track the location of a user with the help of the device's location services. The incentive of this App is, "To aid with the precise information of current location of a person in real time". This Android APP is designed to find and tag the services and people where they are located with the concept of Autonomous GPS. These autonomous GPS find the user location from the mobile's device and it is in-built with smart phones. It works faster with reduced cost compared to the existing system.

Keywords— Android operating system, LBS, Autonomous GPS, Google Map.

I. INTRODUCTION

A. Android

Android is an open source, mobile operating system (OS) based on the Linux kernel, developed by the *Open Handset Alliance*, led by Google, and other companies. The latest version of Android is 4.4 KitKat. Mobile applications can be build using Android and iOS. An Android app is a software application running on the Android platform. Because the Android platform is built for mobile devices, a typical Android app is designed for a Smartphone or a tablet PC running on the Android OS. Android apps are available in the Google Play Store (formerly known as the Android Market), Amazon AppStore, and 1Mobile market and on various Android App-focused sites.

1) Android Benefits And Limitations

Benefits of an Android are scheduled as:

- Open source
- Android scales to all devices
- Time for a change
- Third party development is encouraged.

Android has following limitations:

- Not hold by any huge corporation yet except HTC
- Not support a few applications similar to Firefox
- Several restrictions exist in blue tooth

2) LBS

A Location based services (LBS) is an information and entertainment services, available with mobile devices through the mobile network and utilizing the ability to make use of geographical position of the mobile device. LBS services can be used in a mixture of contexts, such as health, work, personal life, etc. It comprises parcel tracking and vehicle tracking services. LBS have two foremost actions, that is:

1. Finding the location of user
2. Utilizing this information to offer as a service.

Location based Services can be classified into 3 categories:

- A) Public Safety/Emergency Services
- B) Consumer Services

Some cases of location based Services are:

- To determine the nearest business or service, such as an Bank or Hotels
- Getting alerts, such as notification of Sale in Shopping Mall or news of Traffic Jam nearby
- Receiving the location of the stolen phone.

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II. LOCATION-BASED SERVICES – APPLICATIONS

In order to provide more useful, attractive and engaging social networks, apps and services location-components have been added to new innovative projects. I have catalogued some of the applications of LBS in the following way:

- Marketing
- Emergency
- Information Services
- Navigation
- Location Based Social Media
- Mobile Location-Based Gaming
- Sports
- Billing
- Geo-tagging
- Tracking
- Augmented Reality

The remainder of this paper is organized as follows. The background and related work of Autonomous GPS and other techniques are discussed in Section II. The methodology of LBS components is presented in Section III. Android application: working with use of GPS, Google Maps API is explained in Section IV and the idea of proposed system is evaluated in Section V. Section VI concludes this paper. Future scope of this application is conferred in Section VII.

III. BACKGROUND AND RELATED WORK

A. Autonomous GPS

The Global Positioning System (GPS) is a space-based satellite steering system that includes 24 satellites placed network into orbit by the U.S. Department of Defense. On Earth, GPS receivers take this signal information from many satellites and utilize triangulation to determine the user's precise location. Cellular networks are being used to "fill in gaps" in transmission signals.

Today, there are three different transmission modes being used in community corrections to carry the deliverance of accurate, reliable signals to GPS tracking receivers and overcome geographical or atmospheric challenges. These modes include:

- Receiving signals via the GPS satellite network only (Autonomous GPS);
- A combination of GPS satellite data with support from a cellular network (Assisted GPS);
- A method that measures signals from nearby cellular towers and reports the time/distance readings back to the locating towers (Advanced Forward Link Trilateration) to determine an approximate location of the GPS receiver.

In the proposed system, we use autonomous GPS for tracking the user's location from the mobile device. It offers 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.

On the ground, any GPS receiver contains a computer that "triangulates" its own position by receiving 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 give driving or walking directions.

A. GPS Accuracy & Precision

One of the key points and advantages of GPS is its accuracy. Levels of GPS accuracy are extremely high, even for civilian use GPS units. It is also worth defining the difference between accuracy and precision.

- *GPS accuracy*: The accuracy refers to the degree of closeness the indicated readings are to the actual position.
- *GPS precision*: Is the degree to which the readings can be made. The smaller the circle of unknown the higher the precision.

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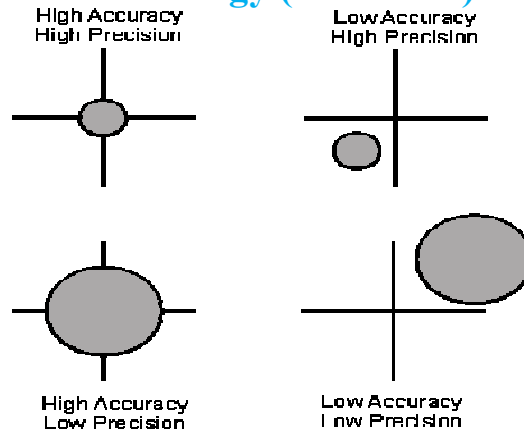


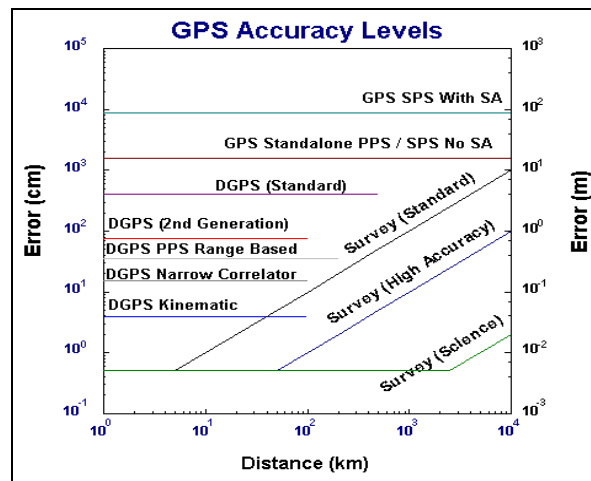
Figure.2.1: GPS Accuracy and Precision

The accuracy expected to be obtained using a GPS receiver will vary according to the overall system used. While accuracy level actually achieved will depend upon many factors, typical estimations of the level of GPS accuracy can be given.

| GPS system | Expected GPS accuracy (meters) |
|---------------------------|--------------------------------|
| GPS with S/A activated | ±100 |
| GPS without S/A activated | ±15 |
| GPS with WAAS | ±3 |
| Differential GPS | ±5 |

B. Levels of Accuracy

The following graph shows the accuracy levels of all currently available systems. The vertical axis is the expected accuracy or error level, shown both in centimeters and meters. The horizontal axis is the distance along the earth's surface between the reference station and the remote user. If there is no reference station, the line is drawn all the way to 10,000 km, all over the earth.



The accuracy obtained in this way depends mainly on the:

- Quality of the reference receiver
- Quality of the user's receiver
- Update rate and data latency (communications bandwidth)
- Distance from reference to user
- Multipath at the reference receiver
- Multipath at the user's site

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Recently, the smart phones (Android, Black berry and iPhone) come furnished with A-GPS technology which provides the spatial coordinates of the user location with the combination of Global Positioning System (GPS) satellites data with support from cellular network and it works indoor and outdoor, responds faster, and uses less battery power.

C. Assisted-GPS

Assisted GPS, also known as A-GPS or AGPS is a system that improves the startup performance, or time-to-first-fix (TTFF), of a GPS satellite-based positioning system. In AGPS, the Network Operator deploys an AGPS server. These AGPS servers download the orbital information from the satellite and store it in the database. An AGPS capable device can connect to these servers and download this information using Mobile Network radio bearers such as GSM, CDMA, WCDMA, and LTE or even using other wireless radio bearers such as Wi-Fi. Generally, the data rate of these bearers is high; hence downloading orbital information takes less time.



Figure.2.2: Architecture of A-GPS System

It deals signal and wireless network problems by using assistance from other services. Such a technology in our smart phones can aid in different ways like tracking current location, getting turn-by-turn direction instructions, route tracking, etc.

1) *The Difference Between Autonomous GPS and Assisted- GPS:* The major difference between both systems is speed and cost. A-GPS devices determine location coordinates faster because they have better connectivity with cell sites than directly with satellites whereas GPS devices may take several minutes to determine their location because it takes longer to establish connectivity with 4 satellites.

AGPS system costs money to use A-GPS devices on an ongoing basis because they use mobile network resources. GPS devices communicate directly with satellites for free. There is no cost of operation once the device is paid for.

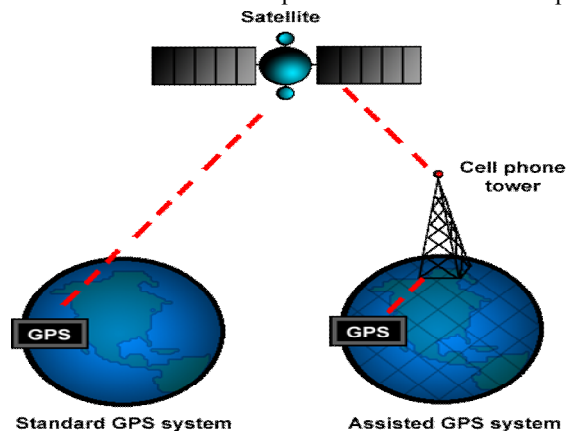


Figure.2.3: Difference between Standard GPS and AGPS

GPS is real-time solution provider whereas AGPS is not. The network usage is required every time we move out of the service area. It is useful only for locating a particular place in small area. There is no privacy in GPS and A-GPS since the Assistance

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server knows the location of the device. There needs to be communication over the wireless for processing of GPS information so this could be expensive.

D. LBS COMPONENTS

Most of Location Based Services need several components. I have suggested the model of “5+1” components of LBS – five technological and 1 human related:

1. Positioning systems – allow geographically localizing the mobile device both outdoor and indoor using: satellite-based systems, Cell-ID, RFID, Bluetooth, WiMax, and Wireless LANs.
2. Communication Network – the wireless network that allows for transfer of data between user (thought mobile device) and server (service provider). Nowadays it is in most cases wireless internet (e.g. GPRS, 3G, and 4G).
3. Service and Application Provider – the LBS provider, including the software (e.g. GIS) and other distributed services and components that are used to resolve the query and provide the tailored response to the user.
4. Data and Content Provider – service providers will usually not store and maintain all the information, which can be requested by users. Therefore geographic base data and location information data will be usually requested from the maintaining authority or business and industry partners.



Figure.3.1: Components of LBS

5. Mobile Devices – any portable device that has capabilities to utilize stated above components of LBS, for example: mobile phones (including smart phones), tablets, palmtops, personal navigation devices, laptops etc.
6. User – operator of the mobile device and the person that is utilizing potential of modern mobile device and infrastructures in order to get value added information or entertainment.

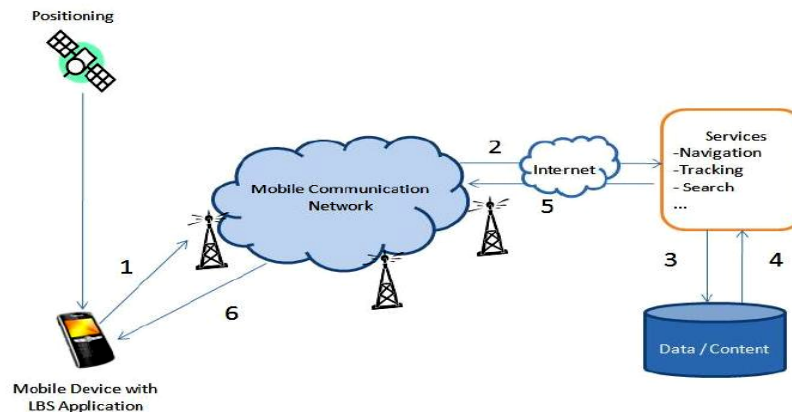


Figure.3.2: LBS Components and Service Process

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Figure-3.2 shows the connections between 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 received 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 associated database to gain needed 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.

IV. METHODOLOGY

Two methodologies used to implement LBS-

- To process location data in a server and to promote 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,

A. 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.

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.

B. Satellites

The Global Positioning System (GPS) uses 24 satellites orbiting the earth. It finds the user position by calculating differences in the times the signals, from different satellites. GPS are in-built with the smart phones.

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 consumes less battery power and requires fewer satellites.

V. 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. Knowing where the user is allows your application to be smarter and deliver better information to the user. When developing a location-aware application for Android, you can utilize 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. To obtain the user location in your application, you can use both GPS and the Network Location Provider, or just one.

VI. CHALLENGES IN DETERMINING USER LOCATION

There are several reasons why a location reading (regardless of the source) can contain errors and be inaccurate. Some sources of error in the user location include:

- Multitude of location sources - GPS, Cell-ID, and Wi-Fi can each provide a clue to user's location. Determining which to use and trust is a matter of trade-offs in accuracy, speed, and battery-efficiency.
- User movement - Because the user location changes, you must account for movement by re-estimating user location every so often.
- Varying accuracy - Location estimates coming from each location source are not consistent in their accuracy. A location obtained 10 seconds ago from one source might be more accurate than the newest location from another or same source.

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A. Android Location API

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.

B. 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:

- 1) *Place Searches* - It returns an array of nearby Places based on a location defined by the user.
- 2) *Place Details* - It returns more specific data about a user defined Place.
- 3) *Place Check-ins* - Check-ins is used to gauge a Place's popularity; frequent check-ins will boost a Place's priority in application's Place Search responses.
- 4) *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.

VII. PROPOSED SYSTEM

Proposal of an integrated android application is based on location information.

A. Implementation of Proposed System

In the proposed system, we are going to track the location of a user with the help of the device's location services. This does not require a user to have a sim card to be mandatory (as we are not tracking based on the signal). The user can easily tag his/her location with the help of WIFI (if available). The user (admin) can then view the current location of particular person with their posted comments and time this information must be available in android mobile device and also in user personalized format.

VIII.PROCESS OF PROPOSED APP

Users are requested to login in the app. This is only for security purpose. Two or more user details (user name, password) will be stored in the database. User logs in to the app. If the user is unauthorized or the username and password is incorrect, then the alert message will be displayed. The app open with main page that will have a text box (to type something), and a “tag” button. When the user taps the button, his current location will be gathered with the help of his mobile device's location services. If the mobile's location services had not been enabled, the app will show an alert message saying “Please Enable Location Services”. If enabled, his current location will be stored in the database with his name. The users can logout of the application. Figure 5.1 shows this scenario.

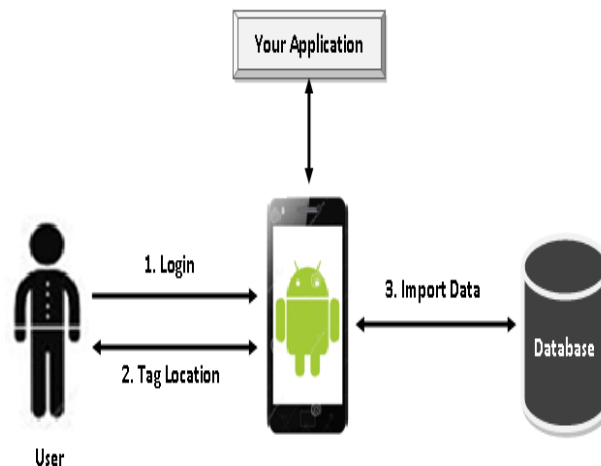


Figure.5.1: User Scenario

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When the admin wants to know the current location of User, then the admin logs in, his main page will contain a “map” button. On tapping the button, Google maps will be generated with the help of Google maps API. The map will contain the User’s tags with his comments (if any). The following figure 5.2 shows this scenario.

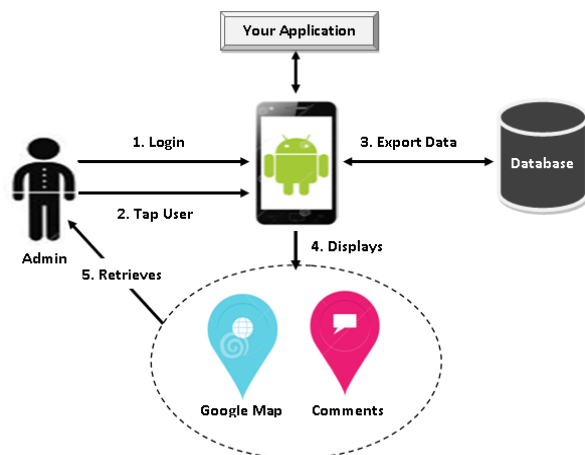


Figure.5.2: Admin Scenario

This application is mainly focused to design for marketing field. For example, sales executives or sales representatives tag their location at each point; it will be viewed by their sales manager, if he wants to monitor their team members or sales executives.

IX. CONCLUSION

Android System provides the opportunity to determine the current geographical location and to build location-aware applications, without focusing on the details of the underlying location technology. To obtain the user location, we can use one of:

- GPS Provider
- Android’s Network Location Provider (availability of cell tower and Wi-Fi access points)

or both of them. Every provider has its cons and pros, and can be used depending on the circumstances at each situation. The use of Location Services is, in order to get the current location, by choosing the best provider at each time.

In this paper, we developed the LBS for people with ease of their communication usage through Android mobile. Once you learn about the location-related APIs and capabilities that the Android platform provides, you can use them to create the next great location aware application. If all the information must be available on a mobile device with the user customized format, then it’s helpful to manage their valuable time effectively and efficiently.

X. FUTURE SCOPE

Yet now we can manage limited number of users identity which is visualization of user location, this will be overcome by means of fetching separate server for gathering user’s information by launching this, we can break the limitation which was occurred in previous task. So my future research will be able to implement the any number user’s identity. And this any number of users information will also be grouped according to the nature of role they performing; it should be achieved by using filtering mechanism.

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