Location Based Services using Android Mobile Operating System

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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 palmtops and iPhones, which are going to replace the bulky desktops even for computational purposes. We have vast number of applications and usage where a person sitting in a roadside café needs to get relevant data and information. Such needs can only be catered with the help of LBS. These applications include security related jobs, general survey regarding traffic patterns, decision based on vehicular information for validity of registration and license numbers etc. A very appealing application includes surveillance where instant information is needed to decide if the people being monitored are any real threat or an erroneous target. We have been able to create a number of different applications where we provide the user with information regarding a place he or she wants to visit. But these applications are limited to desktops only. We need to import them on mobile devices. We must ensure that a person when visiting places need not carry the travel guides with him. All the information must be available in his mobile device and also in user customized format.

Keywords: Android, LBS, GPS, LCS, Google Maps.

1. INTRODUCTION

Location based service (LBS) is emerging as a killer application in mobile data services thanks to the rapid development in wireless communication and location positioning technologies. Users with location-aware wireless devices can query about their surroundings (e.g., finding the nearest restaurant or all shopping malls within 5 miles) at any place, anytime. While this ubiquitous computing paradigm brings great convenience for information access, the constraints of mobile environments, the spatial property of location-dependent data, and the mobility of mobile users pose a great challenge for the provision of location-based services to mobile users.

Over-view of location based Services:

A location-based service (LBS) is a mobile application that is dependent on the location of a mobile device, like mobile phone. Virrantaus et al [1] defined LBS services as follows:

"Information services accessible with mobile devices through the mobile network and utilizing the ability to make use of the location of the mobile device "Open Geospatial Consortium" [2] defined LBS service similarly:"A wireless-IP service that uses geographic information to serve a mobile user, any application service that exploits the position of a mobile terminal."

A Location Based Service (LBS) is an information and entertainment service, accessible with mobile devices through the mobile network and utilizing the ability to make use of geographical position of the mobile device. A LBS services can be used in a variety of contexts, such as health, work, personal life, etc. LBS include services to identify the location of a person or object, such as discovering the nearest banking cash machine or the where about of a friend or employee. LBS services include parcel tracking and vehicle tracking services.

LBS have two major actions, that is:

1. Obtaining the location of user
2. Utilizing this information to provide a service.

These 2 actions are used to answer these 4 questions (below) for a mobile user in a new, fast, and more accurate way, to form the basis for LBS:

Where am I…?

Where is the nearest ...?.

Where is my ...?,

How do l get there?

LBS services can be categorized as triggered LBS services (push services) and user-requested LBS services (pull services) [3]. In a triggered (push) LBS service, the location of user's mobile device is retrieved when a condition set in advance is fulfilled. For example, a call to emergency center can automatically trigger a location request [3]. Advertisement messages can be delivered to users who enter a specific area in a shopping mall, and warning messages can be delivered to users who are in the area where weather conditions will change (e.g. hurricane, rain).

In a user-requested (pull) LBS service, the user decides whether and when to retrieve the location of his/her mobile device and use it in the service. User-requested LBS service can involve personal location (i.e. finding the current location of the user) or services location (i.e. finding the location of the nearest restaurant or bank). Navigation and direction system is an example of pull LBS services [3].

2.   LBS COMPONENTS

In order to make LBS services possible, some infrastructure elements are necessary, including mobile devices, applications, communication network, positioning component, and service servers [4]. 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 provider, and requested information back to the user. Global System for Mobile communications (GSM) is currently the most common standard for mobile network and is used by majority of mobile phones globally. Mobile networks are usually controlled and maintained by operators who provide connectivity for mobile users and charge them for data and voice transmission.

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. Instead user's location can be obtained by using some positioning technologies, such as satellite positioning, cellular network positioning, WLAN stations or radio beacons [5]. 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 (adapted from [4]) 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 (Step 5, 6).
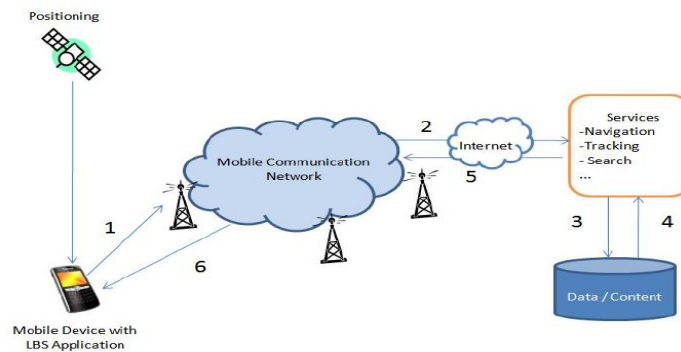

Figure 1 LBS components and Service Process

3.   DISCUSSION

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.
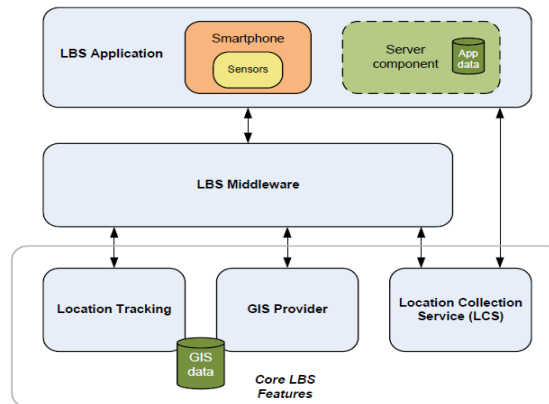

Figure 2 Components of LBS

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.

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 geocasting 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. Geocoding
4. Google-Map

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.

Finding the List of Available Location Provider

To get a list of names for all the providers available on the device, call get Providers, using a Boolean to indicate if you want all, or only the enabled, providers to be returned:

```
boolean enabledOnly = true;
List providers = locationManager.getProviders(enabledOnly);
```

In addition to this GPS provider and Network provider can be accessed directly by using the static variables defined in the LocationManager class:

```
LocationManager.GPS_PROVIDER
LocationManager.NETWORK_PROVIDER
```

Furthermore for finding the provider on the basis of some criteria we can use the criteria class and then can find the best provider for defined criteria using the Best Provider Method as shown is the following code snaps:

```
Criteria criteria = new Criteria();
criteria.setAccuracy(Criteria.ACCURACY_COARSE);
criteria.setPowerRequirement(Criteria.POWER_LOW);
// more criteria here
```

String bestProvider = locationManager.getBestProvider(criteria, true);

If more than one provider is available fulfilling the given criteria then the one with best performance is returned. On the other hand if no provider is found for the defined criteria then criteria are loosened in order Power use, Accuracy, Ability to return bearing, speed, and altitude.

Geocoding

Reverse geocoding provides a way to convert geographical coordinates (longitude, latitude) into street address and forward geocoding provides a mean to get geographical coordinated from street address. For forward geocoding we use getLatitude() and getLongitude() method as shown is the following code

Block

double latitude = location.getLatitude();
double longitude = location.getLongitude();

For reverse geocoding we use getFromLocation method
with geocoder variable as shown is the following code
block

//geocod is geocoder variable
addresses = geocod.getFromLocation(latitude, longitude, 10);

Google Map in Android

Android provides a number of objects to handle maps in LBS system like MapView which displays the map. To handle this a MapActivity class is there. To annotate map it provides the overlays class. Even it provides canvas by which one can easily create and display multiple layers over the map. Moreover, sufficient provisions are there to zoom the map, localize the map by means of MapController.

Following code-line shows the Map Handling in Android:

```
<com.google.android.maps.MapView
android:id="@+id/map_view"
//specify different attributes/>// map controller
MapController mapController = myMapView.getController();
mapController.setCenter(point);
mapController.setZoom(1);
//List of present overlays
List<Overlay> overlays = mapView.getOverlays();
// adding a new overlays
MyOverlay myOverlay = new MyOverlay();
overlays.add(myOverlay);
  mapView.postInvalidate();
```

4.   GPS IN ANDROID

1. Built-in GPS receiver.
2. Requires 2 lines of codes.
3. Requires 1 XML file for properties.
4. System is responsible for updating location change.

5.   USE OF LBS

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." 2 They can be classified in three categories:

1. Public safety or emergency services:

Since the location of the subscriber can be provided by the carrier, the mobile phone is a valuable access point in the times of emergency. In the US, Europe and Japan, it is mandatory by law for carriers to be able to provide such information.

2. Consumer services:

a. Navigation – users get route maps to a particular destination, real time traffic routing that takes into account actual congestion patterns etc.

b. Location based advertising – advertisements of discounts or offers from a store as the user comes within the vicinity.

c. Location based reminders – users can enter in to-do lists, whose location information is activated when the user passes by, for instance, pick up shopping or laundry etc.

d. Family and friend finder – allows users to keep track of the location of their children, relatives or friends, with the informed consent of these subscribers.

e. Location based search – allows users to access local services, or find even more detailed information such as listings and ratings of movies playing in theaters nearby etc.

f. Location based mobile gaming which began a decade ago has larger scope now as positioning and handset technology have improved considerably.

3. Enterprise services:

LBS enables firms in fleet and asset tracking, field service dispatching, route and delivery optimization, and mobile workforce management. This has proved to be extremely useful for small and medium businesses.

6.   ANDROID ADVANTAGE & LIMITATIONS

Advantages of an Android are listed as:

- Time for a change.
- Android scales to every device.
- it's supported by some hardware manufacturers and more to come in the future.
- Open source.
- Third party development is encouraged.

In contrast to advantages Android has following limitations:

- Not supported by any big company yet except HTC
- Does not support some applications like Firefox
- Some limitations exist in blue tooth.

7.   CONCLUSION

Initially mobile phones were developed only for voice communication but now days the scenario has changed, voice communication is just one aspect of a mobile phone. There are other aspects which are major focus of interest. Two such major factors are web browser and GPS services. Both of these functionalities are already implemented but are only in the hands of manufacturers not in the hands of users because of proprietary issues, the system does not allow the user to access the mobile hardware directly. But now, after the release of android based open source mobile phone a user can access the hardware directly and design customized native applications to develop Web and GPS enabled services and can program the other hardware components like camera etc.

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.

8.   FUTURE SCOPE

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. Although this platform is very new and SDK provided is still in its nascent stage, a great number of mobile companies are queuing up to install it on their devices. We chose Android as it is parallel to iOS (supported by Apple) in terms of facilities it provide and is also open source.

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