Location-Based Services

New Opportunities for Innovation

LOCALIZATION

technologies are increasingly becoming an integral part of our lives and help improve the quality of services we use. It is claimed by some that it is a technology powerful enough to become a leading component of the information technology world in the near future. According to Gartner, the LBS market is set to grow from $41 million in 2008 to $95.7 million in 2009 [2]. This is likely to be a slightly optimistic forecast, but nonetheless it is quite apparent in today's world that the number of services using location-based technology will increase. However, it is tricky to say what form future LBS applications will take and what directions should be followed in order to create a user-friendly, fully localize-enabled and comprehensive functionality. This article gives a broad outline of LBS technology, present and possible future applications of it, and also discusses the innovation trends in the area of LBS.

What is a Location-Based Service?

The Global Positioning System consists of satellites orbiting the Earth, control and monitoring stations positioned on Earth itself, and GPS receivers owned by users. GPS satellites broadcast signals from space that are used by GPS receivers to provide a three-dimensional location.

A location-based service (LBS) is defined by the Open Geospatial Consortium as a service which delivers information about location to people who are using wireless, position-aware devices such as cell phones and PDAs [8]. The LBS can also utilize alternative information related to users and their devices such as account context information, user location history or even their personal preferences in order to improve the quality of the application and user experience.

Location-based services have a long history. Since the 1970s, the U.S. Department of Defense has been operating the global positioning system (GPS), a satellite-based infrastructure which is used to determine the position of any object on Earth. Initially, GPS was intended to be used for military purposes but in the 1980s the government decided to make it freely available to other industries on a worldwide basis. Many applications have since been using location data in order to enhance their products and services. However, the boost of LBS in the 1990s was not driven by GPS technology but by another type of location technology coming to prominence around this time. Mobile network operators started using their radio stations infrastructure to obtain a device's location. This technology played an essential role in creating the market for location-based services.

Today there are even more ways of obtaining location data (Table 1) using a mobile device. All of these have pros and cons, and are suitable for different types of applications.

In cellular networks, location is carried out by means of proximity sensing, where the position of a device is determined using the coordinates of the base stations. Generally speaking, the mobile network possesses the area number - called a cell - in which the device is located. The accuracy of the location may then be improved by combining the cell-id with a timing advance value, which is an estimation of the RTT (Round-trip delay time) between base stations and the terminal. The estimation is then used to determine the distance between both parties. GPS on the other hand, is a satellite-based system, with 24 satellites broadcasting location data. A GPS receiver processes the signals received from several satellites and calculates its location basing on the time differences between those signals. The main disadvantages of GPS location are the extended time to first fix (TTFF) and poor indoor coverage. Thus, in order to improve the efficiency of the system a new technology entitled "Assisted GPS" was introduced. This approach combines GPS technology with various methods of determining position using cellular network information. In addition to the mentioned outdoor positioning systems, there are also indoor types. The main difference between them is the target area. The indoor positioning systems focus on closed areas. Such systems are mostly based on monitoring the signal strengths characteristics.

Current Applications

Nowadays, LBS products are employed within numerous domains, ranging from mass-market consumers, customers in specialties applications, business clients as well as being used in industrial and corporate environments, where a vast number of objects and inventory must be identified and tracked on the map.

The most of all LBS-related demands originates from mass-market consumers. The majority of their requests are related to location and navigation queries, including yellow pages listings and business descriptions in a given geographical area. All types of activities where location is of importance are also popular e.g. detailed maps and directions, traffic condition alerts and information regarding services such as gas or food. Sports-related applications, such as running distance or calorie counters by means of which one can track the path traveled or calculate overall distance, speed etc, are also popular among mass-market consumers. Another group is IM applications for mobile phones that enable locating and chatting with friends who are nearby. Today, countless standard IM systems add this feature to their offer. Location-based games in which players must visit different parts of the city in order to retrieve information about other users or further game directions are also a good example.

Certain multimedia data can also improve location-aware services. A user prefers listening to audio directions than to reading static maps with his current position marked, although not only data-related directions alone may be of interest here. Let us imagine that someone is riding a bicycle and using a navigation application. Not only does he appreciate the directions, but he may also like to listen to the sounds of his surrounding environment, such as the trickle of rushing water when he approaches a mountain stream. There is also the possibility for adding three dimensional data, such as models of buildings to the flat map, or including touch user interface support in order to increase user experience [1].

Niche consumer applications are targeted at limited areas of the market. These generally tend to be slightly more sophisticated services and devices tailored for the most financially able people e.g. golf cars equipped with computers providing information such

Table 1. Mobile network platforms for identification [3]

Type	Methodology	Pros	Cons	Industry application
Cell Identifier (Cell ID)	Base station uses radio frequency signals to track mobile device	Relatively widespread infrastructure	Hard to pin down user's exact location to within a few meters	Wireless network providers, police force, banking government, security, welfare
Global Positioning System (GPS)	24-satellite network	Outdoor precision within five-meter range	Expensive. User device must be in direct line of sight. Device needs special embedded chips.	Military applications, commercial applications such as real estate security, police force (not as successful in consumer settings)
Assisted Global Positioning System (AGPS)	Enhancement over GPS. Perpetually locates device and coordinates data flow, unlike GPS.	No "cold starts" Faster fix on location	Expensive. User device must be in direct sight. Device needs special embedded chips.	Military applications, commercial applications such as real estate security, police force (not as successful in consumer settings)
WLAN-based Location Services	Depends on signal strength utilization	No additional hardware infrastructure is needed	Suitable mainly for indoor positioning	Indoor commercial applications

Table 2. Business opportunities in LBS [3]

Demand Level	Typical Services	Typical Business Models
Consumer Demand Location and Navigation Personalized Content	Maps, driving directions, yellow pages	Subscription-based services, pay-per-view, syndication, micropayments
Niche Consumer and Business	Maps, shopping locator service, coupon discounts, alerting services	Subscription-based services, advertising, revenue-sharing, micropayments
Industrial/Corporate	Supply chain management, inventory management, customer relationship management, intelligent transportations and system infrastructure	Application service provider, consultation services, infrastructure provider

as golf course maps or playing tips, or fishing boats equipped with shoal finders.

Another category is alert services, which are used during natural disasters or accidents. During the SARS outbreak in 2003, for instance, Hong Kong mobile phone operator Sunday launched a service that warned subscribers via SMS (Short Message Service) messages about buildings where SARS cases where suspected or confirmed. Such messages were sent to all people who were within approximately a one kilometer radius of the case location.

Business and corporate customers may also benefit from LBS concepts, for example, using it to track goods, people or even entire projects. There are several technologies that facilitate enhancing such activities; devices that are designed to monitor and control the supply chain, the amount of materials and their positions. Another example is the concept of ambient intelligence or pervasive computing, whereby almost all materials and devices contain sensors and form a large network of intelligent, location-aware devices.

Innovation

Be different – to be successful you must invent a service which is distinctive, and which can be recognized by users amongst the millions of other similar products.

Innovation is a colossal word but just what exactly is innovation in the LBS-related segment of the market? The natural method of creating new products is to incorporate new technologies into existing software as new features complementing their previous functionality, as opposed to creating completely new products. This is a common and simplistic approach to introducing new technologies onto the market in addition to stimulating growth of current services simultaneously as they are enhanced with increasing new functionality in line with technological development. This is also a fairly safe way of conducting business since customers are already accustomed to the service and do not require being taught how to use the new services or even informed of why they actually need them.

When it comes to LBS the situation is quite different. Introducing new features to existing solutions is not always possible, and what's more it generally tends to fail to utilize the intrinsic nature of location. As a result, we are offered certain sophisticated location-based features which are added to a recognized application or service and sometimes we may end up wondering "what on earth do I need it for". Have you ever set an alarm notifying you of when a friend is within 100 meters using your Instant Messenger (IM) client? Companies try to convince us that location within your IM contact list is a crucial component, but not everyone sees such a need.

The appearance of location capability within mobile phones, unlike many other features, such as multimedia support, local connectivity, etc. not only adds some extra features to the device and makes it more attractive but also, and most importantly, opens up new and so far unknown areas of applications. What kind of services can be implemented basing on location is a hard question to answer. But it is of paramount importance that these novel services are not to be viewed solely as an answer to the customers' needs. They are used to **create new markets**, revealing to people services that are as of yet unknown to them and giving them a chance to see that these products may come in handy. GPS navigation is a good example. No one expected to have a small box saying "turn left in approximately 50 meters" stuck to the windscreen of their car a dozen or so years ago. There was no voiced need for it in the market as people were not even aware that such a contraption could be created. Location-based services should be viewed in the same light, which when first seen, make us think "how could I have lived without it". This is real innovation.

Here and now – the need is always context specific, the user wants something at that very moment and at that very location. We should be able to forecast this and supply him with it. The user and his need takes precedence, everything else is irrelevant.

So, in order to create an innovative location-based service it is crucial to stop thinking about how to improve our current products with geographical coordinates. It

is essential to give up looking for an application that may benefit from knowing our friends' or our own location. We should rather start thinking about what sort of services users may need at their location at that very moment. It is "here and now" that really matters. Unfortunately, at the same time such services are somewhat risky investments. It is impossible to predict whether it will succeed or end up in utter failure until we present it to the customers. Sometimes, such as in the case of the WWW (World Wide Web), it is vital that people be taught how and what the service can be used for. Only then does it start to generate revenue.

Another area that still requires some progress being made is in middle-layer support for LBS solutions within the mobile platform. As it stands, there is no recognized, platform-independent and commonly acceptable standard or API. Moreover, a particular platform does not even tend to have generic middle-layer LBS support. There are APIs by means of which GPS coordination or cell-id may be accessed, but if one wants to use a more sophisticated method for finding the device's coordinates, using all possible data sources such us GPS, cell-id, IP (Internet Protocol) address, etc., to always obtain at least rough coordinates and guarantee they are of the highest accuracy given the circumstances, one must usually implement these calculations by himself. There are countless techniques for calculating the coordinates of a mobile device, yet it is fairly difficult to find a ready-made tool which can combine different location data sources and provide final values and also guarantee their accuracy. Nor is there a consistent specification of what sort of data is to be provided to developers – **it is not only position that matters here, also properties such as speed or direction of movement** may come in useful e.g. a petrol station advert on a highway should only be displayed to those drivers who are able to pull over – i.e. move in the specific direction. The ideal situation would be to provide developers with reliable APIs for accessing location data, to specify what type of data it should be and possibly a uniform way for handling different location data sources on different platforms and programming languages in order to facilitate the implementation and migration of LBS applications.

Making Money

New revenue streams – services are great when they are making money. But can you predict the earning potential of these same services in 10 years time? Maybe advertising doesn't answers this question.

Taking profitability into consideration, there are numerous ways of making money on a mobile service. However, since users do not want to pay directly for the services they use, **it seems that advertising is starting to take the lead.** The key to success in the field of mobile advertising is rendering the advert truly context dependent and, even better, not explicitly visible to the user. An advertising model based on texts and banner ads used by popular web browsers may serve as a good example here – users are not given adverts but additional links to sites they are in fact searching for. Mobile advertising should and really can be heightened so that it contains similar features. The point is that it is vital that mobile applications and services are highly context dependent. What does this mean? The system must be able to predict what kind of services the user might need at that very moment and the device should be ready to offer those services to the user. How to predict what a user wants and when technology is capable of doing it is not an easy question. However, we can be sure that the location of the device will play a crucial role in the process of rendering the application context-aware. This is because we believe the location to be the most important and powerful context-related factor imaginable.

Today, users are fed up with the amount of services, applications, information and adverts presented to them in the virtual world and look for some selectivity. No one wants to hear about a new tariff promotion when sitting in a restaurant, and the software should be able to predict this. Numerous things can be inferred from knowledge of the device position, speed, direction, average movement or the area where he spends the majority of working hours. When at work, users are likely to be more interested in services such as a new option for dinner or a new parking service. Whereas, during a first visit to a city a person may like to be made aware of the three most important historical monuments to see during a single day trip. Then, a few days later a shopping center available nearby serves as a new point of interest.

Apart from advertising, there are not many effective ways (we are aware of), of making money out of a service's popularity. And so here the question arises relating to the domination of adverts over alternate methods for creating income out of LBS in the future; Are there any other possibilities? What will constitute the main source of funds for LBS creators in 10 years time? We do not know the answer, but what we are currently certain of is that everybody expects the mobile services being provided to be free. The free-of-charge model fosters interest in the application

References

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among customers and, therefore, the LBS applications should also be free in order to generate popularity and guarantee that their designers achieve success in the market. To date, however, no one has been able to provide a truly free, comprehensive Location-Based Service, which in addition has not been decorated with ads – why? The answer may be as simple as this – we do not know how to generate a profit from a service without either retailing the service itself to the customers or selling advertising space. Thus, we believe the monetizing of mobile services is a good place for innovation. If one can come up with **a novel, efficient way of making money** from a service, which is free for its user and which does not involve displaying adverts which customers are already tiring from, it would be a groundbreaking invention.

Conclusions

Localization-based services combine vast numbers of, formerly separated, technologies into one location-aware platform. LBS have been treated as an addition to what is already available within the device, but we believe it is powerful enough to evolve into the heart of mobile platforms and mobility itself in the future. It is highly likely that future mobile applications and services will be driven by knowledge of where the device currently is and what is the most desperately required service at that moment. It is the handset that should deduce what may be needed "here and now" and it should in turn make it available to the user. This constitutes the road to providing a reliable service, fulfilling customers' needs and guaranteeing revenues. ≪

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