A METHOD TO INCREASE ACCURACY IN PREDICTION THE LOCATION OF MOVING OBJECTS APPLIED FOR LOCATION-BASED SERVICE

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ABSTRACT

In the model location based services (LBS - Location-based Service), all moving objects can be monitored and monitored through their geographical location. Data of these objects include information about the location in the past, the present is stored and updated regularly. The query object's position at the time of going to happen with the uncertainty of it is to solve problems and improve accuracy. This report refers to the results of a study on methods to increase the accuracy to predict the location of objects in the near future. The result is applied to the monitoring system, monitoring the movement of objects through interfaces that map PANavCS the authors are developing. The problems were related research and development organizations including storage techniques and query location data of the object and model prediction based on probability logic in order to increase the accuracy of predicted results.

1. INTRODUCTION

GIS technology has been developed and widely applied in many industries, different areas. Along with the Internet, new technologies such as remote sensing technology, wireless communication technologies (GSM / GPRS, WiFi, WiMax ...) and satellite navigation technology (GPS) developed very strong. Mobile devices (cell phones, PDAs ...) are increasingly being used widely for people to access information anytime, anywhere. The combination of these technologies has created a new environment in which all moving objects can determine their position. This is the basis for the development of services based on geographic location (LBS - Location-based Services).

LBS is the intersection of three main technologies, including GIS / spatial databases, Internet and mobile devices / GPS (Figure 1).

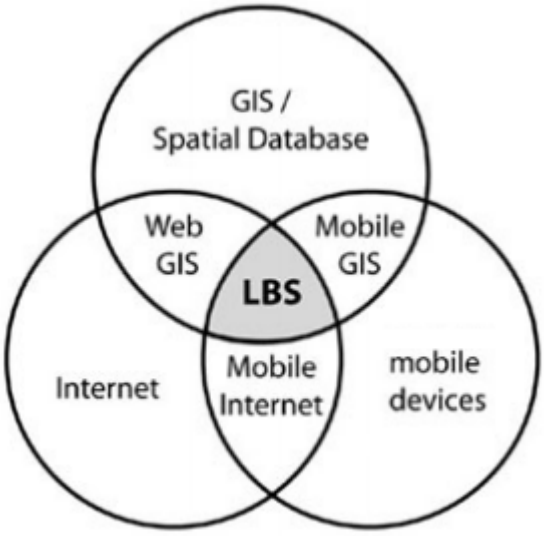


Figure 1. LBS is the intersection of three main technologies

LBS are services specially formulated based on knowledge of the location of the object. Position is seen as an important parameter in the system from which to provide various

information functions to users. LBS consists of four main components:

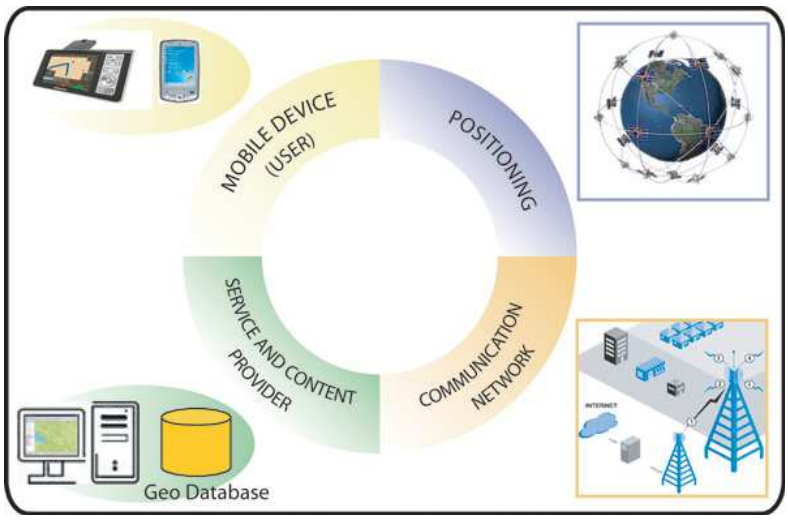


Figure 2. The basic components of the LBS

- Mobile Devices: A tool for users to make requests and receive the desired information returned may be the voice, images, text ... (cell phone, PDA, computer personal navigation devices ...)
- Network communication: a data transfer tasks and service requests from mobile devices to the service provider and transmit information back to the results using
- Positioning System: The equipment to locate the user, the device may be a satellite positioning (GPS) or other devices to locate the BTS ...
- Center System:
    - The data provider and content / database space (Geo Database) provides data and related content such as yellow pages, maps, traffic information ...
    - Provider applications and services: providing services to different users and is responsible for handling service requests: find locations, tracks, guide, call the rescue ...

Figure 3 illustrates the flow of information exchanged between the components of the LBS.

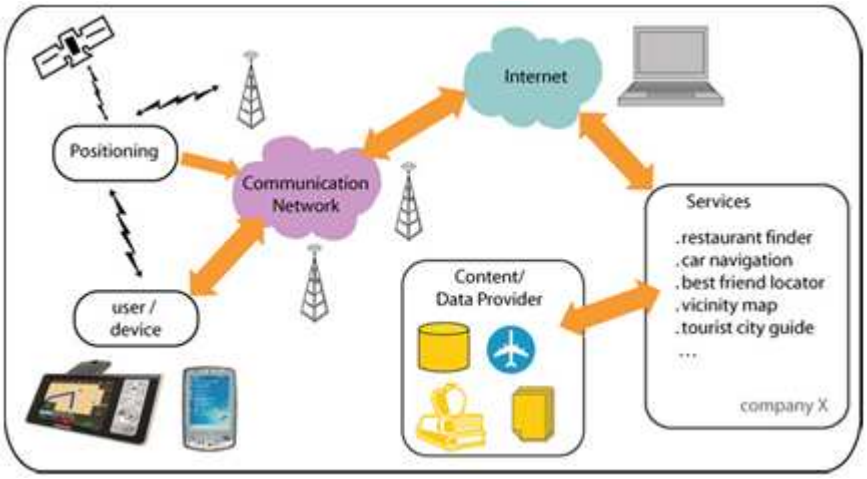


Figure 3. Flow of information exchanged between the components of the LBS system

The field of LBS applications are diverse, as can be told to navigate, navigation, supplying information: search location (bus stops, gas stations, ATM point ...) and management of urban transport; weather forecast; tsunami, earthquake, object tracking and handling of the salvage and rescue ... In any LBS application, information about the location of the object as parameter most important to provide different services to users.

2. LBS DATABASE AND QUERIES

2.1. Store and Update

A very important issue in the LBS system is storing and updating data of moving objects so effectively. Environment and locate the application, the update operation the position of a moving object is often. This led to the trading update to the database is huge. Frequency implementation of the update operation is much more than add a new task object into the system or the query data manipulation. At the case management problem with N moving objects, such as N transaction will add new objects into the system. Since N moving objects continuously over time, so for every time certain (assuming that every 10 seconds) had to have a trading update its new location on the system to ensure accuracy for queries about the location of the object. After about 5 minutes, each object has sent 30 transactions to update the system. Easy to see that after 1 hour using the system, the number of transactions has more than 360 times to update the transaction to add new objects.

Can also see that the period did not update the location information on the system (as in the above problem is 10 seconds), the object may be in a different position than expected due to the speed and can change direction. So all queries on that object during this time can be misleading about the location. If you decrease this time delay (eg 5 seconds), ie increase the frequency of updating information into the system would improve the prediction accuracy of the location of the object but at the expense of the number of transactions online this greatly increased. And vice versa, increasing the time delay (eg 30 seconds) will reduce the number of transactions, but updated to reduce forecast accuracy of the location of the object.

2.2. Querying moving objects

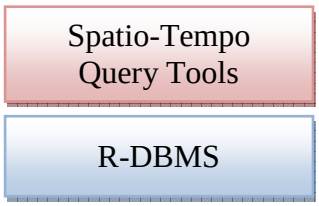
When querying moving objects, users often pay attention to all the information about the current location as well as the past. However, in many cases, the information about the location in the future, especially in the near future is also very interested. Such as the user is on a plane about to land want to know "the taxi has no visitors 1km from the airport within 15 minutes" ...

2.3. Solutions for storage and data query

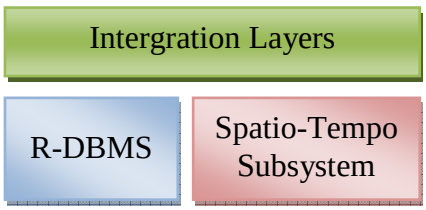
Currently, the authors are research database model space-time (Spatio-temporal Database) to store and retrieve data. This model should represent the objects and their

relationships in space and the existence over time. Database system of space-time can be developed and organized according to three following formats:

- Using relational databases (R-DBMS) with an additional layer performs the function of space-time queries



- Combined database relations with other storage components (index file ...)



- Use database object relational (OR-DBMS)

In the current system the authors are using the first type, additional building floor performing space-time queries on a relational database.

3. PREDICTION MODEL BASED ON LOGIC-PROBABILITY DETERMINATION

Consider a typical LBS application is monitoring and surveillance facilities (eg taxi). The queries that users are often asked to perform:

- Query information about the location in the past: At 7am this morning A taxi where are you?
- Query information about current location: Within 2 km from the position M How many taxis do not have visitors?
- Query information about the location in the future: The taxi from the airport without hotel 1km in 15 minutes ...

To answer queries about the location in the future to predict the location of the object at that time. In fact, the predictions are pretty much met with difficulties due to the precision expected results depend too many factors. The influencing factors can be included such as:

- Speed, acceleration, direction of motion: these factors directly affect the outcome predicted by calculating equation of motion of the vehicle
- Route motion: with applications to monitor facilities, this factor is the road system. Motion usually means never out of this route (except for accidents). So the results correctly predicted to be taken to a suitable position on the road

- Weather conditions environmental factors indirectly affect the speed of moving vehicles, such as rain, the vehicle speed rarely exceeded 60 km / h
- Destination: Knowing the destination can determine more precisely the route that vehicles will have to go through, so that more accurate predictions
- Type of vehicle: This factor indirectly affects movement speed
- Bad traffic, traffic law: This factor also affects the speed and direction of motion of the vehicle, such if the road ahead is blocked, vehicles can move on to other routes less than the rule ...
- Bollywood drivers: each driver has different characteristics will lead to different driving speed ...

Based on the analysis of the influencing factors on, the authors proposed predictive model based on logic - to raise the probability to predict the location of objects in the near future. Other factors affecting directly called constraints, these factors indirectly called coefficients. Constraints related to the object's motion is: velocity, acceleration, direction of motion, motion lines. The impact factor is the weather, environmental conditions, traffic conditions ...

Assess the constraints related to the motion of objects (on roads), thereby determining the actions which may occur, and associated probability coefficients for the possibility of occurrence of the action. The action corresponding to the constraints include:

- Straight:
    - constant velocity
    - Acceleration
        - Slow
        - Fast
    - Deceleration
        - Slow
        - Fast
- Turn right
- Turn left
- Turns head

Assign probability coefficient:

Next Action	Probability at t	Probability at t+i	Probability at t+j
Straight constant velocity	0.6	0.6	0.1
Straight slow acceleration	0.1	0.2	0.05
Straight fast acceleration	0.2	0.1	0.05
Straight slow deceleration	0.05	0.05	0.1
Straight fast deceleration	0.05	0.05	0.2
Turn right	0	0	0.2
Turn left	0	0	0.2
Turns head	0	0	0.1

Queries use the logical probability model

- Query current location: Find all the taxis around the position x 500m radius

SELECT ALL car FROM TBL_CAR WHERE distance(x) <= 500

- Query the future location: find all the taxis around the position x 500m radius within 15 minutes

SELECT ALL car FROM TBL_CAR WHERE distance(x) <= 500 AND time(t)=current(t) + 900

- Query the future location model using probabilistic logic: find all the taxis around the position x 500m radius within 15 minutes, the coefficient is above 50% probability

SELECT ALL car FROM TBL_CAR WHERE distance(x) <= 500 AND time(t)=current(t) + 900 AND p-factor(car) >=0.5

4. SOME RESULTS

Moving Objects Management System - PANavCS

Figure 4. A Location-Based Service

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