The Study of Strategies for acquisition of moving object location

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ABSTRACT

The types of service using location Information are being various and extending it's domain as wireless internet technology is developing and it's application part is widespread, so it is prospected that LBS (Location-Based Services) will be killer application in wireless internet services. This location information is basic and high value-added information, and this information services make prior GIS (Geography Information System) to be useful to anybody. The acquisition of this location information from moving object is very important part for these LBS. After this, when LBS is familiar to everybody, we can predict that LBS system load is so heavy for the acquisition of so many subscribers and vehicles. Moving object database (MODB) system manages objects like subscribers and vehicles that are moving and have telecommunication terminal checked one's location. MODB is consists of 4 part, moving object location acquisition part, moving object location storage part, moving object query processing part, and moving object application part. In this MODB system, acquisition of moving object location part must provide guarantee location information as well as reduce telecommunication overhead.

In this paper, we study of problems in acquisition a huge number of moving objects location and design some acquisition strategies to reduce telecommunication overhead. And after implementation these strategies, we estimate performance of this system and quality of information.

Keywords: LBS, MODB, Moving Object

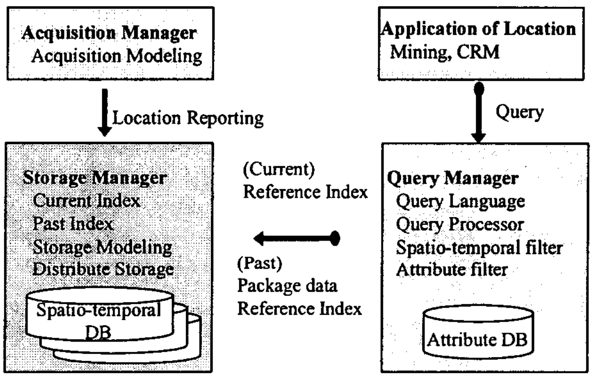
1. INRODUCTION

As wireless internet technology is developing and it's application part is widespread, as services using by user's mobility are extending. Location-based services are services using by real time information of moving object location. This location information is basic and high value-added information, and this information services make prior GIS (Geography Information System) to be useful to anybody. LBS (Location-based services) platform makes this location-based services enable and can be storing, managing this moving object locations basically [1]. The MODB (Moving object database) is core part of LBS platform and presently, is managing current moving object locations and serves current location services. But after this, MODB will manage not only current locations but also past locations and serve high value-added services using by this current/past locations. And when LBS are familiar to everybody, we can predict that LBS system load is so heavy for the acquisition of so many subscribers and vehicles. Because of this reason, acquisition of moving object locations part is very important in MODB parts. So, in this MODB system, acquisition of moving object location part must provide guarantee location information as well as reduce telecommunication overhead.

In this paper, we study of problems in acquisition a huge number of moving objects location and design some acquisition strategies to reduce telecommunication overhead. And after implementation these strategies, we estimate performance of this system and quality of information. In the beginning, we will observe acquisition system architecture in section 2. In section 3, we make sure some acquisition model for moving object model and benchmarking of this model. In section 4, after implementing this system, we examine experiment result.

2. Acquisition System Architecture

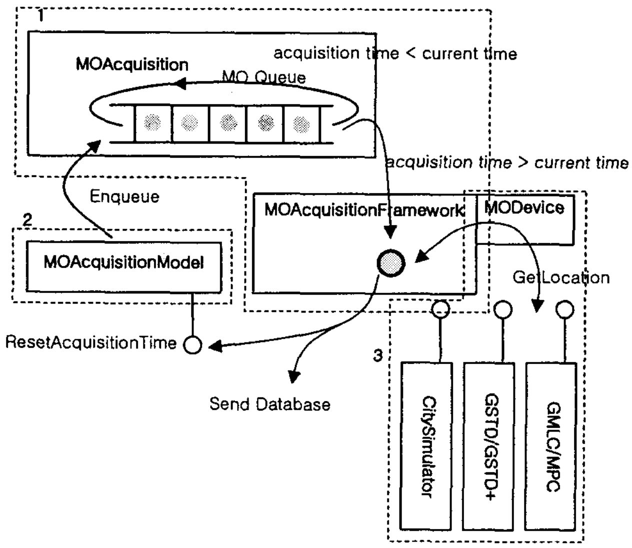
In this section, we observe carefully overall system architecture. Picture 1 shows MODB (Moving Object Database) architecture. It consists of 4 parts, moving object location acquisition part, moving object storage part, moving object query processing part, moving object application part.



Picture 1 MODB Architecture

The acquisition manager acquires moving object location real time and minimizes telecommunication traffic overhead simultaneously. After acquiring information, acquisition manager reports that information to storage manager. Then storage manager distributes current locations and past location to various multiple database system and constructs current memory spatio-temporal index and past disk spatio-temporal index. The query manager retrieves moving object locations through spatio-temporal filter and attribute filter by query language. The application part makes application system like spatio-temporal data mining and CRM (Customer Relationship Manager) using by this stored information.

Picture 2 shows moving object location acquisition system components. This consists of MOAcquisitoin component, MOAcquisitionModel component, MOAcquisitionFramework component, MODevice component.

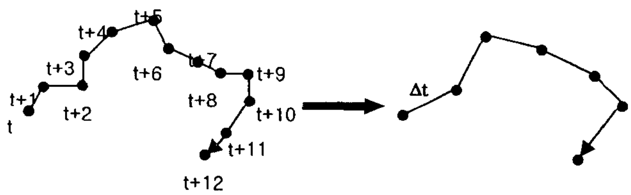


Picture 2 MOAcquisition System Components

The MOAcquisition component checks busily all moving objects which have ID and acquisition time period, in waiting queue whether acquisition time period is passed. When it is on acquisition time, removes that mo from waiting queue and transfers to MOAcquisitionFramework component. This component has thread pool to acquire multiple object locations concurrently. If thread pool has empty thread, assign that thread to transferred mo and deliver it to MODevice component. The MODevice component actually acquires object locations with real time from GMLC (Gateway Mobile Location Center) [4] or MPC (Mobile Positioning Center) [5], GSTD/GSTD++ [2, 3], Citysimulator (IBM) [7] and so forth. Acquired mo is stored to storage manager and is sent to MOAcquisitionModel component. MOAcquisitionModel component reassign next acquisition time period using various acquisition model algorithms. And it is sent to waiting queue of MOAcquisition component.

3. Acquisition Model for Moving Object Location and Benchmarking

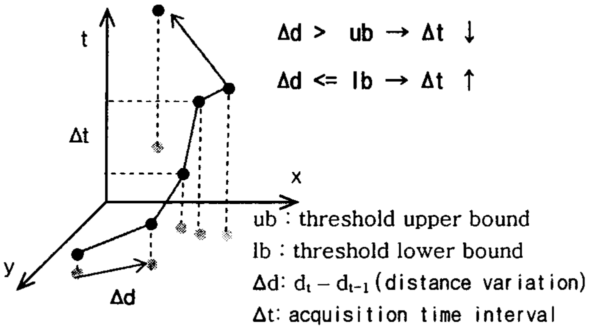
We design various acquisition model for moving object location with minimum telecommunication traffic overhead. In this section, we design 4 acquisition models and methodology of benchmarking. First, picture 3 shows static acquisition model.



Picture 3 Static Acquisition Model

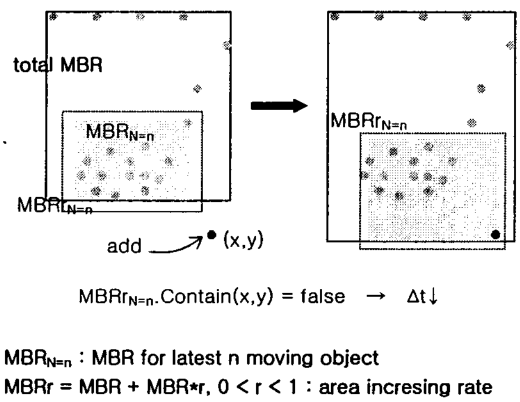
At static acquisition model, all of moving object has same acquisition time period. That is to say, using acquisition time period Δ t, reduce the number of acquisition. This model is effective in case of not large number of moving objects and used more in performance comparison with other models. Generally, we compare other model with this static acquisition model withΔ t =

1. Second, picture 4 shows distance-based acquisition model.



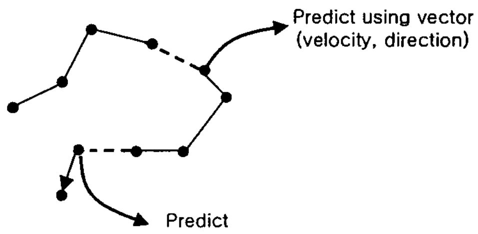
Picture 4 Distance-based Acquisition Model

This model is works if moving distance variation is large, acquisition time period will be short, or if small, it will be long. First of all, it is setting up distance variation threshold(ub : upper bound threshold, lb : lower-bound threshold) and every time acquiring moving object location newly, this moving distance variation is compared with ub, lb and so it is controlled the number of acquisition to make stable state of telecommunication traffic. Third, picture 5 shows group-based acquisition model.



Picture 5 Group-based Acquisition Model

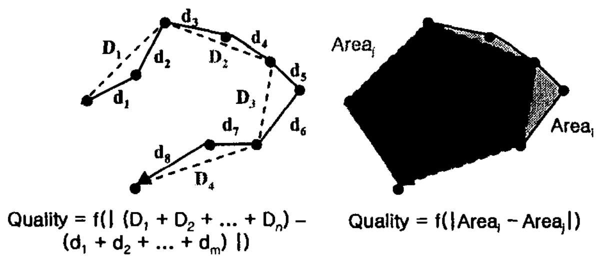
This model, about mo which stays some geometrically area for long time, it makes acquisition time period long until mo leaves that area. So it controls the number of acquisition. We use MBR (Minimum bounding rectangle) for checking whether added moving object is contained by some geometrically area. MBRr is enlarged by increasing rate r ($0 < r < 1$) of MBR and checks containing newly added moving object. If newly added moving object is contained by MBRr, acquisition time period will be long, if not, it will be short. Important parameters are area increasing rate r and the number of latest moving object which makes MBR. The fourth, picture 6 shows predict-based acquisition model.



Picture 6 Predict-based Acquisition Model

The Predict-based acquisition model predicts next moving object location using start point, direction, velocity. But this model is somewhat dangerous because we couldn't guarantee accuracy rate of prediction. So we use this model when telecommunication traffic overhead is so heavy, otherwise we use other acquisition model. That is to say, after setting up telecommunication traffic overhead threshold, if overhead is over that threshold we use this model. And if current location is predicted some moving objects in this time, then next time location must be acquired by other acquisition model for guaranteeing location information qualities.

The moving object location acquisition system has various acquisition models and we must be able to guarantee quality of information acquired throughout this various models. So we can suggest benchmarking model for estimating system performance and quality of information. We can estimate system performance as checking the number of acquisition comparatively static acquisition model with $\Delta t = 1$. Picture 7 shows estimation methodologies of quality of information acquired by acquisition model.

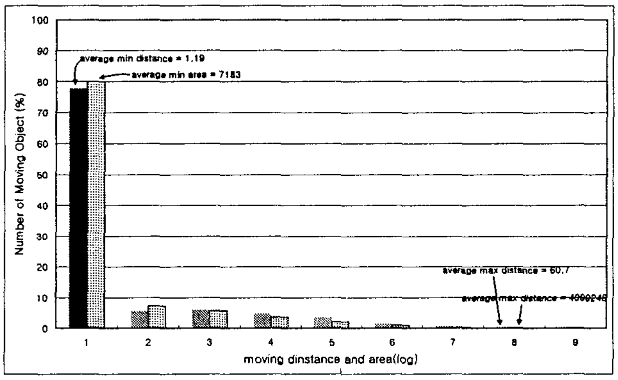


Picture 7 Measurements of Information Quality

The absolute difference value of summed up total moving distance and total area of moving objects between static acquisition model with $\Delta t = 1$ and other acquisition model can be measurements of information quality. This value notifies error rate, as minimum as quality is better.

4. Experiment Result

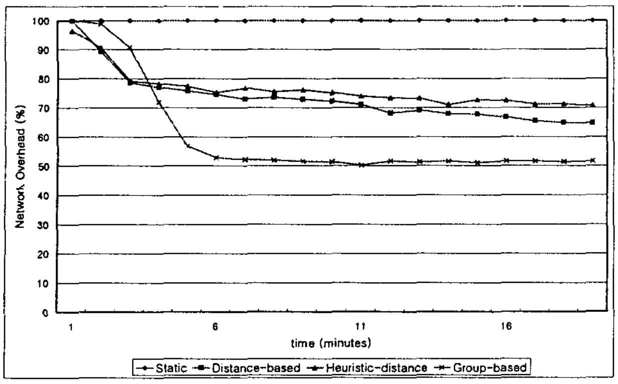
In this section, we estimate system performance and quality of information. We generate moving object data set using CitySimulator (IBM) which can generate large data set of setting parameters - the number of moving objects and the number of rotation – flexibly. We use experimental data set which has 10000 moving objects and 1000 rotates. And we use 4 acquisition models, which are static acquisition model, distance-based acquisition model, heuristic distance-based acquisition model, group-based acquisition model. The heuristic distance-based acquisition model is intelligently distance-based acquisition model. This time, we omit estimation of predict-based acquisition model. Picture 8 shows moving object dataset status. The Graph shows that most of the objects have a little movements and moving area.



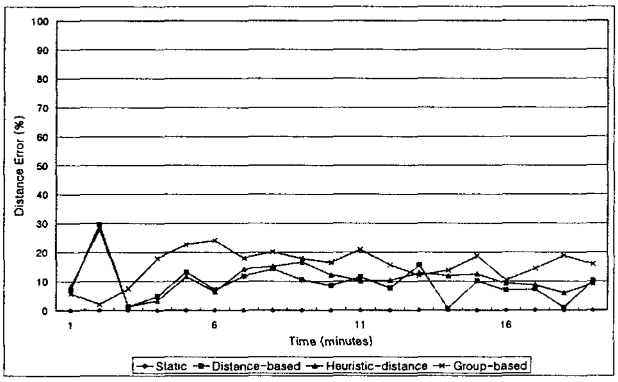
Picture 8 Moving object data set status

Picture 9 shows the number of acquisition of each model. Graph shows that all of models keep status telecommunication traffic overhead fewer than 70%. We set lb = 20, ub = 30 in (heuristic) distance-based acquisition model and r = 0.2 in group-based acquisition model.

Picture 10 shows the moving distance error rate of each model. All of models keep status under 30 % error rates.

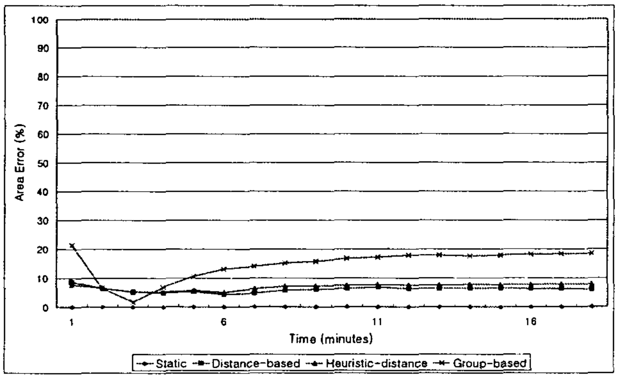


Picture 9 Number of acquisition of each model



Picture 10 Moving distance error rate of each model

Picture 11 shows the moving area error rate of each model. All of models keep status under 20 % error rates .



Picture 11 Moving area error rate of each model

5. Conclusion

In this paper, we have observed moving object acquisition system in MODB and various acquisition models and benchmarking methodologies. And we have estimated system performance and measured quality of information using moving object data sets which are generated by simulators. After this, when LBS is familiar to everybody, these moving object location acquisition model can minimize telecommunication traffic overhead and keep MODB on stable status. As future works, we must study more acquisition model which can be used timely and in various statuses. Also we continuously must estimate system in various data set and various statuses, so make system more stable.

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