



Mobile Location Prediction Methods – A Survey

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Abstract: In the current modern trend, the concept of Mobile location prediction is needed in all aspects. But the techniques currently we are using are not enough to handle the sensitive task. So, the concept of Mobile movement prediction needs some innovative techniques. In this paper we have present a detailed study about the various mobile movement prediction methods are discussed in the various views. This paper defines different travelling strategy with the various methods.

Keywords: location prediction, comparative study, movement prediction.

I. Introduction

The Personal Communication Systems (PCSs) are becoming more popular in the modern computer and communication technologies. In the near future, PCSs will support a huge user population and offer services that will allow the users to access various types of data such as video, voice and images. These Device Communications allows dynamic relocation of mobile users since these systems are based on the notion of wireless access. Mobility of the users in Cells gives rise to the problem of mobility management.

Mobility management in mobile computing environments covers the methods for storing and updating the location information of mobile users who are served by the system. Now a days the emerging topic in mobility management research field is mobility prediction. Mobility prediction can be defined as the prediction of a mobile user's next movement where the mobile user is traveling between the cells of a PCS or GSM network. The predicted movement can then be used to increase the efficiency of PCSs. By using the predicted movement, the system can effectively allocate resources to the most probable to- move cells instead of blindly allocating excessive resources in the cell-neighborhood of a mobile user.

Up until now, there has been a considerable amount of research on mobility management. Most of the research has focused on the problem of location update, which is concerned with the reporting of the up-to-date cell locations by the mobile users to the PCS network. Location update should be performed whenever a mobile user moves to another cell in the network to be able to track the exact location of each mobile user. When an incoming call arrives, the network simply routes the call to the last reported location of the mobile user. Compared to the amount of work performed on location update, little has been done in the area of mobility prediction. These works have some deficiencies, which are explained in the following:

- Many of the completed works do not attempt to find mobility patterns. Instead, the patterns are assumed to be already available. These patterns are then used for mobility prediction.
- In some of these works, prediction is based on the probability distribution of the speed and direction of the mobile user. For collecting such information, highly sophisticated and expensive tools such as GPS (Global Positioning System) are needed.
- Most of the methods studied in these works are highly sensitive to a change in a mobile user's path. For this reason, the prediction accuracy drops in case of noisy data. These methods do not consider the difference between the randomness and the regularity in users' paths (i.e., they do not distinguish a random movement and a regular movement of a user). In general, users follow some path patterns when traveling in network and their random movements are relatively few when compared to regular movements. Therefore random and regular movements should not be treated equally.

II. Comparison of Various Methods

The movements of mobile users were used with great consideration while finding the mobile movement prediction. In this paper, some of the method used by the various authors, what type of data set they were used and the strength of the training set are also considered.

A. Data Mining Algorithm

It is used for the prediction of user movements in a mobile computing system. The algorithm proposed is based on mining the mobility patterns of users, forming mobility rules from these patterns, and finally predicting a mobile user's next movements by using the mobility rules. Through exact prediction of mobile user movements, this algorithm will enable the system to allocate resources to users in an efficient manner, thus leading to an improvement in resource utilization and a reduction in the latency in accessing the resources. This

algorithm will also be to enable the system to produce more accurate answers to location-dependent queries that refer to future positions of mobile users. The performance is using simulation is better than others.

B. *Expectation – Maximization Algorithm*

This Algorithm is an iterative optimization algorithm that assures to find a local maximum of the likelihood function. Starting from an initial guess of parameters, This Algorithm repeats until get convergence, the following two steps. The first one is Expectation step and the second is Maximization step.

C. *Bayesian Learning method*

This method has become a viable alternative to the previous error minimization based approaches. Bayesian methods use probability to quantify uncertainty in inferences and the result of Bayesian learning is a probability distribution expressing our beliefs regarding how likely the different predictions are. Predictions are made by integrating all models over this posterior distribution. This learning method uses probability to represent uncertainty about the relationship being learned. Before data is seen, prior opinions about what the true relationship might be can be expressed in a probability distribution over the network weights that define this relationship. After the training data is presented, the revised opinions are captured by a posterior distribution over network weights. Networks weights that seemed plausible before, but which do not match the data very well, will now be seen as being much less likely, while the probability for values of the weights that do fit the data well will be increased.

D. *Knowledge Based Mobility Pattern Mining*

Knowledge Grid based Mobility Pattern Mining algorithm is used for mobility prediction needs less computation time compared to sequential mobility prediction algorithm and it also supports scalability. This approach shows how the Knowledge Grid system is used for distributed data analysis. It shows better performance to mine frequent user mobility patterns of mobile users.

E. *Markov based Prediction Model*

Markov models have been used for studying and understanding stochastic processes They shown to be well suited for modeling and predicting a user's movement behavior on a cells. In general, the input for these problems is the frequency of visits accessed by a user. The goal is to build Markov models that can be used to predict the next movement that the user will most likely access next

F. *Multi layer Neural Network in ANN*

Mobile movement prediction is based on the mobile nodes history of movement patterns, which has been recorded for a certain time intervals. Multi-layer neural network is used to process the mobile movement pattern for accurate prediction of mobile movements. Movement pattern is the past history of movement of a mobile station recorded for a certain period of time. A three layer neural network with 8 hidden neurons was used to develop the model for mobile movement prediction. The training sets were formed from the data for direction of the mobile host in a particular time interval and the corresponding direction of the mobile host in next time interval is taken for output of the training pattern.

G. *Spatiotemporal Data Mining*

A spatiotemporal database is a database that contains the data and manages both space and time information. For example, tracking of moving objects, which typically can occupy only a single position at a given time. The spatiotemporal databases are an extension of spatial databases. A spatiotemporal database embodies spatial, temporal, and spatiotemporal database concepts, and captures spatial and temporal aspects of data and deals with geometry changing over time and/or real time locating systems. When we applying the mining approaches to these types of databases we can expect the better results.

H. *Hidden Genetic Layer Based Neural Network*

The dataset trained after generating mobility pattern, in the proposed design, contains two hidden layers. While applying the genetic Algorithm for getting the predicted output. The work proposes a two-step method for mobility prediction. The first step suggested a mathematical model for mobility rules extraction from database. The second stage involves clustering of extracted rules head thereby becoming the class for a classification mode.

I. *Extreme Learning Machine*

The extreme learning machines (ELMs), known for universal approximation, to model and predict mobility of arbitrary nodes in a mobile ad hoc network. They capture better the existing interaction/correlation between the cartesian coordinates of the arbitrary nodes leading to more realistic and accurate mobility

prediction based on several standard mobility models. From the results of simulation using standard mobility models illustrates how the proposed prediction method can lead to a significant improvement over conventional methods.

Table 1: Comparison Study of various Mobile prediction method

Authors and Year	Approach / Methods Used	Training Data set used	No. of Users data used
Gokhan Yavas, Dimitrios Katsaros, Ozgur Ulusoy & Yannis Manolopoulos October 2004	Data Mining Algorithm	--	Single User Movement and Predictions
Nguyen Thanh An & Tu Minh Phuong 2007	Expectation – Maximization Algorithm	1000 User Access Paths are generated	1000 Test Cases
Sherif Akoush Ahmed & Sameh 2007	Bayesian Learning method	It contain over 500,000 hours (~60 years) of continuous data on daily human behavior.	75 users are either students or faculty in the MIT Media Laboratory + 25 incoming students at the MIT Sloan business school adjacent to the laboratory
U.Sakthi & R.S.Bhuvaneshwaran January 2009	Knowledge Grid Based Mobility Pattern Mining	Knowledge Grid	--
Samir Bellahsne & Leila Kloul 2010	Markov based Prediction Model	real cellular network in a major US urban area	Many Users
Partha Pratim Bhattacharya & Manidipa Bhattacharya June 2011	Multi layer Neural Network in ANN	Past movement pattern	2 Users Mobiles
Thuy Van T. Duong & Dinh Que Tran February 2012	Spatiotemporal Data Mining	Own Dataset	4000 regular + 1000 random visit trajectories
Huiji Gao, Jiliang Tang & Huan Liu June 2012	Spatiotemporal Data Mining	Nokia Mobile data	3373 unknown location visits from the 80 users
Velmurugan, L & Thangaraj, P. February 2013	Hidden Genetic Layer Based Neural Network	syslog data of Dartmouth college	5500 students and 1200 faculty of Dartmouth College
Lahouari Ghouti, Tarek R. Sheltami & Khaled S. Alutaibi 2013	Extreme Learning Machine	3000 data points	A Grid of 1000 X 1000 meters in geographical Area.

III. Conclusion

This paper focuses current mobile movement prediction methods using in all parts of the world. Most of the above methods were dealt with earlier statistical techniques and Data Mining techniques. Then some authors only use the minimum amount of data as training set. In future, by using Artificial Neural Network concept we can get the accurate prediction of the mobile users with the sample size of maximum.

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