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RESEARCH ARTICLE

Mining Mobile Sequential Pattern in a Location Aware Environment

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Abstract— ***Recent development in mobile communication techniques and GPS enabled cellular phones have introduced a new business model. This emerges to a new way of service called as Location-Based Service (LBS) which use information about user's location to select the information they provide. There is a rapid growth in the use of mobile phones and location based services Technology. Mining user behaviour in mobile environments is an important task in data mining. Existing impact focus on mobile patterns from logs and their impact can't deliver the predictions since there is a constant change in the mobile behaviour. This paper provides an outline about the basic usage of LBS. Mobile user behaviour pattern is one of the critical issue. The existing system is refined with the concept of Genetic Algorithm for mining. Here the concepts of mining and prediction of mobile behaviours with user relations and characteristics are deliberately understood using Segmentation, mutation and crossover process of GA. The prediction strategy uses mobile patterns to predict the mobile user behaviour.***

Keywords— ***Location-Based Service (LBS); Mobile Sequential Pattern Mining; Genetic Algorithm***

I. INTRODUCTION

Data mining is a most commonly used technique for discovering valuable information in a complex data set. A mobile transaction database is complicated as huge amount of mobile transaction logs are produced from the behavior of mobile user. It is used for inducing association rules from transaction database. To provide precise location based services for user effective mobile behavior mining systems are required. In this paper, an algorithm Cluster-based Temporal Mobile Sequential Pattern Mine (CTMSP-Mine), to discover the Cluster-based Temporal Mobile Sequential Patterns (CTMSPs) is extended. Moreover, a prediction strategy to predict the subsequent mobile behaviors is also presented. In CTMSP-Mine, clusters are formed by using an algorithm called Cluster-Object-based Smart Cluster Affinity Search Technique (CO-Smart-CAST) and similarities

between users are evaluated by the proposed measure. Location based services are defined as any service that takes into account the geographic location of an entity. It is used to support user's dynamic spatial decision making. It is also defined as information services accessible with mobile devices through mobile network and utilizing the ability to make use of location of mobile device. LBS is an information or entertainment service which includes services to identify location of a person or object (i.e. Latitudinal and longitudinal position).

Many People use their mobile devices to search for the direction of a particular location. It has been noticed that in a survey 74% of adult use their mobile devices for navigation purposes. Among adult social media users ages 18 and they get information based on location. This provides a path for developing applications mainly based on location to end users. The main difference between these literatures is the involved information of proposed patterns. To increase the accuracy of predictions, the moving path was taken into consideration. However, mobile behaviors vary among different user clusters or at various time intervals. Clustering mobile transaction data helps in the discovery of social groups, which are used in applications such as targeted advertising, shared data allocation, and personalization of content services.

The mobile users are clustered based on their personal profiles (e.g., age, sex, and occupation). in the previous studies. It is difficult to obtain the profile of users in real time application of a mobile environment to perform clustering task. It means the mobile transaction data of users has to be accessed. The similarities of mobile transaction sequences can be achieved by evaluating the transaction sequences (MTSs). Though many number of clustering algorithms available they are not suited for LBS due to the following issues: 1) In Many clustering methods data with spatial similarity measures is processed, LBS scenario requires a method using non spatial similarity measure. 2) Some of the clustering methods require the user to set parameters. It is hard to identify the right parameters for a clustering method to perform clustering task in real time. It has been observed that experimental evaluation under various simulated conditions, the proposed methods signifies excellent performance. The remaining sections are classified as follows. The section 2 discusses about the existing work in the prediction strategies. The section 3 explains about the proposed method. The section 4 deals with the results & Discussions. The conclusion is given at the final section.

II. LITERATURE SURVEY

Agrawal et.al [1] introduced the concept of mining association rule between sets of items in large database of customer transaction. The algorithm used here is Apriori algorithm. This algorithm finds if there is an association between departments in the customer behavior. The main advantage is no redundancy of mining data. The available memory space is managed efficiently. Tseng and Tsui addressed the problem of mining associated service patterns in mobile web networks [15]. Tseng and Lin also proposed SMAP-Mine to efficiently mine users' sequential mobile access patterns, based on the FP-Tree [17]. Yun and Chen proposed a method of mining mobile sequential patterns [5].

Agrawal et.al [2] considered the problem of discovering association rules between items in a large database of sales transactions. Progress in bar-code technology has made it possible for retail organizations to collect and store massive amounts of sales data called basket data. A record in such data consists of item date and items bought in the transactions. The problem of mining association rules over basket data is analyzed.

In mobile web environments users request services through cell phones from an arbitrary location at any time. A sequence of requests of a user form a location service stream and it is called as behavior patterns. The behavior patterns carry not only the traversal path but also the service request. A data mining method called SMAP (Sequential Mobile Access Pattern) Mine is used to discover user pattern along with the associated request. Thus Tseng et.al [16] analyzed the user behavior pattern and efficient mining algorithm in mobile web systems.

A new data mining capability for mobile commerce environment is explored by Ching-Huang Yun et.al [5] in a mobile commerce environment. Moving patterns and purchase patterns are taken into consideration and a model for mobile commerce system is built. Association rule mining and path traversal serves as a basic scheme to determine the frequent mobile pattern. By having different priorities on the factors involving large item sets, traversal paths, and orders of purchases for determining mobile sequential patterns from transaction sequence.

Monreale et.al [9] designed a location predictor on trajectory mining. A method to predict the location of the moving object with certain level of accuracy to predict the next location of moving object. The prediction uses previously extracted movement patterns named trajectory patterns which are the representation of behaviors of moving objects. Here T-patterns are used with temporal information to find out the behaviors.

Spatio-temporal databases that manage information about objects moving in two dimensional spaces are important for many applications. Tracking of moving objects which typically can occupy only a single position at a given time. Among several spatio-temporal structures that focus on predictive query processing, the most popular one is TPR tree (Time Parameterized R-tree). Thus Tao Y., et.al [14] formulated a prediction method of moving objects with unknown motion patterns.

Trajectories of moving vehicles and algorithm for mining frequent patterns of trajectory data had been proposed by Ajay kumar Akasapu et.al [3] for both sparse and dense dataset. Many applications track the movement of mobile objects, using location-acquisition technologies such as Global Positioning System (GPS),Global System for Mobile Communications (GSM) etc. and it can be represented as sequences of time stamped locations.

In ubiquitous environment intelligent mobile agents are mandated to communicate with users and it is enabled by capturing interesting user's behaviour patterns. Temporal mobile access patterns that could discover mobile user's temporal behaviour patterns associated with location and requested services. The user's temporal mobile access patterns are stored in memory space. A compact data structure is used to store data in memory space. It consumes less amount of memory. It is applicable to health care system, mobile web system. Thus Seung-Cheol Lee et.al [12] gave an idea about efficient mining in a mobile environment.

Ester et.al [7] proposed a density based algorithm for discovering clusters in large spatial databases with noise. Density based clustering called DBSCAN is used to handle local density variation within the cluster. It can detect clusters of different shapes and sizes from large amount of data which contain noise and outliers.
Tseng et.al [15] introduced the concept of mining multilevel and location-aware associated service patterns in a mobile web environment. A new data mining method -two-dimensional multilevel (2-DML) association rules mining. Efficient execution and memory consumption of data. In this correspondence, the issue of efficiently mining multilevel and location-aware associated service patterns in a mobile web environment is addressed.

Anant Ram et. al [4] presented a new idea that a density varied DBSCAN algorithm is capable to handle the local density variation within the cluster. A new algorithm DVBSCAN (Density Variation Based Spatial Clustering of Applications with Noise) an enhancement of DBSCAN algorithm is being proposed. This algorithm finds clusters which represent uniform regions without being separated by sparse regions. Experimental results prove that the proposed algorithm satisfies optimized result. Eric Hseuh-chan Lu et.al [6] analysed mining pattern using an algorithm called CTMSP mine. To identify the similarities among users Cluster Object cluster Affinity Search Technique is used. They conducted a series of experiments to evaluate the performance of the algorithm. The performance measures precision and F-measure sounds better for behaviour prediction.

A classifier to mine trajectory data is identified by Sharma et.al [13].The algorithm focussed here is Nearest Neighbour. The experimental investigation shows that classified pattern exhibits the success rate of 98.2. Rama kalaivani et.al [11] proposed an optimization technique to improve the performance of mobile prediction behaviour. This helps in improving the quality of service. Cluster tables are formed to identify similarities of mobile user. The accuracy of prediction process is improved with the results of mining. Hanna et.al [8] presented a new idea that apart from location and requested services time plays a key role in detecting the behaviour of mobile user. Temporal mobile access patterns are compared in terms of complexity and accuracy.

III. PROPOSED METHOD

In the proposed system Genetic Algorithm (GA) is used to identify the mined pattern and predict the behavior of mobile user. Based on the produced user clusters and the time interval table patterns can be discovered by the proposed method. The concepts of mining and prediction of mobile behaviors with user relations and characteristics are deliberately understood using segmentation, mutation and crossover process of GA. The prediction strategy uses mobile patterns to predict the mobile user behavior. The proposed system is given in Fig. 1.

Fig.1 explains the overall system framework. It tells how a dynamic user can get information about services he requested. The service query will be submitted to the server. Based on the location the nearest services will be returned as response message to the mobile user. The pattern of the mobile user is mined at each stage and recorded at the back end. The Hidden Prediction Behavior (HPB) gives a valuable information about pattern prediction. Depending on the products purchased over a period of time the prediction operation is performed. Pattern mining gives a clear picture of mining process in each stage of GA.

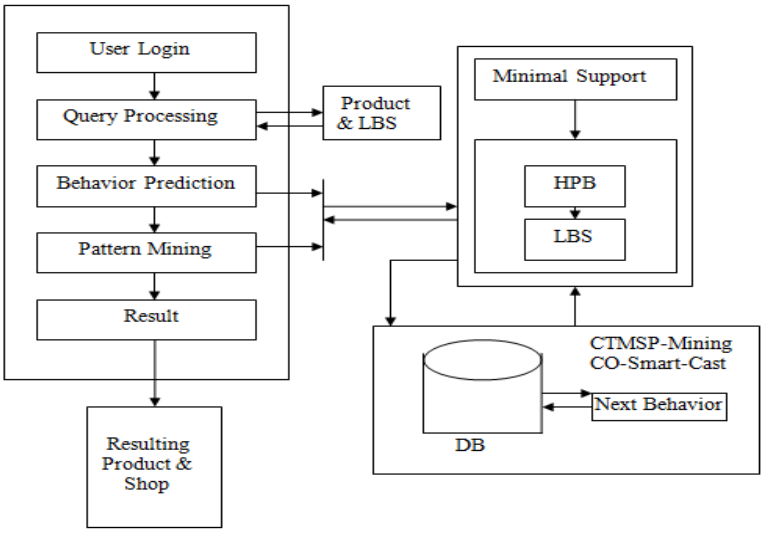

Fig 1: Proposed System Framework

The details of the Business and Application layer are given in the Fig. 2. The mobile transaction database records the mobile transaction sequences of users as they move within a mobile network. It includes information such location, time and service request given by end user.

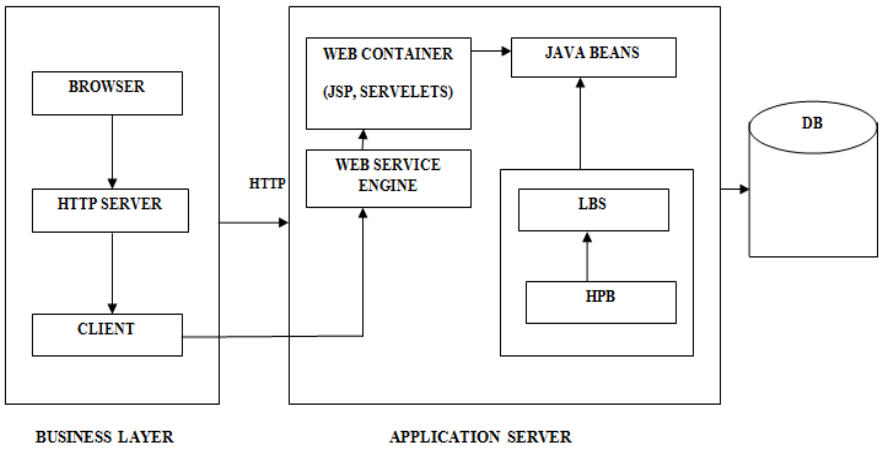

Fig 2: Layered Architecture of the Proposed System

The system architecture involves four important modules,

1. User Query processing.
2. Pattern Mining
3. Behavior Prediction.
4. Resulting Shop Information.

After identifying the location the next step is clustering and segmentation process, a user cluster table is generated and the data is segmented based on it. The ultimate aim of this framework is to provide mobile users an effective mining pattern and prediction of mobile behavior. A mobile transaction database consists of different users in different user group with different mobile transaction behaviors. The mobile transaction sequences are recorded at the backend. The first and foremost task is to form clusters of mobile transaction sequences and identifying the particular group of users.

In a mobile transaction database, similar mobile behaviors exist under certain time segments. Segmentation process is initiated by segmenting the data based on location. There are three processes in Genetic Algorithm: 1) segmentation 2) crossover and 3) mutation. For the segmentation operation a proportion of the current population is selected to product the next population in each generation.

IV. RESULTS AND DISCUSSION

This section deals with the cluster based results in each stage and how mining is performed in each stage for online shopping application dataset. Initially clusters are formed based on location, then mining is done based on service feature and finally results are produced based on given service request by the user. Once the user purchases the product then count will be automatically updated. The results generated from segmentation of GA are given in Fig. 3.

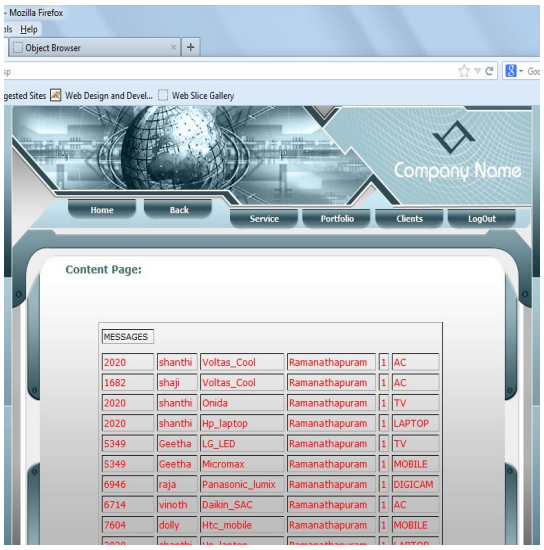

Fig 3: Mining Result based on Location

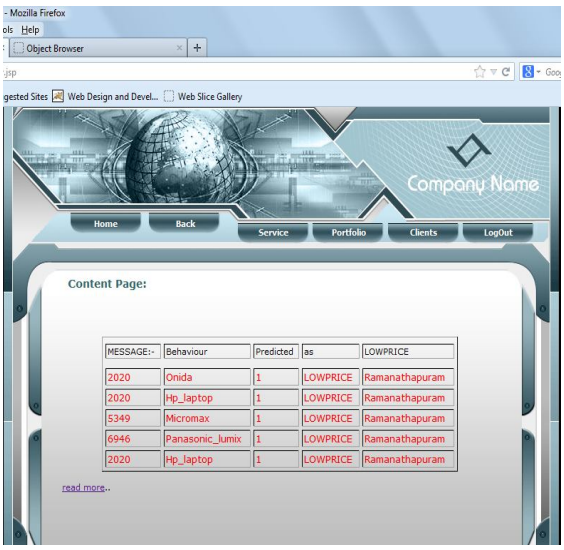

Fig 4: Mining Result based on Category

In Fig 4 Mining process as result of crossover operation is shown above. Location based result gives information about how many mobile users bought a product in that particular location and category based result tells about how many users in that particular location of specific category preferred the product. Fig 5 provides the mining pattern based on one single product. This result is related to mutation process of GA.

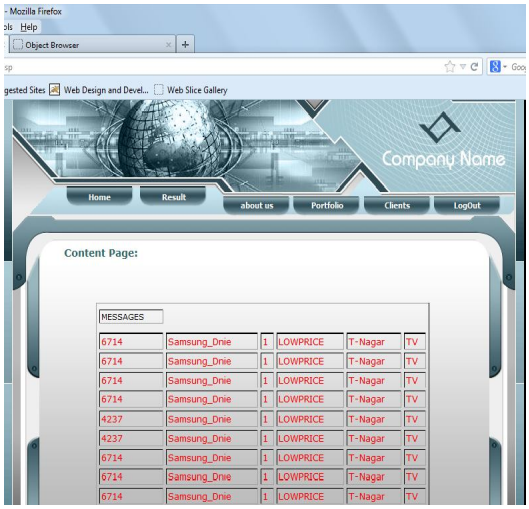

Fig 5: Mining Result based on Product

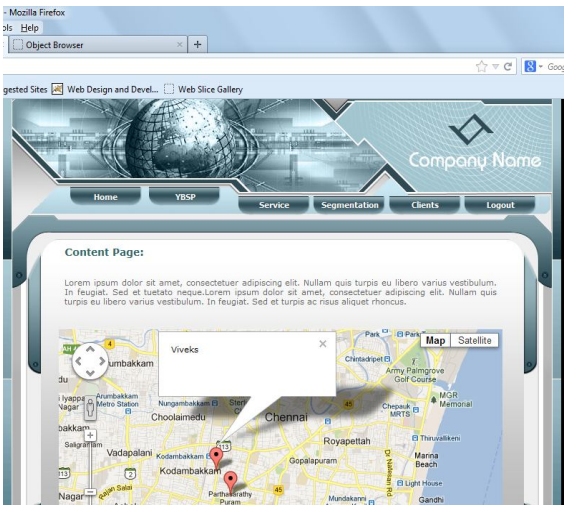

Fig 6: Nearest Shop Information

The above said process varies depending on the kind of users whether they are existing user or new user. Fig 6 depicts the nearest shop information to the users from which he can get an idea to purchase the product. To identify which product has the highest count and which region shows the maximum product sale a graph is generated.

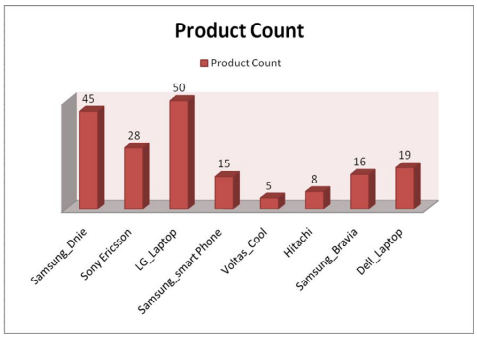

Fig 7: Graph Representation based on Product Count

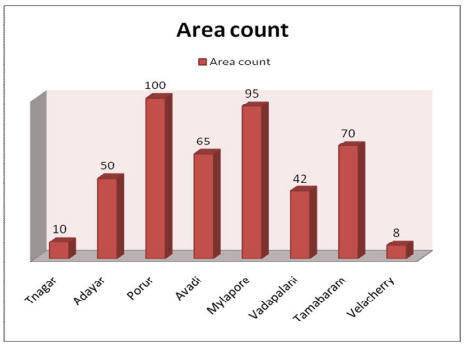

Fig 8: Graph Representation based on Location

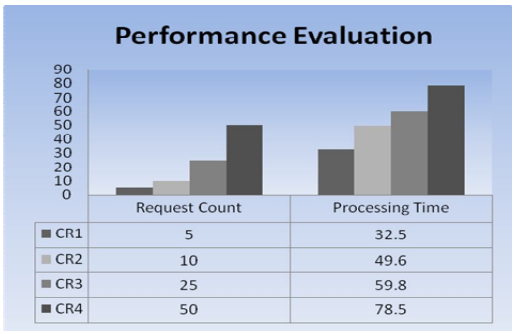

Fig 9: Performance Evaluation based on request count

Fig 7 and Fig 8 shows the graph generated based on product count from the sample data set. The results also deal with the product which has crossed the highest sale. The performance is evaluated to improve accuracy and time interval. In Fig 9 Performance evaluation based on user request count and processing time is shown. Both are directly proportional to each other.

V. CONCLUSION

Thus an extension of CTMSP and CO-smart CAST data mining algorithm for mobile sequential pattern using Location based services is discussed in this paper. A prediction strategy is proposed to predict the subsequent user mobile behaviors using the discovered patterns. The mobile sequential patterns are mined efficiently by analyzing the mobile transaction sequences. Furthermore GA helps in identifying the mobile user patterns in each stage and prediction strategies. The extended method achieves high-quality clustering results. In addition, this method can be applied to other applications, such as GPS navigations, with the aim to enhance the performance parameter precision for predicting user behaviors.

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