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Study of User Behavior Pattern in Mobile Environment

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Abstract: Mobile communication is rapidly emergent articulation of the communication surroundings. Users move to the various location and access various services to accomplish their requirements in mobile environment. These location navigation and service invocation are characterized as a Mobile User Behavior Pattern (MUBP).User behavior pattern analyses mobile user's destination point and their service utilization. Region pattern inquires the details of users target location. Access pattern specifies the services utilized by mobile users. User behavior pattern provides better quality and good services to the mobile users in time. User behavior patterns are not only helpful for user, but also for service providers. Analysis of user behavior pattern gives benefit to the users by invoking the services without traffic congestion problem and to the service providers by contributing the immediate response to mobile users. This study analyzes the behavior of user pattern in detail related to existing work of 24 authors from the past few years.

Keywords: Access pattern, congestion problem, Mobile User Behavior Pattern (MUBP), region pattern, service provider

INTRODUCTION

In recent days wireless communication plays a vital role among the users. Mobile communication has become a very important and swiftly growing technology as it allows users to transmit data from remote field to other remote or fixed fields. Various surveys reveal that the mobile users' behaviors exhibit various measures of reliability. Mobile user behavior pattern consists of detailed information of service requirements and mobility models that is essential to Quality of Service (QoS) and roaming support. Most of the users in a mobile environment do not travel at arbitrary. They voyage from place to place with specific purposes in mind. The most prominent feature of wireless networks is mobility support, which enables mobile users to communicate with others in spite of location. There are numerous factors that persuade the performance of a mobile environment, including the infrastructure (the number and location of the access points), the number of active users, their mobility and traffic patterns, the wireless technology at hand and so on. Through the base station, Mobile users are connected to the network by means of wireless link. Base stations are classified into clusters and connected to server. It is authoritative for synchronizing base stations to provide information services.

The Behavior pattern is a progression of location navigation, service invocation, the concurrence of location and service. Mobile users can travel to various locations and invoke the services through base station. Location and services may or may not be same for different users. Some users may move to same location and access same services. Others may move to same location and access different services. These are illustrated as region pattern and access pattern. Mobile users can reach the destination tower through various intermediate towers. The Threshold value is set commonly for all the towers in all base station. There is a chance for towers having more number of users against a threshold value. This leads to a serious problem in traffic. To avoid this problem, behavior pattern concept is included in the existing method. If the tower contains more number of users than the specified threshold value, service provider has to allot alternate path to reach the destination.

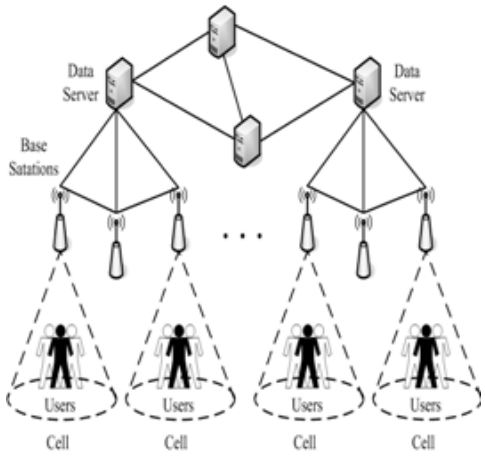

Fig. 1: Mobile computing architecture

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Region pattern describes the succession of location frequently imposed by mobile users. Access pattern depicts the services frequently invoked by users. Location and service may be in different base station. So to reach corresponding base station, it has to cross intermediate base stations. This is depicted in Fig. 1.

Region-Access pattern specifies both location and service utilization of mobile users. The main objective is to reach destination tower from source location through the shortest distance. The objective of this study is to survey the various patterns and methods used to analyze the user behavior patterns in mobile environment.

OVERVIEW

Our primary aspiration is to scrutinize user behavior for high-quality information services in mobile environments. Mobile User Behavior Pattern (MUBP) techniques are used to uncover user behavior patterns. The key point, however, is to widen valuable mechanisms for location movement and service request based on user activities. Among the previous work on analyzing mobile user behaviors, most of the authors have in depth description how to allocate access point to mobile users. In this paper, different methods proposed by various authors are discussed. This study concentrates on the following areas: Base station placement and channel allocation, Mobile commerce, Mining techniques in mobile environment, Location Based Services.

Base station placement and channel allocation: Ghosh and Mitra (2008), termed usage of soft computing in mobile communication. Genetic algorithm is the most widely used soft computing technique for base station placement and channel allocation. The problem in base station placement addresses a number of issues including traffic density, quality of channels, interference scenarios, number of base stations and other network parameters. The goal of the base station placement is to select minimum number of base station location which maximizes the coverage area. Channel allocation is the physical characteristics of communication between two entities. It minimizes connection set up time and maximizes the number of simultaneous communication sessions. The channel allocation is classified in to two classes. They are fixed channel assignment and dynamic channel assignment. This is illustrated in Fig. 2. In fixed channel assignment, each cell is allocated with the fixed number of channels. In dynamic channel assignment, channel allocation is either based on traffic condition or measurement of carrier-to-interference ratio. In mobile communication, user behavior is uncertain and imprecise in nature. This behavior can be handled by soft computing techniques.

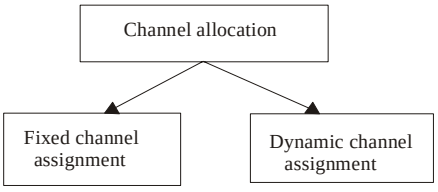

Fig. 2: Classification of channels

Mobile commerce: Hsueh-Chan *et al*. (2011) proposed a technique called Mobile Commerce Explorer (MCE) for casting and anticipating mobile user behaviors and their purchase transactions in mobile environment. Mobile Commerce Explorer (MCE) includes three methods which are Similarity Inference Model (SIM), Personal Mobile Commerce Pattern Mine (PMCP-Mine) and Mobile Commerce Behavior Predictor (MCBP). SIM evaluates resemblance between stores and items. PMCP-Mine is innovating commerce patterns of mobile users. MCBP speculates probable mobile user behaviors. He conducted an experiment in MCE and result shows that high accuracy in different analysis.

Sakthi and Raghuvel (2011), illustrated Distributed Pattern Miner (DPM) for mining mobile user behaviors in web environment. Location plays the vital role to enhance the mobile services. Distributed Pattern Miner (DPM) extracts location-aware service request pattern available in distributed databases on a Data Grid. The location and service request patterns signify recurrently requested services and the equivalent location of mobile users in mobile web environments. In prospect, these patterns are used to predict the next location of mobile users and the service requests. Service providers in mobile web environment efficiently utilized the discovered knowledge for providing faster services and reduce the computational time. This is possible due to the combination of data grid technology and the distributed mining algorithm.

Mining techniques in mobile environment: Hsun-Ping *et al*. (2011), suggested a method BeTracker that affords mobile users with query-based behavior tracker platform to determine mobile sensor data. This method is useful to recognize obscure creature activities and facilitate efficient routing approach. The user specified information may be an entity of user behavior or relational structure. It must be in chronological time duration and has the superior control in sensor data.

Vincent *et al*. (2007) portrayed Temporal Mobile Sequential Patterns (TMSPs) for Location Based Services (LBS).Temporal Mobile Sequential Patterns effectively realize the sequential pattern of users in LBS environment and also predicts the subsequent progression of mobile user. Analysis of TMSP is systematic under different condition by setting various parameters. The fitness function of Genetic Algorithm (GA) engenders the time segmentation intervals appropriately. He suggested

mining of both sequential patterns embedded with moving path and time interval concurrently.

Vincent and Kawuu (2006), specified Sequential Mining Access Pattern (SMAP) for deriving user behaviors including location and service. Innovation of user behavior can extremely promote the augmentations on system performance and excellence of services. Observably, the mobile user's behavior patterns, in which the location and the service are intrinsically contemporaneous, become more composite than those of the conventional web systems. Through experimental assessment under various simulation conditions, SMAP-Mine demonstrates excellent performance in terms of accuracy, execution competence and scalability.

Hsueh-Chan *et al*. (2012) proposed a specific narrative algorithm called Cluster-based Temporal Mobile Sequential Pattern Mine (CTMSP-Mine). Mobile user clusters are formulated by an approach Cluster-Object-based Smart Cluster Affinity Search Technique (CO-Smart-CAST) and comparison between users are appraised by Location-Based Service Alignment (LBS-Alignment). A time segmentation approach finds segment time period wherever related mobile distinctiveness survive.

Location based services: Balaji and Ling (2011), described an approach MobiMix to defend mobile users' location privacy. He compared this Mobimix with spatial cloaking based location privacy protection. But Mobimix used mix zones to smash the permanence of location coverage. Mix zones are constructed by geometry of zones, statistical behavior and movement patterns of users. Assembly of mix zone is scrutinized by considering mobile users' routing patterns and movement actions. He tested Mobilmix in simulation environment that yields competent and more attack resilient features.

Chao and liming (2011), depicted a two layer model that focused a user behavior in mobile virus dissemination. He classified behaviors of users as operational behavior and mobility behavior. Evaluation have been accomplished in two layer model for Blue Tooth (BT) and Short Message Service(SMS) based viruses by providing a mobility algorithm that utilizes supplementary mobility aspects and real data traces. Comparison and observation has been performed to evaluate energetic diffusion processes in terms of scope and transmission rapidity

Fang-Mei *et al*. (2011) has examined user's pre-and post-adoption modernism behaviors in emergence of a gap between the post-adoption of the earlier invention and the pre-adoption of the new invention. He took up the survey in Taiwanese mobile phone users and pragmatic review to record on how 2G Mobile Data Services (MDS) users espouse 3G Mobile Data Services (MDS). Morale difference exist among the pre-and post-users' recognized satisfaction of the distraction services granted by 3G Mobile Data Services. The newer technique may be difficult for users to handle, but it makes the environment as helpful and excellence. The reality is that many users formulate comparisons between generations, education is a benefit. Mobile operators should instruct users to acquire improvement of the progressed quality of 3G MDS.

Tzung-Shi *et al*. (2012) intended about the mobile user behavior pattern to facilitate mobile environment. Mobile service systems have the competence to mine a valuable request from rich information. He specially considered user behavior as User Movement Behavior Patterns (UMBPs), in which four typical features are used. They are Mobile User (U), Location Movement (L), Timestamp (T) and Service Request (S). In UMBP graph-matching algorithm is introduced to define grouping, sorting and joining operations in database management system and depicts the strong affiliation along with *U*, *L*, *T* and *S*. Simulation results in UMBPs fabricated excellent performance results in terms of execution effectiveness and scalability.

Maria *et al*. (2011) presented about user activities in cellular network according to time and space. Traffic problem is analyzed to make the channel free cellular network. Traffic loads can be estimated very accurately by applying the method of lognormal distributions. This has been Probability Density Function (PDF) can be molded by mixture models.

Fong *et al*. (2011) suggested web surfing approach to evaluate the user activities and behaviors that applies temporal web access patterns. Fuzzy technique is mainly considered to grant the timely personalized recommendations about the user activities. It is applicable for signifying real-life temporal concepts and appealed possessions of episodic pattern-based web admittance tricks. Experimental results in web surfing have shown that the specified method attain successful periodic web manifestation.

Brad *et al*. (2011) discussed about Unified Theory of Acceptance and Use of Technology (UTAUT) to examine compliance of users in location based services by carrying out forbidden evaluation. Embracement and utilization of location based services are impelled by hedonic efficacy and assurance intensity of individuals. He found out supplementary number of hypotheses that affords well-built squabble manipulation in espousal and convention of Location based Services.

Klaus *et al*. (2011) have characterized security, safety and privacy in mobile telephony networks. By abusing the location details and mobility prototype of mobile users, an individual's confidentiality is threatened. Despite the fact that the methodological features are not properly weakened by privacy enhancement, users' safety and security may be directly distressed. Due to this fact it may

yield incorrect user position under critical conditions. Therefore an enhancement is needed to tradeoff among the creature confidential level and their social network securities.

Yanfeng *et al*. (2009) depicted concept concerning transient entropy to recognize users moving speed. According to the speed, he described behavior patterns into four types: frequent locations, frequent trajectory, meaningful location and moving mode. The foremost contribution is to provide a platform that converts the enormous location information into behavioral patterns which promotes the trajectory based services by abridging the behavior revealing. The major technologies used in the platform are pattern selection and run time mining algorithm. Pattern selection collects the data present in important Information as much as possible. Similarly Run time mining algorithm utilizes less storage space.

Yuheng and Attila (2009) illustrated classification technique to predict the geographic regions using location based services in IP Multimedia Subsystem (IMS). In depth analysis of classification led to forecast the future generation network. Location based services use datasets in the database that are solved by statistical classification function. In future generation network two situations may arise they are:

- Learning the geographic regions in which convinced incident occur
- Learning incident that happen within definite geographic provinces

Location filters and Type Filters are used to classify the geographical region and concern the discriminant analysis to find out the behavior of each region. This process provides complete updated information to enable the services for regions over Next Generation Network (NGN).

Chao and Zesheng (2009) represented patterns that specify the movement of users. This can be illustrated with assured statistical metrics called routing decision. Routing decision uses store-carry-forward technique to analyze location and movement of users. There may be a chance for delay to occur due to communication gap. Another metric used to envisage delay is expected delay dependent. Using dijikstra's algorithm, it find out the shortest routing to avoid the delay. The upgradation of routing performance may be dynamic owing to buffer size and traffic congestion.

Ian and Wenye (2004) illuminated the User Mobility Profile (UMP) frame work for assessing service patterns and exposing mobile users. It comprises Location description, mobility and service requirements. The service requirement is evaluated by using mean-square error method for every user. He designed new mobility approach for stochastic behaviors, historical records and prognostic future locations. To adopt these approaches new adaptive algorithm has been formulated that governs the expectations of mobile terminals by the way of location probabilities and moving directions. He simulated this UMP that shows the proposed schemes are efficient on mobile environment. Therefore mobility management is handled by manipulating blocking/dropping probabilities and service requirement for future locations are predicated with high accuracy.

Giovanni and Paolo (2008) stated synthetic mobility and user behavior model that unambiguously takes the extent of user satisfaction into account. He mainly focused on geographical mobility, user-generated traffic and the wireless technology. These three features establish user-perceived Quality-of-Service (QoS) level, which may have an authority on the mobility of users for those who are not having mobility patterns. But they can decide to progress to fewer jam-packed areas of the network. Wireless QoS Model (WiQoSM) is easy to use and organize and it engenders user and traffics at the access point. In order to generate statistical properties of traffic traces, WiQoSM allows the superior tuning of disjoint attributes and provides the flexibility while choosing parameters such as number of users and access point.

Gkoulalas-Divanis *et al*. (2009) proposed an approach called PLOT (Privacy in Location Based Services: an Open-Ended Toolbox). The extensive agreement of Location Based Services (LBSs) in location tracking technology simulates severe apprehensions to user privacy. As significance, PLOT approach has been proposed to guard the location information which is corresponded during a request for LBS. It tenders an array of interesting characteristics such as supporting both real and synthetic movement data, handling movement data as well as the underlying model of user movement and providing transportation for next prospect when the key location privacy approach stop working.

Zhengbin *et al*. (2009) depicted a novel crisis in mining Individual Friendship Pattern (IFP) for exemplifying the communication behavior of each user in mobile call logs. The IFP symbolizes the user's current regular affiliations and their magnitude, which is an exclusive aspect like fingerprint and is valuable for many purposes such as user resolution and viral marketing etc. this problem can be solved by establishing stable time and a hybrid comparison measure involving the IFPs.

Alexy and George (2009) proposed a skeleton for modeling human behavior by treating every user's data as a detach language. Language representations are used for predicting movement and offering metrics to compute the exactness of the predictions. Generalized suffix tree has been constructed to tally subsequence and categorize unique user movements.

CONCLUSION

Users Behavior in mobile environment shows a discrepancy according to circumstances, Location movements and service requests. Location movement and circumstances specifies about where the mobile users base station is available based on the destination. Service request expounds which type of services mobile users are accessing. In this paper, studies about user behavior patterns, their distinct functionalities and various methods of finding those patterns in different mobile environment are analyzed in detail.

To mitigate Uncertainties and imprecision, soft computing technique is essential. Optimization along with Genetic Algorithm (GA) approach is helpful for solving location management problem. Mobile Commerce Explorer (MCE) uses three methods to forecast user behavior and their purchase transactions. BeTracker determines mobile sensor data using Query-based Behavioral model. Mobile Data Services (MDS) specifies about how the users are utilizing 2G and 3G services in Next Generation Network (NGN). Location Based Services describes the sequence of locations visited by users. Wireless QoS Model (WiQoSM) analyses the traffic in mobile communication. Mobile User Behavior Pattern (MUBP) is a hopeful trend that calls for the amalgamation of data mining, information management and service computing techniques.

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