ISSN 2320 - 2602
Volume 2, No.9, August 2013
International Journal of Advances in Computer Science and Technology
Available Online at http://warse.org/pdfs/2013/ijacst07292013.pdf

Personalized Mobile Search Engine by Analyzing Query Travel Patterns with Association Rule Mining

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ABSTRACT

Mobile based search engine the major problem is that the interaction between mobile users and search results are managed by small numeral of factors in the mobile phones .In order to manage these problem collect user query and their relevant result to satisfy the user profile according to the interest. To perform this by observing the different types of concepts in the personalized mobile search engine (PMSE), it captures the user preferences concepts by mining click through data. In Personalized mobile search engine (PMSE) preferences of each user are ordered in ontology based model and each user profiles are ranked with the use of multi-facet for future search results.

The search result can be classified into location and content based concepts based on their importance information. Improve the PMSE result by investigate methods to develop normal query travel patterns from the location and clickthrough data to further enhance the personalization effectiveness of PMSE. By introducing an association rule mining algorithm collect the different travel patterns by original search engine result in each and every query of user from the original personal mobile search engine profile. Association rule learning is used for finding the interesting query travel pattern results from each user query in PMSE search engine. From this query related patterns of the user to identify strong rules discovered in databases using different measures of interestingness. They introduced association rules for discovering regularities between normal patterns and query related patterns in the personalized mobile search engine result.

Keywords: Association rule mining, Click-through data, concept, location search, mobile search engine, ontology, personalization and user profiling.

1. INTRODUCTION

Search engine plays a major important way to search the applicable information from the Web. Though, the investigate results acquire may not forever be cooperative to the user, as investigate engine fail to be familiar with the user purpose behind the query. Because the exacting word might denote numerous things in different contexts and the predictable background can be strong-minded by the user unaccompanied. For picture, particular a investigate keyword "apple", a consumer might be penetrating intended for fruit apple or for apple computer. Characteristic search engines provide alike set of consequences without bearing in mind of who submit the query. Consequently, the obligation arises to have personalized web search [1] organizations which give yield suitable to the user as extremely ranked pages.

To manipulate this type of issues personalized user profile based system are proposed in previous work personalized Web searches [1, 2] have been developed. In personalized search (PS) how to adeptly attain user' information requirement is a key difficulty. Therefore it is tremendous to achieve user's need simply from the user given query or keywords. In web search system the main difficulty is that doesn't imagine concerning the difference surrounded by personality user needs. To overcome this difficult by integrating information the meta-search engine in mobile surroundings. Meta search engine with personalized helps individuals search problem to find the important information according to user's interest.

None of the previous work support the result based on concept and location based results. It either considering the location or concepts in single manner not produces both results simultaneously by observe the requirements of dissimilar type of users, there personalized mobile search engine (PMSE) which represent disparate type of concepts in disparate ontology's. it categorize the user information into both content and location based concept from user given query with personal search engine result .It adopt the metasearch engine approach which relies on marketable search engines such as Google, Yahoo to achieve a actual search. The client is responsible for receiving the user's requests, conveyance the needs to the PMSE server, display the return consequences. Lastly collecting their click throughs in organizes to obtain

their personal preferences. The PMSE server is responsible for performing the task to the main search engine and as well as rank the results according the different user and their similar query based results in the server side and return result to the client side in PMSE. To distinguish the diversity of the concepts associated with a query and their relevancies' to the user's preferences, dissimilar entropy measures are introduce to equilibrium the weights among the content and location concepts.

In this PMSE doesn't support to develop usual travel patterns that is search related patterns and query patterns beginning the GPS. To perform this use of association rule mining to collect query patterns from the initial stage of the search process and it further enhance click through data result in the personalization efficiency of PMSE.

The major contribution of the work as follows:

- A query based travel patterns are associated from each user and query patterns are mined from each GPS location of user with association rule mining .From this we found the query patterns and after that search results based on query patterns mined from ARM. It enables best personalization results from each user and provides best result for each query.
- Personalized Search mobile Engine (PMSE) which makes the use of complete information presented with the objective of is the query and ontology values to find the applicable penalty.
- PMSE finding the content and location based concepts for user profiling; it utilize similarly the content and location preference to personalize search consequences for a user.
- PMSE accept the server-client model in which consumer query are promote to a PMSE server for dealing out the training and reranking quickly with RSVM. PMSE clients working with Android platform and the PMSE server on a PC to confirm the results. Experiential result demonstrates that our design conserve expertly key user needs.

2. RELATED WORK

Mining Association rules is the major research area in the datatmining [3]. For example the, given a set of transaction where each transaction consists of the set of items, i.e. the association rule is expressed in the form $X \underset{A}{\Rightarrow} Y$, where X and Y are sets of items. The problem of mining association rules was first introduced in [3] and later broadened in [4], for the case of databases consisting of categorical attributes alone. Association rule mining (ARM) is a technique for finding co-occurrences, correlations, and frequent patterns, associations among items in a set of transactions or a database. Association Rules with confidence and support above user-defined thresholds (min-conf and min-sup) were found. As data continues to grow and its complexity increases, newer data structures and algorithms are being developed to match this development.

Mainly the Association Rule mining (ARM) process can be divided into two steps. The first step involves finding all frequent itemsets or large itemsets in the databases. Once the frequent itemsets are found from the dataset then association rules are generated [5]. ARM is widely used in market-basket analysis. For example, frequent itemsets can be found out by analyzing market basket data and then association rules can be generated by predicting the purchase of other items by using the conditional probability [3], [4].

Jie Yu et al., [6] suggested removal user context based on interactive compute for personalized Web search of user given query. It accomplish user's real-time requirement to satisfy the information based on the personalized search. Obtainable approaches focal point added on construct user profile which depends on Web pages/documents which influence the effectiveness of search engine. In addition, dynamics of user profile is frequently unnoticed. To contract with this difficulty, the author has introduced a method with the intention of acquire the consumer background to totally present preferences of users for successful personalized search. Lastly, growth of user context in use by introduce forget factor to merge the self-governing user context snap in a user session. It can efficiently build user context based on person user information require.

Fang Liu et al., [7] recommended personalized Web search for humanizing retrieval usefulness. The user profiles are subsequently utilized to improve recovery good organization in Web search and a widespread outline is premeditated from the look for the past of the user's and a group hierarchy correspondingly. Web search is performed according to together the user query and the collection of category. A figure of profile knowledge and group mapping approach and a synthesis schema are obtainable and evaluate. Investigational outcome demonstrate with the intention to personalize Web search is very effective.

Xuwei Pan et al., [8] proposed context based personalized Web Search result by improving the information retrieval results it can be performed by integrating the profile of each user with interest. Subsequent to the process of the process three significant technologies to complete this process which are semantic indexing for Web resources, modeling and obtaining user context and semantic resemblance matching in the middle of Web resources and user context.

Kyung-Joong Kim et al., [9] developed a personalized network investigate engine use fuzzy concept network with linkage structure. The majority of the well-known search engines formulate employ of connection structure to find out accuracy effect. Characteristically, a link-based investigate engine provide superior-quality output than a text-based investigate engine. On the additional hand, they have difficulty in provide the result that satisfies the specific user's preference. Personalization is required to maintain an additional suitable result. Among many approach, the fuzzy model network according to a customer profile can differentiate a user's individual interest appropriately.

Depending on a user profile, the fuzzy model network rearrange five outputs of the link-based investigate engine, as well as the structure present a personalized better value result.

Chen Ding et al., [10] suggested personalized network investigate with self-organizing record. The generally used network investigate engines provide the related response set for different users, even still the users probably will have different preferences. C. Biancalana et al., [11] future a new way for personalized network investigate use social classification in query expansion. public network and joint tagging systems are quickly attain more recognition as most important means for categorization and sharing data: users tag their bookmarks so as to put together things easier for information sharing and later visit.

Personalized network investigate with position preference is suggested by K.W.-T. Leung et al., [12]. Since the quantity of network in order develop at very quick pace, investigate engines should be capable of retrieve information base on the user's preference. In this paper, the author suggested a story network investigate personalization procedure that recognize the user's interests and preference with the help of concept by taking out investigate output and their click-throughs. Because of the important role played by the place information in mobile search, the author designed to divide concept into satisfied concepts and location concepts, and classify them into ontologies to create an ontology-based, multi-facet (OMF) summary to accurately recognize the user satisfied and place interests and hence improve the search accuracy OMF enhance the accuracy considerably compared to the baseline.

J. Lai et al., [13] compare personalized network investigate outcome with user outline. The huge information presented on the Internet make it complex for user to attain required information from the network search results in a more personalized approach. For the same solution word, most of the investigate engines present the related result to each user without considering user preference.

B. Smyth [14] proposed a community-based approach to personalizing network search. Researchers can influence the essential information produced within investigate community by gather users' search behaviors the queries they enter and results they choose at the community level. It focus on the collaborative Web search method that give confidence the proposal to facilitate collection of people examine behaviors can their precious form of search knowledge and distribution of this information makes adapt conservative search-engine outputs possible.

3. ASSOCIATION RULE MINING BASED QUERY TRAVEL PATTERNS AND PERSONALIZED MOBILE SEARCH ENGINE (PMSE)

3.1 Association Rule Mining (ARM)

Association rule learning is a well-liked and well research technique for discover attractive relatives among variables in PMSE search engine. It is planned to distinguish physically powerful rules exposed in search engines using dissimilar procedures of interestingness. Based on the conception of well-built rules, Rakesh Agrawal et al. Introduce association rules for discovering regularities among products in important transaction data record by point-of-sale (POS) systems in supermarket. Association rules are typically compulsory to keep happy a user-specified smallest amount support and a user-specified minimum confidence at the similar instance.

Association regulation generation is typically opening up interested in two divide steps: Primary, minimum support is practical to discover all frequent query patterns in a user clickthrough data. Next frequent query itemsets and the minimum confidence restraint be second-hand to appearance rules. To discover a query traveler's interest extract beginning search based user click all the way through files whilst the personal user search the consequences on or after mobile .Whilst user enter query base path or traversal patterns are recognized initially and after that we make frequent itemset with the intention of number of instance the user click thorough files and find the majority significant travel patterns in the clickthrough files. This investigate focus on the travelers who use mobile search contain the majority frequent based links in together location and concept based ontology ,previous to so as to we discover the frequent itemset that is additional numeral of period user look for the comparable web pages or concept and location.

Beginning this compute the support and confidence standards of the click through files and the majority relevant regular query patterns results are considered as consumer the majority important concepts and location then yet again go on the concept to rank the feature for both content and location ontology.

Association Rule Mining (ARM) query travel pattern to explore for go target that is user concept consequences ,practical data mining and association rules method to investigate the association among travelers' profile and their transactions in the data .After this examine the identify majority important pattern to investigate the outcome and can amplify opportunity for the competitive operations of tourism firm to respond the travelers' demand effectively.

Specified a set of user click through is measured as set of items $I= \{i_1,i_2,i_3,\ldots.i_m\}$ and a record of transactions with travel patterns $DB= \{t_1,t_2\ldots t_n\}$ where $t_i=\{I_{i1},I_{i2},\ldots I_{ip}\}$, $p \leq m$ and, if $A \subseteq I$ with $\boldsymbol{K = |A|}$ is called a k-itemset or simply an itemset. Let a database D be a multi-set of subsets of I as shown. Each $T \in DB$ supports an itemset $A \subseteq I$ if $A \subseteq T$ holds. An association rule is an expression A => B, where A, B are item sets and $X \cap Y = \emptyset$ holds. Number of transactions T supporting an item $\boldsymbol{A}$ w.r.t DB is called support of $\boldsymbol{A}$, $Supp\ (A) = |\{T \in DB \mid A \subseteq T\}| / |DB|$. The strength or confidence (c) for an association rule $\boldsymbol{A => B}$ is the ratio of the number of transactions that contain $\boldsymbol{A \cup B}$ to the number of transactions that contain $\boldsymbol{A}$, Conf $(\boldsymbol{A \rightarrow B})$ =Supp $(\boldsymbol{A \cup B}) / \boldsymbol{Supp\ (A)}$.

After that the query patterns are analyzed with the help of the patterns in association rule mining .PMSE first performs the functions with RSVM training at the PC server side with user profile based preferences. Lastly clickthrough data says the precise user preference on the search results are stored into PMSE server and protects the user privacy .Personalized query collects the query travel patterns from the original query patterns in ARM, after that query based results uses a concept and location based contents by maintain the ontology that the result returned from the search result based on user interest in query travel patterns by considering both location and concept information.

It is classified into two categorize content concepts and location concepts with patterns returned from ARM. Observe the significant individuality of the content concepts and location concepts on dissimilar perspective of each user.

3.2 Content Ontology

Content ontology method extracts all the keywords or terms and phrases from the web-snippets and search engine results by user given query (UGQ). Here the most repeated UGQ based query patterns are analyzed after that it calculate the confidence value for moat time occurrence of the USQ in top documents measure the amount of a particular keyword/phrase C_i with value to UGQ

$$\mathbf{support}\ (\mathbf{C_i}) = \frac{\mathbf{sf(C_i)} * \mathbf{QTP(C_i)}}{\mathbf{n}} |\mathbf{C_i}|$$

where $\mathbf{sf(C_i)}$ is the snippet frequency related to concepts C_i and n is the number of web-snippets from UGQ and $| C_i |$ is the numeral of conditions in the keyword/phrase C_i $\mathbf{QTP(C_i)}$ is the snippet frequency containing the most related query patterns in the concepts C_i .

After that find the relations among concepts for ontology formulation. Measure the contrast between two concepts which coexist a group on the search results might represent the same topical interest with query travel patterns. If coexist $(C_i; C_j) > \boldsymbol{\delta_1}$(is a threshold), then C_i and C_j are measured as comparable. If pr $(C_j \mid C_i) > \boldsymbol{\delta_1}$ (is a threshold), score C_i and C_j child.

3.3 Location Ontology

Extract location concepts are different from with the purpose of extracting content concepts with similar query travel patterns results from ARM. The predetermined location ontology with QTP is used to associate region information with the explore results. The entire part of the keywords and key-phrases from the Query patterns documents (QPD) returned for query (UGQ) are extracted with exact matches of the results in location concept.

3.4 Diversity and Concept Entropy

Measuring the diversity between the location and content ontology based results with similar in search engine .here the PMSE consist of a content feature and a location feature it select the consequences based on the entropy can be designate the uncertainty associated among the information comfortable of the investigate results from the user's point of Query Travel Patterns(QTP). Two entropies calculate content entropy H (C_{UGQ}) and location entropy H (L_{UGQ}) to calculate the uncertainty associated with the content and location information in the search engine result of each user preferences.

$$\mathbf{H_{CQTP}(UGQ)} = -\sum_{\mathbf{i=1}}^{\mathbf{k}} \mathbf{p(C_i) logp(C_i)}$$

$$\mathbf{H_{LQTP}(UGQ)} = -\sum_{\mathbf{i=1}}^{\mathbf{k}} \mathbf{p(L_i) logp(L_i)}$$

User Click through entropies affects the user's events in search outcome; it can be able to use as a submission of the diversity of the user's good. Formally, the click content entropy and click location entropy $\mathbf{H_{\overline{LQP}}(UGQ, UC)}$of a query UGQ submitted by the user UC are defined as follows:

$$\mathbf{H_{\overline{CQTP}}(UGQ, UC)} = -\sum_{\mathbf{i=1}}^{\mathbf{k}} \mathbf{p}\ \ \mathbf{(\overline{C_{i,UC}}) logp(\overline{C_{i,UC}})}$$

$$\mathbf{H_{\overline{LQTP}}(UGQ, UC)} = -\sum_{\mathbf{i=1}}^{\mathbf{k}} \mathbf{p(\overline{L_{i,UC}}) logp(\overline{L_{i,UC}})}.$$

QT is total number of content concepts that are clicked by query based patterns the number of content concepts clicked by user UC, $\mathbf{C_{UC}} = \mathbf{C_{1CU}}, \mathbf{C_{2CU}}, \dots, \mathbf{C_{qtCU}}$ is the number of period that the content concept C_i has been clicked by

$$|\overline{\mathbf{C_{UC}}}| = |\overline{\mathbf{C_{1UC}}}| + |\overline{\mathbf{C_{2U}}}| + \cdots\cdots\cdots + |\overline{\mathbf{C_{qtU}}}|, \mathbf{p}(\overline{\mathbf{C_i}}\mathrm{U}) = \frac{|\overline{\mathbf{C_{iUC}}}|}{|\overline{\mathbf{C_{UC}}}|}, \mathbf{v}$$

is the numeral of location concepts with query patterns $\overline{\mathbf{L_{UQTP}}}$,

$$\overline{\mathbf{L_{UQTP}}} = \{\overline{\mathbf{l_{1U}}}, \overline{\mathbf{l_{2U}}}, \dots\dots\dots, \overline{\mathbf{l_{vU}}}\}$$

But these mentioned concepts the customer predilection doesn't present the safety method in the profile.

3.5 User Preferences Extraction and Privacy Preservation

User preferences based query patterns results are returned from location concepts and content concepts in the above step to make security in the user profile based results preference ,first mining the results with the set of feature in both content and location concepts related to query patterns alongside through prospect queries to the PMSE server for discover end result reranking. SpyNB it can be adapt with PMSE to mining the QTP with user preference and after that converse how PMSE preserve user privacy. The SpyNB method QTP is the positive set of query patterns, U the

unlabeled set and QTPN the query predicted negative set obtained from original set.

$$\boldsymbol{d_i < d_j, \forall l_i \in QTP, l_j \in QTPN}$$

The PMSE clients deliver the user's clickthrough data from QTP .It make a feature vector based query pattern based clickthrough data and the filtered ontology according to the privacy ideals at different expRatio. If it doesn't satisfy it forwards UGQ (User Given Query) to PMSE server. PMSE make use of mindistance to pass through a filter the concept in the ontology. Mindistance is defined by $\boldsymbol{D(C_{i-1}, C_k)}$ and concept C_i will be prune back and it satisfy the subsequent situation.

$$\frac{\boldsymbol{D(C_{i-1}, C_k)}}{\boldsymbol{D(C_{i-1}, C_k) + D(root, C_{i-1})}} < \boldsymbol{mindistance}$$

Where $\boldsymbol{C_{i-1}}$ is the direct parent of $\boldsymbol{C_i}$, and $\boldsymbol{C_k}$ is the leaf node of concept. The concept entropy $H_{CQP}(U_{UGQ,P})$ of the user profiles can be compute using the following equation:

$$\boldsymbol{H_{CQTP}(U_{Q,P}) = -\sum_{C_i \in U_{UGQ,P}} pr(C_i) \log pr(C_i)}$$

$$\boldsymbol{expRatio_{UGQ,P} = \frac{H_{QTPC}(U_{UGQ,P})}{H_{QTPC}(U_{UGQ,0})} - \sum_{C_i \in U_{UGQ,P}} pr(C_i) \log pr(C_i)}$$

Ranking SVM is working to learn a modified ranking purpose for examine consequences according to the user satisfied and position preferences. For a given query (UGQ), a set of content concepts and a set of location concepts are extracted on or subsequent the search result as the article features. To take out the concepts calculate similarity and parent-child relations of the concepts in the extracted concept ontologies are also built-in in the preparation based on the dissimilar types of relations such as Similarity, Ancestor, Descendant and Sibling. The content feature vector $\boldsymbol{\phi_{CQTP}(UGQ, d_k)}$ with the subsequent equation:

$$\boldsymbol{\forall C_i \in s_k, \phi_{CQTP}(UGQ, d_k)[C_i] = \phi_{CQTP}(UGQ, d_k)[C_i] + 1}$$

For supplementary content concepts C_j that are related to the content concept C_i

$$\boldsymbol{\forall C_i \in s_k, \phi_{CQTP}(UGQ, d_k)[C_j] = \phi_{CQTP}(UGQ, d_k)[C_j] + \mathbf{Ancestor}(C_i, C_j) + \mathbf{Descendant}(C_i, C_j) + \mathbf{Sibling}(C_i, C_j) + \mathbf{similarity_R}(C_i, C_j)}$$

Location feature vector l_i is extract from the web snippet and equivalent values are incremented in the location feature vector and incremented location feature vector $\boldsymbol{\phi_l(UGQ, d_k)}$ with the subsequent equation:

$$\boldsymbol{\forall C_i \in s_k, \phi_{lQTP}(UGQ, d_k)[l_i] = \phi_{lQLP}(UGQ, d_k)[l_i] + 1}$$

$$\boldsymbol{\forall C_i \in s_k, \phi_{lQTP}(UGQ, d_k)[l_j] = \phi_{lQTP}(UGQ, d_k)[l_j] + \mathbf{Ancestor}(l_i, l_j) + \mathbf{Descendant}(l_i, l_j) + \mathbf{Sibling}(l_i, l_j) + \mathbf{similarity_R}(l_i, l_j)}$$

Best result optimize the search result in both content and location concepts in query travel patterns (QTP) to combine the two weight vectors and find the final weight vector for user U'0. s ranking. The two weight vectors of query patterns are first normalize previous to the mixture:

$$\overrightarrow{w_{UGQ,U}} = \frac{e_{CQTP}(UGQ,U)}{e_{CQTP}(UGQ,U) + e_{LQTP}(UGQ,U)} \overrightarrow{w_{CQTP(UGQ,U)}} + \frac{e_{LQTP}(UGQ,U)}{e_{CQTP}(UGQ,U) + e_{LQTP}(UGQ,U)} \overrightarrow{w_{LQTP(UGQ,U)}}$$

Let $\boldsymbol{e(UGQ,U) = \frac{e_{CQTP}(UGQ,U)}{e_{CQTP}(Q,U)+e_{LQTP}(UGQ,U)}}$

$$\overrightarrow{w_{UGQ,U}} = e(UGQ,U)\overrightarrow{w_{CQTP(UGQ,U)}} + (1 - e(UGQ,U)\overrightarrow{w_{LQTP(UGQ,U)}}$$

will rank the documents in the returned search according to the following equation , $F(UGQ,d) = \overrightarrow{w_{UGQ,U}} \cdot \boldsymbol{\phi(UGQ, d)}$

4. EXPERIMENTAL RESULTS

In this section estimate the effectiveness of PMSE and association rule mining based query pattern mechanism. Evaluate the performance of the system with number of occurrence based on both PMSE and association results of each user preference by considering the ambiguous and explicit query of user given different query types based user profile with satisfies the query and location concepts. Association improves the quality of the personalization and accuracy of the values is measure with prediction values with different query types, compare with the techniques.

4.1 PMSE Ambigous and Explicit Query Results

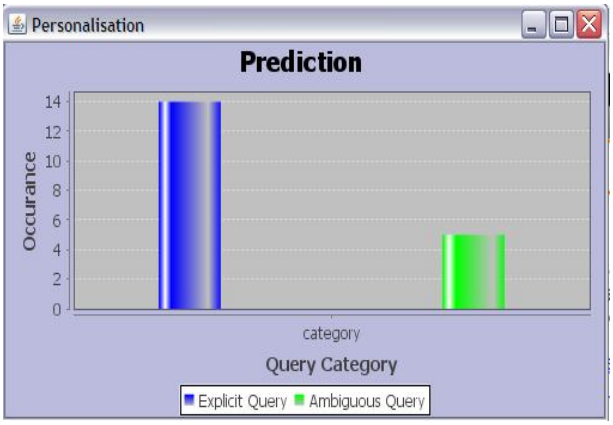

Figure 1: Prediction

In this graph measure the prediction accuracy performance of the explicit query and ambiguous query based on based on number of occurance in the personalization based mobile search engine.

4.2 PMSE Ambigous and Explicit Query Results with Association

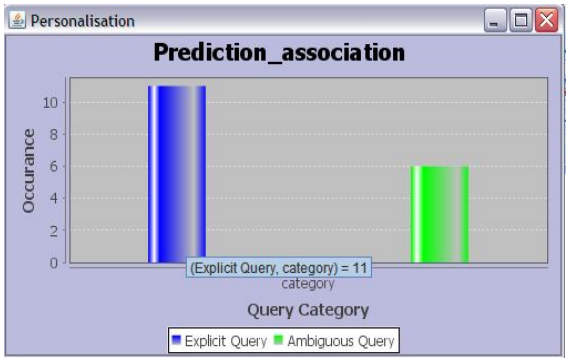

Figure 2: Prediction association

In this graph measure the prediction accuracy performance of the explicit query and ambiguous query based on based on number of occurrence in the personalization based mobile search engine With association , it produces best prediction in less number of occurance in the QP problem system produces best prediction result than PMSE.

5. CONCLUSION AND FUTURE WORK

5.1 Conclusion

PMSE extract the user preferences on both content and location based on the user clickthrough data .To become accustomed to the user mobility, it also included the user's GPS locations in the personalization procedure to examine the location and help to increase retrieval efficiency, mostly for location queries. Query patterns scheme contribute new information which gather more and more on folder to suit the user profiles consequences novel user is searching for travel information on mobile devices, the scheme determination study user performance transaction which user clicks. The scheme determination to gather new data and examine them then interpret to user. The scheme will motivation to learn increasingly whilst numerous of users click further on mobile request. It will accumulate additional data and repeatedly examine the recently obtained data. If the travelers' behavior changes, the pattern in database also change. The scheme will work more precise and work efficiently all along with the dynamics of the result.

5.2 Future Work

In addition through the huge expansion of the information obtainable on the Web, it is very complex for Web search engines to assure the user information obligation only by means of a short vague query. Dissimilar Query based results dissimilar on or after every user, query based recommendation system determination aid user to discover the vague query .In future work comprise the query based recommendation procedure to identify the user alike queries and their results.

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