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# Relevance of tree structure in Location Based Service

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***Abstract:*** *Mobile computing enables its clients to have unrestricted mobility access while maintaining network connections in its mobility mode. During mobility client's may request many services from the server. Location Dependent Information Services (LDIS) is a application where information provided to users depends on their current locations. Existing location based services are implemented with different index based searches, but they failed to provide more accurate result to the user. The proposed framework has been implemented by similarity based searching method. This framework consists two different methods namely: M tree and K-d tree. M-tree is designed for computing the distance of high dimension data using Distance-based indices. K-d tree is a space-partitioning data structure for organizing points in a k dimensional tree.*

***Keywords:*** *GPS, MOVNet , LDIS, LBS, GUI, MTree, K-d Tree, R-Tree.*

## I. INTRODUCTION

Location dependent services have been developed for mobile and wireless networks to find different services. In this service, data will be determined by the geographical location of the mobile user from where he sends request. These services are responsible to identify the location information and provide necessary information about that specific location. It requires client devices, application data, network connectivity and the actual content to deliver the service on the user's phone. Existing services used different approaches like indexing techniques R-tree, R*-tree, grid, k-d tree, b+ tree, inverted file etc for location query processing. These approaches are not able to support continuous and similarity based search queries. Mobile users also face issues in the Consistency and reliability of data access. B tree, B+ Tree, R-tree or R*-tree are the most frequently indexed based searching approaches been used for processing location based queries in mobile environment. Recent web service provider's are using R-tree or R* -tree for searching of location based data. But analysis shows that Construction and maintenance of R-tree, R* -tree takes more CPU (distance computations) and I/O. The implementation of the tree is also very difficult. R*-tree is only applicable for multidimensional data. R-tree cannot be considered as a good option if huge amount of data is existing in data base .

To overcome these problems, the proposed framework has essential of two different indexed base services i.e. M-tree and k-d tree. M-tree is a tree based data structure. It organizes and search large data sets from metric space. It helps to search similarity based data like range based data and k-nn neighborhood data. M-tree's results are defined by a distance function that satisfy the positivity, symmetry and triangle equality range[1]. K-d tree is a another nearest based searching approach which hierarchically decomposed the space into a small number of cells such that no cell contains too many input objects [2]. It provides a fast way to access any input object by position.

## II. LITERATURE SURVEY

Location based services provide information of the mobile devices which tells about its present location and is capable of modifying the current information. The information service allows users to pull down information about the location and the service. Location dependent queries are generally depend on either nearest neighbours or range based queries. The indexing structures with respect to the context of LBS(Location Based Service) ,traditional indexes (Rtrees, kd-trees ) adopt either overlapped partitioning schemes or backtracked search algorithms. These features increase response times for an in-memory index within an on-demand data access mode[3]. Searching for similar objects into a large collection of objects stored in a metric-space database has become an important problem [4]. The distance between two moving objects highly depends on the length of edges, connectivity of vertices as well as the current locations of the objects. To efficiently manage both stationary network connectivity and dynamic object position updates, MOVNet (moving objects in road Networks) utilizes a dual-index structure. It stores the stationary network data on-disk R-tree and used in-memory grid index which supports the position updates of moving objects[5]. Ordered-Cell Group designed base on grid index structure. It makes use of e spatial order sequences through a number of density-conscious optimizations. It speed up the search efficiency by implementing compaction of identifiers of OCG cells that maximize the fan-out of index node and decrease the depth of the index[6]. To achieve better Performance of different Categories of services, location-based web services

 

integrates inverted files and R*-trees. They are able to handle both textual and location aware queries which is requested by the mobile client.

Three different combination inverted file and R*-tree schemes had been studied for executing the queries: (1) inverted file and R*-tree double index, (2) first inverted file then R*-tree, (3) first R*-tree then inverted file[8]. This may include data that is needed for device connectivity and call processing, such as SIP proxy settings, end-system scripts (Call Processing Language), Language for End System Services (LESS) and authentication information, as well as personal data such as address book entries, buddy-lists, speed-dial settings and ring tone audio files.

VN-tree (Verona-Neighbors tree) is the other approach designed based on the Verona diagram. Its uses dual graph (the Delaunay Triangulation) for searching the data. This method adopted a no overlapping partitioning scheme and backtracking free search algorithms for answering several types of queries. Various experiments shows that comparably R*-tree, VN-tree consistently provides outstanding performances [7].

Few researchers had applied a fuzzy logic model and genetic algorithm for capturing the uncertainty of parking availability and reflect it in a parking finding system. With this system, users used to be informed the uncertainty of the parking space, therefore he was able to choose their departure station[9]. Bayesian method is the other approach used for location determination in WLAN. They have also used Kalman filter to improve the accuracy of location determination. Clustering is the another approach suggested by many researchers for determining the location.

A cluster based approach known Cluster-Object based Smart Cluster Affinity Search Technique (COSmart-CAST) build upon a cluster model for mobile transactions. It is based on the Location-Based Service Alignment (LBS-Alignment) similarity measure. Here, Author had used Genetic Algorithm (GA) for producing a more suitable time interval table[10].

M-tree has been adopted as one of best of the one of the best similarity based searching technique. It considers only relative distance of objects to organize and partition the space. It measure the distance between objects in a from of metric, so that triangle inequality property can be applied .The complete process help us to prune the search space.

k-d tree is a binary tree which helps to store the spatial data in very simple manner. As one moves down the tree, one cycles through the axes used to select the splitting planes. Points are inserted by selecting the median of the points being put into the subtree, with respect to their coordinates in the axis being used to create the splitting plane. This method leads to a balanced k-d tree, in which each leaf node is about the same distance from the root. [11]. The proposed framework had taken advantages of M-Tree and K-d to retrieve most nearest data. When user send s a query , these two approaches will calculate the distance between Current user's current location coordinate and location coordinate which present in database. Application server will analyse output which had come from these two indexing approaches. The one ,which produce the shortest distance ,that result will pass to the users.

## III. PROPOSED MODEL

In order to retrieve user's current location the proposed model uses GPS, Cell-id, Wi-Fi. Apparently it uses m-tree and kd-tree for calculating and comparing the high dimension data. The server compares the results of both the trees and sends the nearest data to the client. The proposed framework consist two major module which helps to give more nearest and accurate result of the location based service queries.

I. Finding Current Location of Mobile User Proposed Location Based Architecture determines user location using cell tower and Wi-Fi signals .Access of location-based services is handled by the Location Manager system interface. Figure 1 shows that Current Location can be fetched using two ways: 1. GPS (Global Positioning System) 2. Network Service Location

 

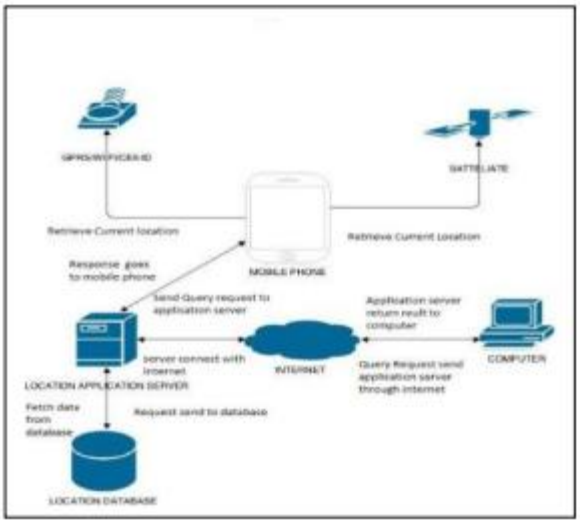


Fig1: Proposed Location Based Service Architecture

GPS (Global Positioning System) GPS finds the user position by calculating differences in the time based on different satellites[5] inputs. GPS signals are decoded by Mobile unit.

Network Service Location Network service provider will adopt two positioning technique for identifying the location of the user:

i. **Cell-id:** Base Transceiver Station (BTS) is a piece of equipment that facilitates wireless communication between mobile unit and a network. It combine collection of component like LAC(Local area code), MCC(Mobile country code), MNC(Mobile Network code), Cell ID, Signal Strength and first Timing Advance. Mobile phone is interacting with BTS through cell-id and Multiple number of BTS connected with Base Station. Multiple base station connect with MSC(Mobile switching Centre). MSC use when device move from one to another place. When user uses cell-id network location provider ,it first send LAC,MCC,MNC from mobile unit to cellid database then inside the database find longitude and latitude of all BTS and compute the Triangulation. After computation it return the current location of user to application server**.**

ii. **Wi-Fi:**For the proposed architecture WI-Fi-based positioning system is used for the device is having GPS facility. Identifying the position done through wireless access points is based on measuring the intensity of the received signal and the method of fingerprinting..

B. Location Based Query Processing: Location query process is achieved by M-Tree and K-d Tree indexing techniques. M-Tree: M-tree is distance-based indexing technique which store distance properties in metric space for high dimension data. K-d Tree: K-d tree is a space-partitioning indexing technique in which points are organizing in k dimensional space. The Proposed Location Based Service architecture (figure:3) consist 3-Tier architecture. Presentation layer consists of pages like .java or desktop based form where users can sent request in the form of query. This layer will help to identify the current location of user from mobile device by either taking a help of cell-id, GPS, or Wi-Fi provider. These Providers return the Current location information in the form of longitude and latitude direction. Next, Current location coordinate passed to Business logic layer(BAL). Responsibility of this layer is to validate the business rules of the component and communicating with the Data Access Layer(DAL). Using this layer, All location data will be fetched from database. It also store the current location coordinate information into M-Tree. Additionally it calculates the Euclidean distance between current coordinate and all location coordinate. Then it consider the smallest distance data. Same query passed to K-d tree also. K-d tree find the point in the tree that is nearest to a given input query and return that data to application server . The application sever will filter both results and nearest data will be send to mobile device. At last, Data Access Layer is that contains methods to enable business logic layer to connect the data and perform desired actions. Later, DAL accepts the data from BAL and sends it to the database. DAL gets the data from the database and sends it to the business layer..

 

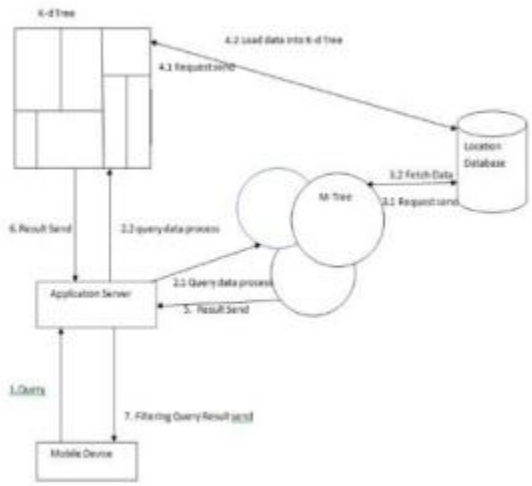


Fig 3: Location based Query Processing

## IV. IMPLEMENTATION

The proposed model is created by including Samsung galaxy Android OS, v4.2.2 (Jelly Bean) , chipset Exynos version 4212, CPU version Dual-core 1.5 GHz, GPU version Mali-400, internal RAM 1.5 GB. One computer is used as Application Sever and the other one as a Database Server. Android Mobile device has been used as a client. The Application Server contains both the indexing technique whereas database server contains all the location related sample data. For experimental purpose, 1000 location data had been saved in database server. The data set has been implemented using both the trees and the results are given below:

**Result of M-tree and Kd-tree:**

| Number Of data | K-dTree Time(Milisec) | M-tree(Milisec) |
|---|---|---|
| 200 | 22 | 18 |
| 400 | 47 | 42 |
| 600 | 76 | 68 |
| 800 | 125 | 108 |
| 1000 | 142 | 124 |

For experimental purpose, a data set of 1000 records has been gradually increased to understand the efficiency and accuracy of the algorithm. Table 1 shows the relation time taken by the trees during communication. Initially, experiment started with 200 datasets, and increase to 1000 datasets. Comparison between M-Tree and K-d Tree By looking to Fig 6, we can understand that searching and retrieval speed of M-tree is more efficient for searching than k-d tree. But the combination of both trees help us to retrieve more nearest nearest location in location based service. The optimization used by M-tree search algorithms for reducing the number of distances to be computed is highly effective, saving up to 40% computations.

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