Privacy Aware Monitoring Framework for Moving Top-K Spatial Join Queries

U.L.Sindhu, V.Sindhu, P.S.Balamurugan

Abstract— ***In moving object environment, it's unfeasible for database to track the random object movement and to store the locations of object exactly all the times. The basic issue in case of moving object monitoring is efficiency and privacy. We used a framework for moving object to hide their own identities by execution of probabilistic range monitoring queries. The Privacy-aware monitoring framework for spatial join queries which is flexible, it addresses two issues; such as "efficiency and privacy" in monitoring moving object. Because of blurring exact position of object and increase in unnecessary updates costs it's not possible to provide accurate result. So, we propose an efficient processing of continuously moving top-k spatial keyword (MkSK) queries over spatial query processing for the problem of privacy aware monitoring framework. This develop an efficient query processing, evaluation and reevaluation based on spatial queries which could be effective for computing safe zones that guarantee correct results until the user remains in safe zone, the reported results will be valid and no limiting of frequent updates from objects. The Voronoi Cell Optimization technique which accelerates depth sorting by clustering polygon has been implemented. Our solution is common for moving queries employ safe zones. In our performance study, we compare it with an existing approach using simulation. Our proposed approach outperforms than the conventional approaches without compromising much on the concept of safe zone to save computation and communication costs.***

Index Terms— ***Nearest-neighbor queries; probabilistic queries; range queries; spatial databases***

I. INTRODUCTION

In advent of mobile computing environment and ubiquitous computing, moving clients can access various information from anywhere and at any time and monitoring continuous spatial queries over moving objects is required in various daily applications such as fleet management, child care and cargo tracking. The privacy aware monitoring framework which is flexible and addresses issues such as accuracy, efficiency and privacy and the fundamental problem is when and how a moving client should send location updates to the server. The monitoring accuracy is very low, because of unnecessary updates and query reevaluation will increase the cost. The server workload is not balanced over time. Basic idea is to maintain a rectangular area, called safe region, for each object. The safe region is computed based on the queries. As long as the objects reside inside the particular safe region recent results of all queries remain valid. The client updates its location when it moves out of its safe region.

This framework also fails to address the privacy issue, that is, it only addresses "when" but not "how" they send location updates. The common approach is that the bounding box contains the probability distribution of client exact location and the bounding box no longer uses unique query results is its benefit. The results defined will be as a set of possible results with their probabilities. Fig. 1 shows a typical monitoring system framework, which consists of a base station, a database server, application servers, and a huge number of moving objects. The database server manages the information about a location of objects. The application server gathers monitoring spatial requests and registering spatial queries at the database server. Which continuously updates the query results until the query gets deregistered.

The proposed approach is enhanced with the optimal top-k spatial keyword query processing and utilizes the concept of the safe zone to save communication costs computation. This enhancement aims for the solution that (i) It guarantees at any point in time the client has a correct result (ii) optimizes the computational server-side cost and (iii) Also optimizes the client/server communication cost. Here, we develop techniques capable of pruning entire sub-trees that cannot contribute to the safe region.

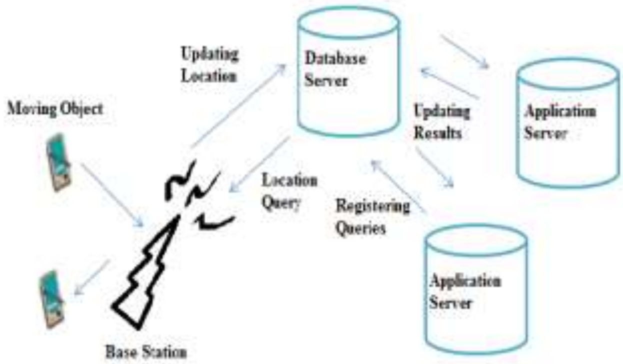

Fig 1: System Framework

Then, we present an advanced solution for computing the safe zone efficiently, with two optimizations for enhancing the power of the pruning rules. We accelerate depth sorting by clustering polygons recursively based on Voronoi diagrams. Priority orders need to be assigned a fixed set of polygons within the cluster. This process is time-consuming, and decreases the number of clusters. We use the weighted distance $d_w(q, p)$ as the ranking function for M*k*SK queries.

Revised Manuscript Received on March 2012.

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A key strength of this function is that different measurement units of the weights and the spatial distances do not affect the query results because the units effect is canceled in the ratio of the weights used.

II. CONSTRUCTING MODEL FOR PRIVACY-AWARE LOCATION

In constructing a privacy aware location model, each time a client detects their genuine point location, which is encapsulated into a bounding box. The client-side location updater who decides whether to update that box to the server or not. The database server handles sequential location updates on a first-come-first-serve basis. With the latter assumption have been made to minimize the cost of location updates and is equivalent in minimizing the total number of updates. Note that bounding box shape also depends on the client-side location updater which is different from a δ-square. In this privacy aware location model the object construction along with its random movement has been designed.

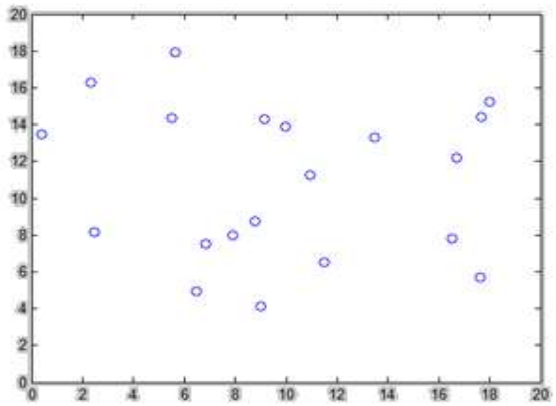

Fig 2: A model for privacy-aware location

For each registered query, the database server stores: 1) the object parameters 2) the current query results and 3) the quarantine area of the query. The quarantine area can be used to identify the queries whose results may be affected by an incoming location update. It originates from the quarantine line, which is a line that splits the entire space into two regions: the inner region and the outer region. An object becomes a result object if it enters the inner region; otherwise, it becomes a non-result object.

III. QUERY PROCESSING, EVALUATION AND REVALUATION

In query processing, evaluation and revaluation of the query processing is takes place. We proposed the detailed algorithms to evaluate and reevaluate a spatial query Q based on most probable result. This we can infer from the definition of the query result. The query Q also differs from a conventional spatial query because the object locations are in the form of

δ-square for object updating. In this section, instead of regarding Q alone as a special query type, the alternative approach by regarding the space where special Euclidean space has been defined for the object locations. From a conventional Euclidean space, spatial relations such as overlapping, containment, or even distance are implemented differently. To evaluate a range query q in conventional Euclidean space, we use the best-first search (BFS).

The user will be requesting the center point such as [x, y] then the query will be processed in database server then evaluation of query result takes place until the object found in particular safe region. If the object moves out of that safe region then again reevaluation of query result takes place. The algorithm terminates if r which is the resultant object have been returned. In evaluation process based on the range query what the user requested at that time instant it will report all the objects that reside at that particular range, even they can able to provide the exact requested object alone but main contribution of the paper to provide privacy so the resultant object which falls within the range along with other objects by clustering method based on certain parameters will be returned, then safe region construction for the resultant object in the next computation will be followed. If the requested query might changes its safe region then reevaluation is required.

IV. SAFE REGION COMPUTATION AND UPDATION STRATEGY

In this process we will be computing the safe region for the selected queries. Initially we will be constructing the safe region for the range query and then for the kNN queries. The location manager in database server computes optimal safe region for an individual query q, which is the inscribed circle with the longest perimeter of q's inner or outer region, get separated by the quarantine line. Two cases exist for safe region updating, first case the server will updates the affected query results and in second case the database server determines new resident domain for the object, hence it provides accurate query results with minimum server processing cost and frequent location update.

Therefore, the safe region is obtained in two steps: finding the quarantine line, and then, finding the Ir- lp. It is fixed that safe region must contain the updating object p (i.e., its centroid), because, this object has to send an immediate location update after moving client receives this safe region. Further enhancing safe region by expanding the size of safe region based on certain parameters such as object speed, query flow, velocity and time. Hence certain resultant object which falls under those factors will be grouped together. So more number of objects can come under particular safe region, on other hand decrease in frequent location updations.

V. PROPOSING MOVING TOP-K SPATIAL KEYWORD QUERY PROCESSING

In this, we are proposing our enhanced technique of moving top-k spatial keyword query processing. We proposed an advanced technique which is capable of pruning entire sub-trees which cannot contribute to the safe region. Then, we present an advanced solution for computing the safe zone efficiently, with two optimizations for enhancing the power of the pruning rules. The initial step of this process is sub-tree pruning.

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In sub-tree pruning we are having the following technique. Let R be the minimum bounding rectangle (MBR) of a subtree, and let wu(R) be the upper bound of the weights of all the objects. Where p* the top result of q and w(p), the weighted distance. Given a region R, we define its minimal dominant region as:

$$Dom_{p^*,R} = \bigcap_{p \in R, 0 \leq w(p) \leq w^u(R)} Dom_{p^*,p} \quad (1)$$

With the MkSK query, all users have an up-to-date result when they move. Voronoi cells optimization which enhances pruning rules have been used as safe region for range queries. From the given a set of spatial objects, a Voronoi diagram uniquely partitions the space into disjoint regions. The region including object p includes all locations which are closer to p than to any other object p'. Point q inside the cell p <=> D(q, p) <=> D(q, p'). Voronoi diagrams have linear complexity {|v|, |e| = O(n)}. The weighted distance plays important role in the MW-Voronoi diagram. Let us take D as data set of point p = (px, py) along with weight w(p) is known only when the query is received. $\| q\ p \|$ denotes their Euclidean distance. The weighted distance between p and query point q is defined as:

$$d_w(q, p) = \frac{q\ p}{w(p)} \quad (2)$$

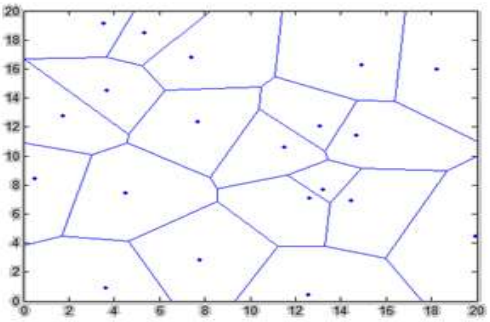

Fig 3: Voronoi cell optimization

In upgraded Voronoi cell optimization by varying f the number of edges for circle if f increase it represents tightly as a circle hence it makes temporary safe region makes more tree nodes to be pruned thus reduce the I/O cost. The moving circular range queries safe region is captured by a set of objects that affect the safe region. To obtain view independent priority order all the polygons within a cluster are pre-computed hence it is a time-consuming process. The simple task in Voronoi clustering post-processing phase is sorting the clusters repeatedly using the property of Voronoi diagrams when the position is changed. Decreasing the number of clusters and time of sorting depends on the number of clusters are Voronoi clustering advantages. It also performs the recursive refinement in order to reduce the size of the data set.

VI. PERFORMANCE METRIC

Finally in this performance metric we will be evaluating the performance of the proposed approach of moving top-k spatial keyword query processing with existing approaches. The parameter metrics used here for evaluating the performance of the proposed approach are accuracy monitoring, wireless communication cost and CPU time. There exist two graphs which compares cost and computation time for PAM framework and voronoi cluster. The result expected will be scenario based and the prediction is accurate.

Cost comparison Time comparison

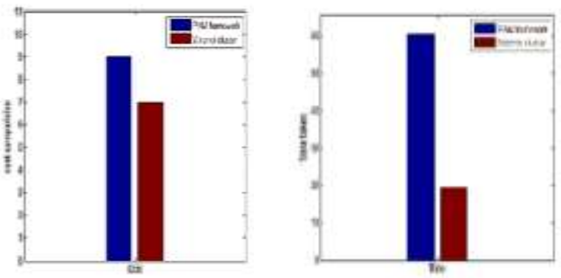

Fig 4(a): performance measure based on cost comparison. Fig 4(b): performance measure based on time comparison.

VII. CONCLUSION

The privacy aware monitoring framework for monitoring continuous spatial queries over randomly moving objects, the integration of privacy into monitoring framework poses challenges in design of PAM. To overcome the problem exists in privacy aware monitoring framework. We proposed an approach is enhanced with the optimal top-k spatial keyword query processing. This enhancement aims for the solution that guarantees that the client has a correct result at any point in time, optimizes the computational server-side cost, and also the client/server communication cost.

We develop techniques capable of pruning entire sub-trees that cannot contribute to the safe region to improve efficiency. Voronoi cells optimization which enhances pruning rules have been used as safe region for nearest neighbor queries have been used. It applies with two optimizations for enhancing the power of the pruning rules and reduces the search space. The proposed has been evaluated through simulation results. In future work, it is of interest to examine the processing of moving top-k spatial keyword queries over road networks.

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