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Privacy Preservation Approach Using Grid Base Techniques for Mobile Users

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ABSTRACT: Location-based services (LBS) require users to continuously report their location to a potentially untrusted server to obtain services based on their location, which can expose them to privacy risks. Unfortunately, existing privacy-preserving techniques for LBS have several limitations, such as requiring a fully-trusted third party, offering limited privacy guarantees and incurring high communication overhead. In this paper, we propose a user-defined privacy grid system called dynamic grid system (DGS); the first holistic system that fulfills four essential requirements for privacy-preserving snapshot and continuous LBS. (1) the system only requires a semi-trusted third party, responsible for carrying out simple matching operations correctly. This semi-trusted third party does not have any information about a user's location. (2) Secure snapshot and continuous location privacy is guaranteed under our defined adversary models. (3) The communication cost for the user does not depend on the user's desired privacy level, it only depends on the number of relevant points of interest in the vicinity of the user. (4) Although we only focus on range and k-nearest-neighbor queries in this work, our system can be easily extended to support other spatial queries without changing the algorithms run by the semi-trusted third party and the database server, provided the required search area of a spatial query can be abstracted into spatial regions. Experimental results show that our DGS is more efficient than the state-of-the-art privacy-preserving technique for continuous LBS..

KEYWORDS: Location Based Service, Privacy Preserving, Spatial Cloaking, Peer-to-Peer, Dual-active.

I. INTRODUCTION

In today's world of mobility and ever-present Internet connectivity, an increasing number of people use location-based services (LBS) to request information relevant to their current locations from a variety of service providers. This can be the search for nearby points of interest (POIs) (e.g., restaurants and hotels), location aware advertising by companies, traffic information tailored to the highway and direction a user is traveling and so forth. The use of LBS, however, can reveal much more about a person to potentially untrustworthy service providers than many people would be willing to disclose. By tracking the requests of a person it is possible to build a movement profile which can reveal information about a user's work (office location), medical records (visit to specialist clinics), political views (attending political events), etc. Technological advancements in GPS-enabled devices, coupled with lower manufacturing costs, has resulted in smart phones effectively becoming ubiquitous. While smart phones provide a plethora of valuable applications to the user, the real power comes in their ability to leverage location-based services. Location-Based Services (LBSs) are permission-based applications that use real-time location intelligence from a customer's mobile device. This data facilitates the providers in rendering diversified services based off the user's geographic location and known landmarks. Therefore, having access to your location would not be of any value on its own, but relating it to other locations provide this endeavor meaning and value. To further clarify this, if a user is travelling and using such a service and they can identify points of interest along their travel path that would be of interest to them, then it would add value to the service provided. The strength of LBSs come when combining the user's geographical locations with identified points of interest (POI). As an example, a quick online search could no only enable the user to find the location of a particular POI, but combining this request with the user's geographical location can enhance the result by providing directions to said POI.



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II. LITERATURE SURVEY

The advent of high-speed wireless networks and the popularity of portable devices have fueled the development of mobile computing. Compared to traditional computing paradigms, mobile computing enables clients to have unrestricted mobility while maintaining network connection. The ability of users to move and identify their own locations opens up a new kind of information services, called location-dependent information services (LDISs), which produce the answer to a query according to the location of the client issuing the query . Examples of mobile LDISs include nearest object searching (e.g., finding the nearest restaurant) and local information access (e.g., local traffic, news, and attractions. The spatial property of location-dependent data introduces new problems for data caching research. First, the cached result for a query (e.g., the nearest restaurant) may become invalid when the client moves from one location to another. The maintenance of the validity of the cached data when the client changes location is called location-dependent cache invalidation. Second, the cache replacement policy on the client has to consider the sizes of the valid scopes p(hereinafter called valid scope areas) of the cached values. The valid scope of a data value is large, the chance for the client to issue the same query within the valid scope, thus generating a cache hit, is also large. As such, the cache replacement policy should try to retain the data value with pa larger valid scope area in the cache [1].

Owing to increasing demands from mobile users, Location-Based Services (LBSs) have received a lot of attention in recent years. Examples of queries for location-based services include "find the nearest gas station from my current location", "find all the cinemas within 1 km radius", "which buses will pass by me in the next 10 minutes?" and so on. While data objects in the first two examples are stationary, those in the last example are mobile. In this paper, we focus on queries issued by mobile users on relatively static data objects, because they are the most common kind of queries in LBSs. The movement of mobile clients presents many new research problems for location-dependent query processing there are several technical issues involved with the implementation of an LBS, which include locating the position of a mobile user, tracking and predicting movements, processing queries efficiently, and bounding location errors [2].

Consider a computing environment with a large number of location-aware mobile objects. We want to retrieve the mobile objects inside a set of user-defined spatial regions and continuously monitor the population of these windows over a time period. In this paper, we refer to such continuous queries as range-monitoring queries. Efficient processing of range-monitoring queries could enable many useful applications. similarly, we might want to track traffic condition pin some area and dispatch more police to the region if the number of vehicles inside exceeds a certain threshold. In such applications, it is highly desirable and sometime critical to provide accurate results and update them pin real time whenever mobile objects enter or exit the regions of interest. Unlike conventional range queries, a range-monitoring query is a continuous query. It stays active until it is terminated explicitly by the user. As objects continue to move, the query results change accordingly and require continuous updates. A simple strategy for computing range monitoring queries, and updates their results accordingly. This simple approach requires excessive location updates, and obviously is not scalable. Each location update consists of two expenses - mobile communication cost and server processing cost. If a battery-powered object has to constantly report its location, the battery would be exhausted very quickly. It is well-known that sending a wireless message consumes substantially more energy than running simple procedures [3].

Mobile devices with computational, storage, and wireless communication capabilities (such as PDAs) are becoming increasingly popular. At the same time, the technology behind positioning systems is constantly evolving, enabling the integration of low cost GPS devices in any portable unit. Consequently, new mobile computing applications are expected to emerge, allowing users to issue location-dependent queries in a ubiquitous manner. Consider, for instance, a user (mobile client) in an unfamiliar city, who would like to know the 10 closest restaurants. This is an instance of a k nearest neighbor (kNN) query, where the query point is the current location of the client and the set of data objects contains the city restaurants. Alternatively, the user may ask for all restaurants located within a certain distance, i.e., within 200 meters [5].

This is an instance of a range query. Spatial queries have been studied extensively in the past, and numerous algorithms exist (for processing snapshot queries on static data indexed by a spatial access method. Subsequent methods focused on moving queries (clients) and/or objects. The main idea is to return some additional information (e.g., more NNs expiry time validity region that determines the lifespan of the result. Thus, a moving client needs to issue another query only after the current result expires. These methods focus on single query processing, make certain



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assumptions about object movement and do not include mechanisms for maintenance of the query results (i.e., when the result expires, a new query must be issued). Recent research considers continuous monitoring of multiple queries over arbitrarily moving objects. In this setting, there is a central server that monitors the locations of both objects and queries. The task of the server is to report and continuously update the query results as the clients and the objects move. As an example, consider that the data objects are vacant cabs and the clients are pedestrians that wish to know their k closest free taxis until they hire one. [6]As the reverse case, the queries may correspond to vacant cabs, and each free taxi driver wishes to be continuously informed about his/her k closest pedestrians. Several monitoring methods have been proposed, covering both range and kNN queries. Some of these methods assume that objects issue updates whenever they move, while others consider that data objects have some computational capabilities, so that they inform the server only when their movement influences some query.

III. PROPOSED SYSTEM

We propose a novel hybrid LBS technique that integrates location cloaking and private information retrieval. We have also implemented and evaluated our proposal to determine its practicality on resource-constrained hardware. The results show that users can achieve a good compromise between privacy and computational efficiency with our technique unlike all other existing LBS proposals.



Fig 1: Proposed System Architecture

Our contribution is based on three fundamental points; First: while Dewri's matrix measurements was 320×320 grid covered 32×32 km2, where each cell reflects to 100×100 m area with 124.5 KB data transferred. This measurement of each cell will not achieve the accuracy that the user is looking for, as well as providing the user with unnecessary needed information. Figure 3 demonstrated the major idea about the previous restriction. Suppose the user was in location (x, y) and his inquires was about some restaurant or coffee, Dewri's system will provide him a matrix about all the red spots, which is far from his interest. In fact, what he need is just an information about the nearest neighbor from his location. As a result, we zoom this area to attain the goal of accuracy while maintaining the same quantity of transmitted data that is described in the rectangle shape in the same figure. The new similarity matrix utilized the main concept of Dewri's matrix 320×320 grid - where we will still in (124.5 KB) transferred data -, but each cell assimilates to 10×10 m area. This new cell will achieve the accuracy and efficiency results for user.



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ALGORITHMS

Step 1: Peer Search Step

- 1. Initially set number of peers required k=4, Area(A)=Amin// min area i.e search peers within min area.
- 2. Broadcast a request (containing ID of user U) to all neighboring peers.//req
- 3. Each peer generates a new record r that contains its ID, current location and a timestamp i.e. <p, (xp, yp), tp>
- 4. Send record r to user U. // r is result
- If ($(NumPeer(List) \le k) \& (Area(A) \le Amax)$)
 - For (i=0;i<=NumPeer(List);i++)
 - get (i)th records
 - a. Expand the Area(A) by adding some constant value.
 - b. Broadcast request to the peers.
 - c. Receive records from peers.
 - d. Update number of peers in List (i.e. k).
 - End for

End if

If (NumPeer(List)=NULL) // if no peer found

a. Select the user as having the latest timestamp.

End if

5. Send the records in List, k, location of user U, Area(A) and ID of peer having latest timestamp to central server(i.e. Location Anonymizing Server).

Step 2: Cloaked Area Step

- 1. If (NumPeer(List)>k)//i.e. is peers are found
 - a. Select one peer records.
 - b. Show a region A previously defined before searching peer(to show that peer is within that region).
- 2. Else//if peers are not found
 - a. Set latest timestamp = ID of user U
 - b. Add some constant value to U's latitude and longitude.
 - c. Determine region A=Amin//region will become min area previously defined in line 1 of algorithm

End if

3. If $(Area(A) \ge Amin)$

1.

- a. Return Area A as user's blurred location information
- b. Also return location of peer having latest timestamp.
- 4. Else
 - a. Extend Area A by random distance.
 - b. Return Area A as user's blurred location information
 - c. Also return location of peer having latest timestamp.
 - End if

Forward the request along with fake location information and bounded area to Location-based server.

MATHEMATICAL MODEL

 $\label{eq:second} \begin{array}{l} Fu = \{ Requested \ user \ for \ data \} \\ Fm = \{ Data \ providers \ upto \ n \} \\ Fb = \{ Fu^{Fm} \} \\ Since, \\ Input = \{ Fm \} \qquad // \ it \ should \ be \ DDL, \ DML, \ DCL \ commands \\ Output = \{ Fb \} \ // \ it \ should \ be \ a \ data \ table \ Success \ Condition, \\ Fu \ \neq |Fu| \ \neq NULL \end{array}$



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Fm≠|Fm|≠NULL Failure Condition,

If (F[i] ≠)

n[i]=null; }// user not available in database authentication time Fu[i] = =NULL, Fm [i]|= =NULL

IV. RESULTS AND DISCUSSION

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For the proposed system comparison we analyze the our work with some existing systems. The Searching technique might be affect to searching time complexity base on k-anonymity users. The given table 1 shows the comparative results of system

Cryptography	Data Size in	Encryption	Decryption
Technique/	MB	Time in	time in
Algorithm		Milliseconds	Milliseconds
IBE	100	254	265
Hashing	100	269	271
AES	100	310	305
Proposed	100	210	201

Table 1: Encryption technique comparison for proposed system

Here below graph show the system query performance with different number of queries



Fig 2: The cache hit ratio of the three cache replacement policies with increasing users query number.

Every simulation has numerous intervals (whose lengths are Poisson distributed), and during each interval, the simulator selects a random subset of mobile users to launch spatial queries (the query intervals are also based on the Poisson distribution). The subset size is controlled by the user defined mean number of queries per minute (e.g., 1000 queries per minute). To obtain results that closely correspond to realworld conditions, we obtained our simulation parameters from public data sets.



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V. CONCLUSION

In the given work, we proposed a dynamic grid system for providing privacy-preserving continuous LBS. Our DGS includes the query server and the service provider, and cryptographic functions to divide the whole query processing task into two parts that are performed separately by QS and SP, we give the survey of location-based privacy preserving. First, we summary the anonymity technologies, such as location k-anonymity, location obfuscation, location spatial cloaking, and Spatio-temporal cloaking. Then, we give the privacy attack models based on location server. Finally, we overview the privacy-aware location query processing.

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