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Hybrid Spatio Location Algorithm to Enhance Qos forHeterogeneous Mobile Devices in Location Based Services

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Abstract: In this mobile revolution era, there is more advancement in providing information to the mobile users through location based service models. Location Based Service is a type of information service accessed through mobile devices which provides the identification of people and object location. It guides mobile users when entering or leaving from a location to another. When information are transmitted from the Service provider to mobile user, there are some propagation delay due to the quality parameters such as bandwidth, jitter etc. The important issue dealt here is the location of mobile users needs to be acquired periodically. Sometimes the server which handles the location service request gets over burden when the mobile users are increased. It raises a complex and critical issue to properly locate with accuracy as well to provide the required service in an appropriate manner without time delay and loss of data. To maintain a balance between the Location Based Service and Quality of Service, This paper presents a Hybrid Spatio Location algorithm for providing quality service in a timely manner to the user precise requirements. The proposed algorithm reduces the irrelevant location information based on mobility and also its resource utilization enhances the quality of service by reducing the delay as with the immediate response in locating the user by identifying its shortest path.

Key words: Location based services, quality of service, complex, critical, manner

INTRODUCTION

The rapid growth of mobile devices such as mobile phones and other hand held devices have contributed to the development of an emerging class of services in the mobility environment called Location-Based Services (LBS). An LBS provides information which is relevant to the spatial location of a receiver. LBS constitute an innovative technological field which influences the way that people organize their mobility and other activities, in their geographical location. LBS is atype of information serviceand has a number of uses inmobile networkingtoday as an entertainment service which is accessible with hand held mobile devicesthrough themobile networkand it utilize information on the geographical position of the mobile device. It include services to identify a person or object in a particular location such as discovering the nearest ATM machine, nearest fuel station, restaurants etc. It includes personalized weather services and even location-based games. It is necessary to provide QoS in these networks by providing the proper radio bearer and also ensures that the handoff between base stations is smooth. However, the location information enclosed with the query request may lead to personal re-identification (Yan *et al*., 2010). Sometimes the request made by the user is not processed at the moment due to hand over arises at that time so they are unable to receive the service. In order to enhance the QoS, routing is required to find a shortest path that fulfils the QoS requirements of the query requested. If this path does not exist or if the routing protocol used is failed to find it, the query requested will be refused. The growth in demand for high speed and high quality multimedia communication is providing opportunities and challenges for next generation in wireless network designs and also entail diverse Quality of Service (QoS) requirements for different mobile applications (Yang *et al*., 2007). To provide QoS guaranteed services are most necessary for

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future wireless networks which include mobile ad hoc networks and wireless sensor networks. This study ensures the QoS in providing the information over kces.

Literalure review: The research objective is to allow the mobile user to request services with enhanced location anonymity to the service provider. Several location anonymity techniques have already been proposed (Hu and Xu, 2010). Based on the underlying methodologies, these techniques can be divided into three categories: Spatial Cloaking, Transformation, pseudonym. Spatial Cloaking is the most widely used privacy preserving technique for users accessing LBS. The main idea behind cloaking approaches is to blur a user's exact location in a larger cloaked region and to make them indistinguishable among the set of other users located in the cloaked region. Spatial cloaking can be grouped into Centralized and Decentralized, depending on where the cloaking is taking place.

Many existing approaches in spatial cloaking are based on a centralized architecture. These approaches rely on the existence of a trusted Intermediary server called location anonymizer which protects a user's private location and identity information from an untrusted location server (Gruteser and Grunwald, 2003; Mokbel *et al*., 2006; Gedik and Liu, 2008; Kalnis *et al*., 2007; Gedik and Liu 2005; Bettini *et al*., 2005). The main idea in centralized cloaking is to put an anonymizer between the users and the location server to prevent the server from learning users' precise location information and identities. Every location-based query is first sent to the anonymizer which transforms the user's exact location to a cloaked area (i.e., rectangle or circle) and forwards the query to the LBS server for that cloaked area. Depending on the approach, these parameters can be specified by each user independently or are chosen as system parameters. During the second phase, the privacy-aware location server which is modified to process a cloaked region query, generates a candidate list which is guaranteed to include the nearest neighbour of any point inside the cloaked region. This list is then transferred to the client side for further refinement to obtain the final result set (Khoshgozaran and Shahabi, 2010). The blurred spatial area can be based either on the k-anonymity concept (Samarati, 2001; Sweeney, 2002a, b) i.e., the area should contain at least k users or on a graph model that represents a road network (Duckham and Kulik, 2005). However the centralized approach has several disadvantages. This approach requires an anonymizer as sophisticated as the location server itself, to act as a proxy between users and the server per query. There are chances for single point of failure and bottleneck due to communication overhead. Another important drawback is that, in many scenarios cloaking users' location information in a larger region or among k-1 other users does not protect user's location information. This is due to the fact that based on user distributions in the space and the value of k (or similarly size of the cloaked region), precise user location can be derived using several techniques. To overcome these limitations, decentralized approaches have been proposed that construct cloaked region. The approaches proposed (Chow *et al*., 2006; Ghinita *et al*., 2007) assume users communicate with each other to collaboratively form a cloaked region. Finally, propose a graph model to represent possible user's locations and denote the cloaked region by a set of vertices in the graph. The client progressively gives more information about her precise location until the query result set reaches her desired accuracy. Hashem and Kulik, (2011) have developed a decentralized approach to protect user privacy during the access of LBSs using wireless ad-hoc networks. Users do not need to trust any involved party including their peers, the LSP or the infrastructure provider. It exploits the wireless advantage that all users in communication range can overhear a message to anonymize the communication among users.

In another study (Kang *et al*., 2009) the location-based alert service consistently observe the location of a mobile user and alert the user when approaching and entering into or leaving from a specified region or a selected area and provide certain services previously set by the user. Two effective location acquisition algorithms for the location based alert service namely the speed-based acquisition algorithm and the angle-based acquisition algorithm. The proposed algorithms (Kang *et al*., 2009) are to decrease the communication overload by controlling the location acquisition time interval based on the movement of the users. The speed-based acquisition algorithm adjusts the location acquisition time interval based on the speed of a user so that when the user is moving faster the location acquisition time interval is shortened and vice versa. The angle-based acquisition algorithm considers only the alert areas which are on the direction of a mobile user to adjust the location acquisition time interval. Location acquisition algorithms aim at minimizing the overhead on the network load and communication cost when acquiring location information of users (Jin and Nam, 2008). By efficiently controlling the location acquisition time intervals, unnecessary location information is not gathered and the number of location acquisitions itself is reduced. The static location acquisition algorithm acquires location information by using a fixed time interval. The static algorithm is simple and easy to apply but as the overhead of the server increases together with the increase in the number of users, the algorithm becomes not suitable for the services that might handle a large number of users. The distance-based acquisition algorithm dynamically controls the location acquisition time interval in the ratio of a mobile user's recent moving distances and thus can be applied to irregular moving speed circumstances where a mobile user might be moving with different speeds from time to time. But with all these methods, there are drawbacks due to the increased level of users.In LBS system (Ilyas and Vijayakumar, 2012) presented is 2D method by assuming the cloaked area as circle which will determine the wavering location of a mobile user but data duplication occurs due to its insufficient coordinate values for determining other parameter relates mobile user.

Our work is similar to (Ilyas and Vijayakumar, 2012) but with improved communication and response with a different method not related to cloaking, the mobile user area is treated as sphere with clockwise rotation. Moreover Simulation results show that it has less communication overhead and high quality of service.

MATERIALS AND METHODS

Improved system and location discovery: The proposed new system that employs the supremacy of ad-hoc networking for the wavering user location from third party LBS servers by providing the 3D approach by assuming the arbitrary area as sphere, henceforth three coordinates they determine the wavering location as well as the data consumed by the end user from the LBS server. Sometimes, the received data may not coincide with the actual location service rendered by the server due to its mobility. In addition to this, the distance between the Service available area and the Mobile User is calculated and displayed at the user terminal. Mobile User and each participating users determines their location as surrounding spheres, where the user location cannot be identified by a third party vendor. The user, who wants to access the LBS service, first determines the size of the sphere namely Global Spherical Area in terms of its radius. Also it determines 'K-1' number of participating mobile users for encircling the location. The arbitrary rotation process is executed under two stages. Initially, the query maker calculates its Spherical Rotated Area (SRA). Then it sends a broadcast message to all its nodes which are normally one hope away from the user location, the parameters of the initial GRA. On receiving the message, each peer calculates its SRA. Then it performs a spatial 'within' operation to identify that GRA contains its SRA. The peer returns its SRA along with Boolean result of the

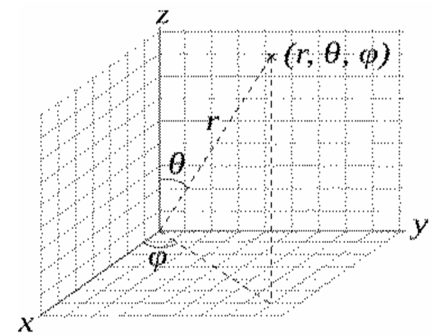

Fig. 1: Self rotation

spatial operation. The query maker then checks for the K-uncertainty and execute the process with hope distances > 1 until the K-uncertainty is met. The GRA will be a minimum radii circle which encloses all SRAs. Then our Hybrid Spatio Location Algorithm selects a query requestor to forward the query along with GRA to LBS Server.

Computing SRA: The algorithm in the proposed approach generates a spherical arbitrary area which contains the peer's exact location anywhere in the sphere. Let (X,Y) be the exact location of the mobile user. The location might be received from GPS or any other means. In order to obtain maximum uncertainty, rotate the point (X,Y) with a rotation in the shape of sphere. But if such a sphere is generated, in case challenger can easily recognize the location of the user as it may be centre of the sphere. So we generate a pseudo sphere with centre (x_0,y_0) that must include the point (X,Y) any where in the sphere. Let R be the radius of the self rotated sphere (Fig. 1). In order to find a random point (x_0,y_0), we randomly choose a distance value r. Let r = Random value where $0<r\leq R$, θ = Random value where $0\leq\theta\leq\pi$ and φ= Random Value where $0°\leq\varphi<360°$ (2π rad):

$$X_i = X_0 + r \sin\theta \cos\varphi$$

$$Y_i = Y_0 + r \sin\theta \sin\varphi$$

$$Z_i = Z_0 + r \cos\theta$$

where $r\leq R$. The rotated arbitrary area (spherical area) with radius R, then can be calculated. This ensures that the new location of the mobile user is within or on the boundary of the newly created undetermined sphere with centre coordinates (X_0, Y_0, Z_0).

RESULTS AND DISCUSSION

Computing GRA: Let K_l and K_h be minimum and maximum uncertainty level of the query maker. Also let R_l and R_h be the lower and upper radius of the circular area which the query maker wants to wavering which we call them as Globally Rotated Area (GRA). R is selected in such a way that it balances the K-uncertainty and a best area which includes all other 'K-1' self rotated nodes. At the initial step, the Query maker pass a message to all its 1-hop nodes requesting its pseudonym, the wavering origin (X_{pi}, Y_{Pi}) of the Self Rotated Area (SRA) and the radius of SRA; if SRA of the peer Pi is within the Globally Rotated Area (GRA). Initially the message is sent down to all 1-hop nodes with a value R. If the query maker fails to find sufficient number of SRAs within the limits of GRA, query maker either decrease the value of K or it increase the value of R. This process continues until the value of K >= K_l and the value of R reaches R_h.

The hybrid spatio location algorithm: This research introduced an algorithm to compute the Globally Rotated Area of the query maker. This is an algorithm which executes until the desired level of uncertainty is obtained. Assuming that 'K' is the desired uncertainty level of i and R_l and R_h be the lowest and highest radius of the Globally Cloaked Area, i.e., the area of globally rotated area is $\pi R_l^2 \leq GRA \leq \pi Rh^2$. To compute the GRA, we have to find the smallest sphere r that encloses a K-subset (including it's SRA) from the n SRAs. The SRA of a user i is described by its undetermined centre (X_i Y_i) and the radius r_i. If the initial GRA with radius R_l and query maker's undetermined centre ($X_0 Y_0$) is not able to contain all K-1 SRAs then the value of R (Radius of GRA) is incremented in each step until R_l reaches the value R_h. The developed Hybrid Spatio Location Algorithm (HSLA) with a time complexity of (0.8+n) where n is the hop count. Initially, the message is passed to all 1-hop nodes. All group of users receiving this message, computes its own SRA, perform a spatial 'within' operation with GRA (The 'Within' predicate in spatial geometry returns t (TRUE) if the first geometry is completely inside the second geometry). If the result of the 'Within' operation is true, then function returns the undetermined centre of the SRA and the radius of the SRA. The numbers of SRAs are counted after each hop iteration, if the number of SRAs are below the K-uncertainty level, then hop is incremented and continued the process until the system desired parameter h_{max} is reached.

Hybrid spatio location algorithm

Input parameters: Hmax : The maximum node count ; K : The uncertainty level; R_l : The upper radius value of the GRA ; R_h : The lower radius value of the GRA; X_0, Y_0 : Coordinates of Query maker x_0 , y_0 : Centre of the GRA circle; RGRA: Radius of GRA; X_i, Y_i , R: Reference Values

Output parameters: A : The Globally Rotated Area of the Query maker that covers K-SRAs
X_i : X-coordinate of the wavering user position; Y ; Y-coordinate of the wavering user position ;R : Radius of SRA (undetermined sphere)

Algorithm:

1. A á
2. Let S be the set of SRA
3. S á
   x X-coordinate of the user position from GPS
   y Y-coordinate of the user position from GPS
   z Z-coordinate of the user position from GPS

Let r = Random value where $0 < r \leq R$, θ = Random value where $0 \leq \theta \leq \pi$, φ= Random Value where $0° \leq \varphi < 360°$ (2π rad), R = Required radius of the undetermined circle (SRA)

$X_i = X_0 + r \sin\theta \cos\varphi$
$Y_i = Y_0 + r \sin\theta \sin\varphi$
$Z_i = Z_0 + r \cos$ è
Where r $\sqrt{x^2+y^2+z^2}$, θ=tan'(-1√(x'2+y'2)/z) and $\varphi = \tan^{-1} y/x$
Compute Spatial Within operation for SRA with RGRA as radius
Return xi, yi, z_i and R as reference and Return true if spatial within operation is true

4. x_0 X-coordinate of the centre of SRA of Query maker
5. y_0 Y- coordinate of the centre of SRA of Query maker
6. z_0 Z -coordinate of the SRA of Query maker
7. AGRA Initial Area of GRA with circle R_l
8. for $R = R_l$ to R_h step 1 do
9. for h = 1 to h_{max} step 1 do
   i. if Compute SRA = true then add SRA to S
   ii. Count Total count of Nodes after Computing their SRAs and within the geometrical boundary of AGRA
   iii. if Count < K then continue else stop
10. if count < K the continue to step 8 else stop
11. Stop

Once the Optimal GRA has been computed, the query maker randomly finds a query requestor from the set of available nodes within the GRA. The nodes are addressed with their pseudonyms that are sent back from nodes, during the process of computing SRAs along with QoS parameters. The query is then forwarded to the query requestor and it is submitted to the LBS server with GRA. Since the GRA is a wavering area, challenger may find it difficult to locate the query maker. The LBS server returns a list of results applicable for this GRA. Therefore the obtained set of results the query maker filter the values that he is concerned.

Evaluation: The experimental results of our system are compared with greedy based computation in (Illyas and Vijayakumar, 2012). The time complexity of Greedy algorithm is O(log n) where as our system the time complexity is determined as O(h) where h is the hop of the nodes that are included in the

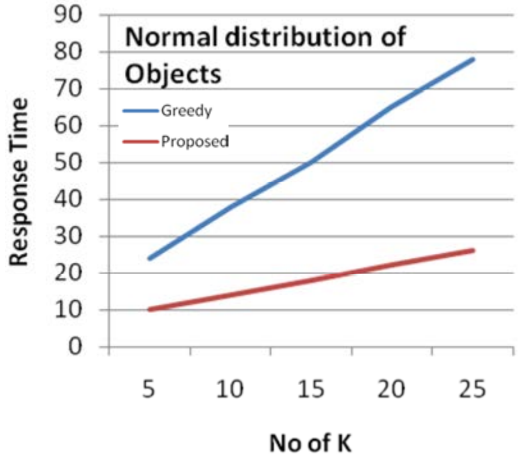

Fig. 2: Mean Response time for K subset of 25 SRAs

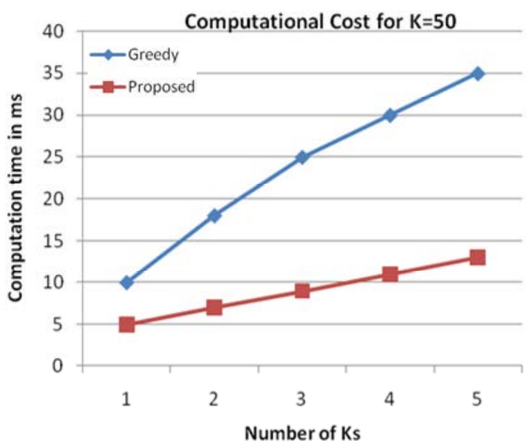

Fig. 3: Computational cost for a subset of 50 SRAs

the GRA. The simulation software OMNET++ is used for the experiments on a Pentium 2.8 GHz and 2 GB RAM with varying K and R values for GRA. For all K the system has shown remarkable performance when compared to Greedy in (Illyas and Vijayakumar, 2012), because all SRA computation and the selection of optimal GRA are done at peers simultaneously, instead of computing at the system of query initiator which ensures that QoS parameters are verified. Figure 2 shows the average response time for Greedy algorithm and for our Hybrid algorithm. Figure 3 shows the computational cost for generating GRA for a set of 100 users. Since, in our system, the SRAs are calculated at the user node such that the value of the uncertainty level K or the numbers of users does not affect the total computational cost. All the computations are distributed in our system simultaneously. Where as in the case Greedy the GRA is calculated by the query initiator and the computational cost of GRA is directly proportional to the value of and the number of peers.

CONCLUSION

In this research study, the Hybrid Spatio Location algorithm illustrated which need less computation at user node, also ensures the Location Based Service request are processed along with assured level of QoS. Hence, the query results are processed in a timely manner. In this case, the query maker does not want to trust anyone including the other user nodes and any third party service providers. Even users do not reveal their absolute locations, instead presents only their self rotated areas. The system presented here fully distributes all computations and even GRA calculation is done at peers. Evaluation of the proposed system with different size of K-uncertainty level which shows good accuracy and optimal results.

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