Section: Research Paper

Quality of Service Improvement for Diverse Mobile Devices Using Hybrid Spatio Framework (HSLA) Algorithm

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Abstract

With the growing availability of mobile devices, there is also rising demand for location-dependent applications. To fulfill this demand, different Location Dependent Services (LDSs) have been developed in recent times. In this submitted work, HSLA is proposed for yielding the service in time in addition to the user's precise quality demands. In order to use the LDS service, the customer must first choose the radius of the sphere known as the Global Spherical Area. The query maker randomly selects a query requester from the set of available nodes once the optimal GRA is determined. When computing the Spherical Rotated Area (SRAs) together with the QoS parameters, the nodes are identified by their pseudonyms that are sent back from the nodes. The query is then returned to the requester and sent together with GRA to the LDS server. The challenger may have trouble identifying the query creator because the GRA is an undefined area. The LDS server then provides a set of outcomes suitable for this GRA. Hence the query maker filters out the values, he is concerned about, from the set of results obtained. But it does not take the QoS constraints into consideration for achieving resourceful LDSs.

Keywords - *LDS , GQPSO, Jitter, QoS, Spherical Rotated Area, Global Spherical Area*

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1. INTRODUCTION

Through the great Location Dependent Service (LDS) models, information delivery to mobile consumers has advanced significantly in this period of the mobile revolution. The LDSs is a category of information service that can be accessed by portable devices like smart phones and other hand-held gadgets, and it offers location-dependent services for both persons and objects[1][2]. When approaching, entering, or departing from one site to another, it directs mobile users. There is some propagation delay involved in the information transmission from the service provider to the end user in this case, so it is necessary to periodically determine the locations of mobile users. When the number of users rises, the server that processes location service requests occasionally becomes overworked[3][4].

Through the great Location Dependent Service (LDSs) models, information delivery to mobile consumers has advanced significantly in this period of the mobile revolution [5]. The LDSs is a category of information service that can be accessed by portable devices like smart phones and other hand-held gadgets, and it offers location-based services for both persons and objects. It guides mobile users as they move from one site to another whether approaching, entering, or leaving. There is a propagation delay involved in the information transmission from the service provider to the end user, so it is necessary to periodically determine the locations of mobile users. When there are more users, the server that handles location service requests can get overworked[6][7]. As a result, it becomes difficult and crucial to accurately locate the object and offer the necessary service without delay or data loss in a timely manner. The suggested method outlines a Hybrid Spatio Location Algorithm (HSLA) for meeting both the user's exact quality requirements and delivering the service promptly. The chosen approach decreases the amount of unnecessary location data based on movement and improves QoS by speeding up the process of locating the user by figuring out their quickest route.

Overall resource use should be taken into account while making QoS routing decisions[8] so that this algorithm minimizes the end-to-end delay[9] in service for each query and minimize the average delay at the same time.

1.1. LDSs in Mobile Network

The rapid growth of mobile devices, like mobile phones and other hand held devices have provided to the establishment of a raised class of services in the mobility environment, which is termed as Location-Dependent Services (LDS)[9][10][11]. LDS is a variety of information service and has many usage in mobile networking now a days, as an entertainment service, which can be used with the hand held mobile devices via the mobile network, which, in turn, uses these information on the geographical position of the hand held device [12][13]. Examples of such LDS involves the identify which is closer to options, like a cellular telephone user looking for an information regarding the restaurants gives only the set of choices in the nearby places [14]. An architecture that includes the following five elements is used to execute an LDS service: a mobile device (such as a PDA or smart phone), an applications and services provider, a communication link, a positioning system (GPS receiver), and a data provider [15][16]. The user uses their mobile device to access the data. This could be a mobile phone, a PDA, a desktop, laptop, or a GPS system for a vehicle.

It falls into one of these two groups: multipurpose devices or single-purpose devices. Devices with single-purpose were made with a certain purpose in mind and cannot be used for another[17]. The multipurpose category of devices is utilized for the doing the work other than LDS, like cell phones, PDAs etc. The communication network is utilized for the transmission of the user's requests from the mobile device to the corresponding service provider and the latter's revert back to the former. Nevertheless, the location information disclosed with the query request may proceed ahead to personal re-identification [18][19]. Here at times there is feasibility for hacker to join the location of few specific individual which depends on the external knowledge. Additionally, the fast adoption of other wireless technologies like WiFi (802.11) presents cellular operators with both a danger and an opportunity and is likely to influence the future development of LDS. The angle-based and speed-based algorithms[20] are two popular location acquisition strategies that are utilized in many recent research.

The speed-centered algorithm manages the time of location acquisition which will be paused according to the user's speed, so that the user's time intermission is shortened for reaching the location acquisition, and conversely[21][22]. When choosing a location acquisition time interval, the angle-based acquisition algorithm only considers locations that a mobile user may access. These algorithms concentrate on reducing network load overhead, which reduces announcement overload and communication expense when acquiring users' whereabouts. The fixed time interval is utilized by the static location acquisition algorithm to obtain the whereabouts[23][24]. The static approach is straightforward and simple to implement, but it is unsuitable for services that manage large numbers of users since server overhead increases as the number of users increases. The distance-based acquisition[25] technique can be applied to circumstances where a mobile user may occasionally move at different rates because it dynamically adjusts the location acquisition time interval in relation to the mobile user's most recent movement. But with all these methods, there are disadvantages because of the increased user count[26].

2. PROPOSED METHODOLOGY

2.1 Improved System and Location Discovery

In LDS system 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[27]. The proposed system utilizes the supremacy of ad-hoc communication networking for the wavering individuals' location from the servers used by third party LDS 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 LDS server. Sometimes, the received data may not coincide with the actual location service rendered by the server due to its mobility[28]. In addition to this, the distance between the service available area and the mobile user is calculated and displayed at the user terminal.

In order to ensure that a hacker cannot detect the location of a mobile user or any participating user, they individually define their own location as nearby spheres. When a user wishes to use the LDS service, they must first calculate the radius of the "global spherical area" sphere. In order to circle the location, it also calculates K - 1 the total number of participating mobile users. There are two stages to the arbitrary rotation procedure. The query creator first determines its Spherical Rotated Area (SRA)[29].

Then it broadcasts the original Globally Rotated Area's (GRA)[30] parameters to all of its nodes, which are typically located one hop away from the user location. Each peer determines its SRA as soon as it receives the message. It then uses a spatial "inside" operation to determine whether the GRA contains the SRA. In addition to the Boolean outcome of the spatial operation, the peer also returns its SRA. 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 the proposed HSLA selects a query requester to forward the query along with GRA to LDS Server.

2.2. Computing SRA

The algorithm in the proposed approach generates a spherical arbitrary area which contains the peer's any precise spot within the sphere.

Let the precise position of the mobile user be (X,Y). GPS or any other device may be used to determine the location. Rotate the point (X,Y) with a sphere-shaped rotation to get the most uncertainty possible. However, if such a sphere is created, the adversary may readily identify the user's location since it may be at the centre of the sphere. Therefore, we create a pseudo-sphere with the point (X,Y) present anyplace on the sphere and its centre at (x_0, y_0). Let R be the sphere's radius after self-rotation. We select a distance value r at random in order to locate the random point (x_0, y_0).

Let r θ, and φ are the randomly selected values with their respective values in within range $0 < r \leq ,R$, $0 \leq \theta \leq \pi$, and, $0° \leq \varphi < 360°$ (2π rad)

$$X_i = X_O + r \sin\theta \cos\varphi \quad \ldots\ldots\ldots\ldots (1)$$

$$Y_i = Y_O + r \sin\theta \sin\varphi \quad \ldots\ldots\ldots\ldots (2)$$

$$Z_i = Z_O + r \cos\theta \quad \ldots\ldots\ldots\ldots (3)$$

Then, it is possible to determine the rotating arbitrary (spherical) area having radius R. This guarantees that the mobile user's new location is either inside or on the edge of the freshly constructed undefined sphere with centre coordinates (X_0, Y_0, Z_0)

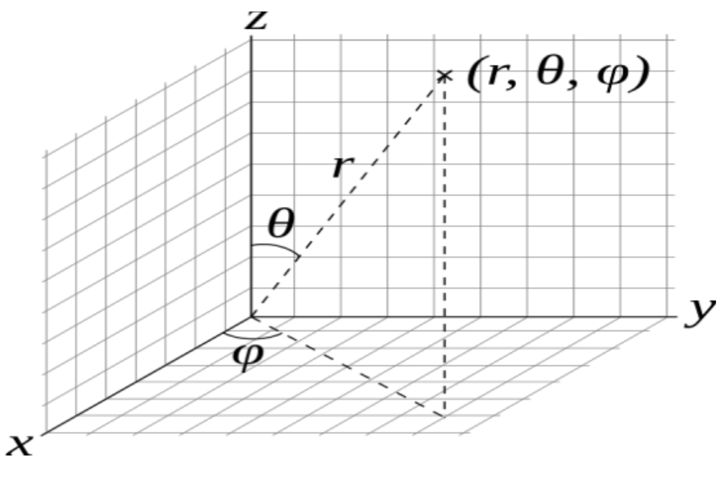

Figure 1 : Self Rotation

2.3. 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 P_i is within the GRA.

Let K_h and K_l represent the query maker's maximum and minimal levels of uncertainty. Additionally, let K_h and K_l be the upper and lower radius of the circular region that the query creator wants to falter, which we refer to as a GRA. R is chosen so that it strikes a balance between the K-uncertainty[31][32] and the best region, which contains all other K-1 self-rotated nodes. If the Self-Rotated Area (SRA) of the peer Pi is within the GRA, the query maker sends this information to all of its (1-hop) nodes asking for its pseudonym, the wavering origin (X_{pi}, Y_{Pi}), and the radius of the SRA. The message is initially broadcast with a value R to all 1-hop nodes. If not enough SRAs are found within the boundaries of GRA, the query maker either increases R or decreases K . This method keeps going until R reaches R_h and $K >= K_l$

2.4. The Hybrid Spatio Location Algorithm

The suggested study developed an algorithm to determine the query maker's globally rotated area. Until the required amount of uncertainty is reached, this algorithm runs. Assuming that Rh and Rl are the highest and lowest radii of the Globally Cloaked Area[33][34], respectively, and that K represents the desired level of uncertainty of i, hence the area of GRA will be $\pi R_{l2} \leq$ GRA $\leq \pi R_{h2}$. The smallest sphere (r) that encompasses a K-subset of the n SRAs, including its SRA, must be identified in order to calculate the GRA. By its radius (r_i) and uncertain centre (X_i, Y_i) , the SRA of a user i is explained. The value of R is raised step by step until R_l reaches to R_h, if the initial GRA (having radius R_1) and the query maker's uncertain centre (X_O, Y_O) is unable to incorporate all K-1 SRAs. The proposed Hybrid Spatio Location algorithm (HSLA), with n number of hops, has a temporal complexity[35][36] of (0.8+n).

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.

Input Parameters

h_{max} : Max node count ;

K : Uncertainty level;

R_l: Upper radius value of GRA ;

R_h : Lower radius value of GRA ;

X_O, Y_O : Query maker Coordinates.

x_O , y_O : Centre of GRA circle;

R_{GRA}: Radius of GRA;

X_i, Y_i, R : Reference Values

Output Parameters:

A : The Query Maker's Globally Rotated Area that includes K-SRAs

X_i : X-coordinate against wavering user position;

Y_i: Y-coordinate against wavering user position ;

R : Radius of SRA (undetermined sphere)

Algorithm:

1. A← α

2. Let S be the set of SRA

3. S← α

    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)

$$X_i = X_O + r \sin\theta \cos\varphi \quad \ldots\ldots\ldots\ldots\ldots \quad (4)$$

$$Y_i = Y_O + r \sin\theta \sin\varphi \quad \ldots\ldots\ldots\ldots\ldots \quad (5)$$

$$Z_i = Z_O + r \cos\theta \quad \ldots\ldots\ldots\ldots\ldots \quad (6)$$

Where $r = \sqrt{x^2 + y^2 + z^2}$, $\theta = \tan^{-1}\frac{\sqrt{x^2+y^2}}{z}$, and $\varphi = \tan^{-1}\frac{y}{x}$

Compute Spatial Within operation for SRA with RGRA as radius Return x_i, y_i, z_i and R as reference and Return true if spatial within operation is true.

4. x_O ←X-coordinate against centre of SRA of Query maker

5. y_O ←Y- coordinate against centre of SRA of Query maker

6. z_O← Z -coordinate of the SRA of Query maker

7. AGRA Initial Area of GRA with circle R_1

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 requester[37] 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 requester, and it is submitted to the LDS server with GRA. Since the GRA is a wavering area, challenger may find it difficult to locate the query maker. The LDS 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.

3. EXPERIMENTAL ANALYSIS

The experimentation results of the proposed system is compared with the Greedy based computation submitted in [38]. The time complexity of Greedy algorithm is O(log n) whereas in the proposed model, it is determined as O(h), where h where h is the distance travelled by the nodes in the GRA. For experimental analysis, a Pentium 2.8 GHz computer with 2 GB of RAM and the simulation programme OMNET++ are utilized with different K and R values for GRA. For all K, the system has manifested exceptional performance compared to Greedy in, because all SRA calculations as well as the (best) GRA selection are performed simultaneously at peers, rather than computing on the query initiator's system, which ensures that the QoS parameters are verified.

Table 1 : Response time vs number of k subset of 25 SRAs

Number of K	Response time (ms)	
	Greedy computation	HSLA
1	15	20
2	18	25
3	19	28
4	21	30
5	23	30

Table 1 represented the response time for number of k. The graphical representation of response time is shown in Figure 2, which shows the average response time for Greedy algorithm and for the proposed Hybrid algorithm.

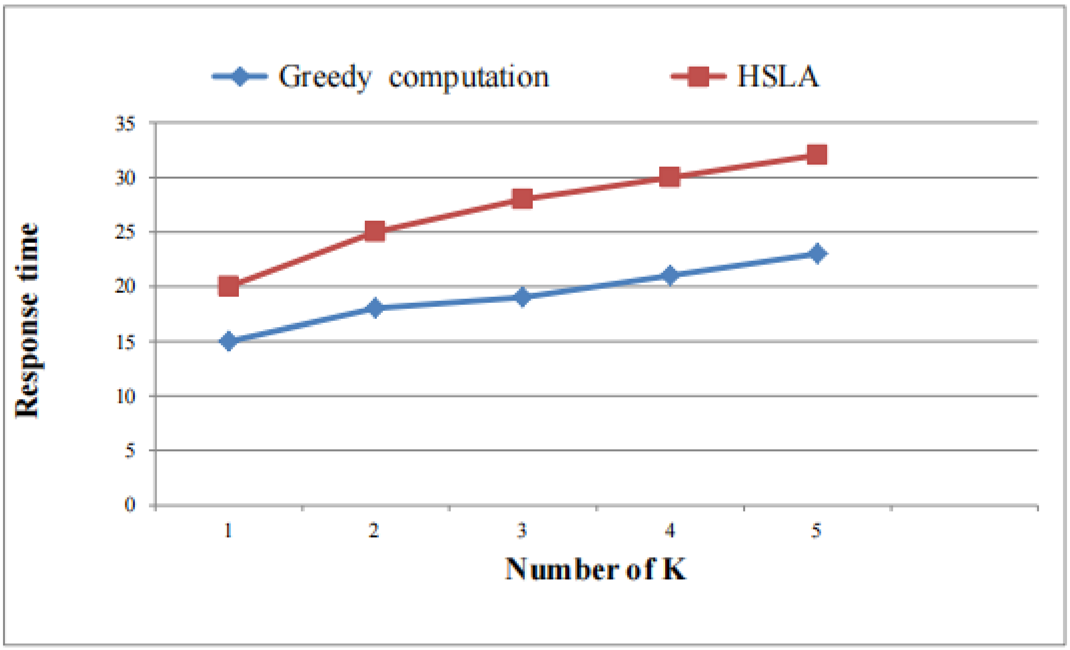

Figure 2 : Mean Response time for K subset of 25 SRAs

Table 2 : Computation time vs number of K subset of 25 SRAs

Number of K	Computation time (ms)	
	Greedy computation	HSLA
1	25	15
2	28	18
3	29	19
4	31	21.5
5	33	23

Table 2 represented the computation time for number of k. The graphical representations of these values are shown in Figure 3.

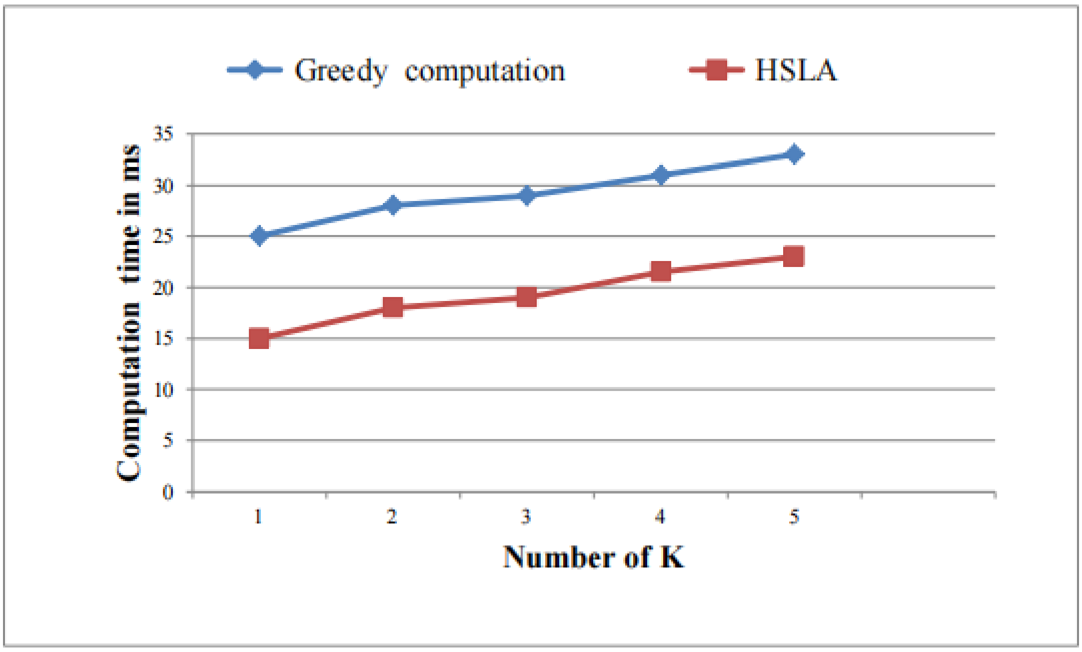

Figure 3 : Computational time for a subset of 25 SRAs

Table 3 represented the packet delivery ratio for number of k. The graphical representation of PDR values are shown in Figure 4, which indicates the time for generating GRA for 100 users.

Table 3 : Packet delivery ratio Vs. number of K subset of 25 SRAs

Number of K	Computation time (ms)	
	Greedy computation	HSLA
1	72	74
2	75	76.51
3	76	78.41
4	78	80.49
5	80	81.56

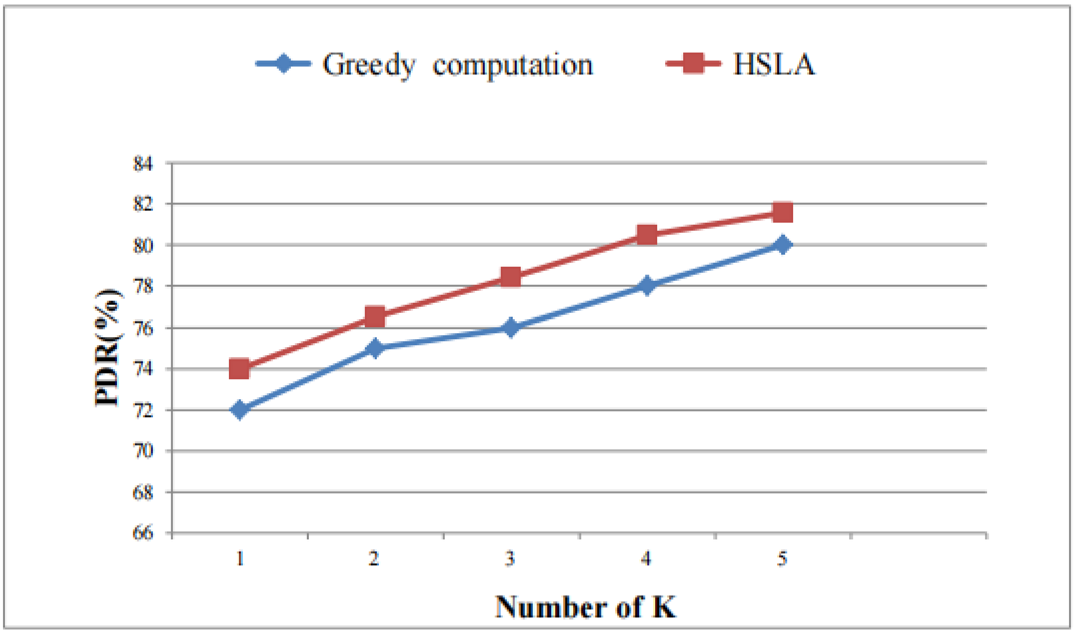

Figure 4 : PDR for K subset of 25 SRAs

Figure 4 shows the packet delivery ratio of proposed and existing system. Since the SRAs are computed at the user node in the proposed system, neither the value of the uncertainty level K nor the count of users has an impact on the overall computational expense. In the proposed approach, entire computations are spread simultaneously. As opposed to Greedy, where the inquiry initiator determines the GRA and its processing cost is directly proportional to K and sum count of peers, n.

Table 4 : Response time vs number of k subset of 50 SRAs

Number of K	Response time (ms)	
	Greedy computation	HSLA
1	16	22
2	17	26
3	20	28
4	23	33
5	25	34

Table 4 represented the response time for number of k. The graphical representation of response time is shown in Figure 5.

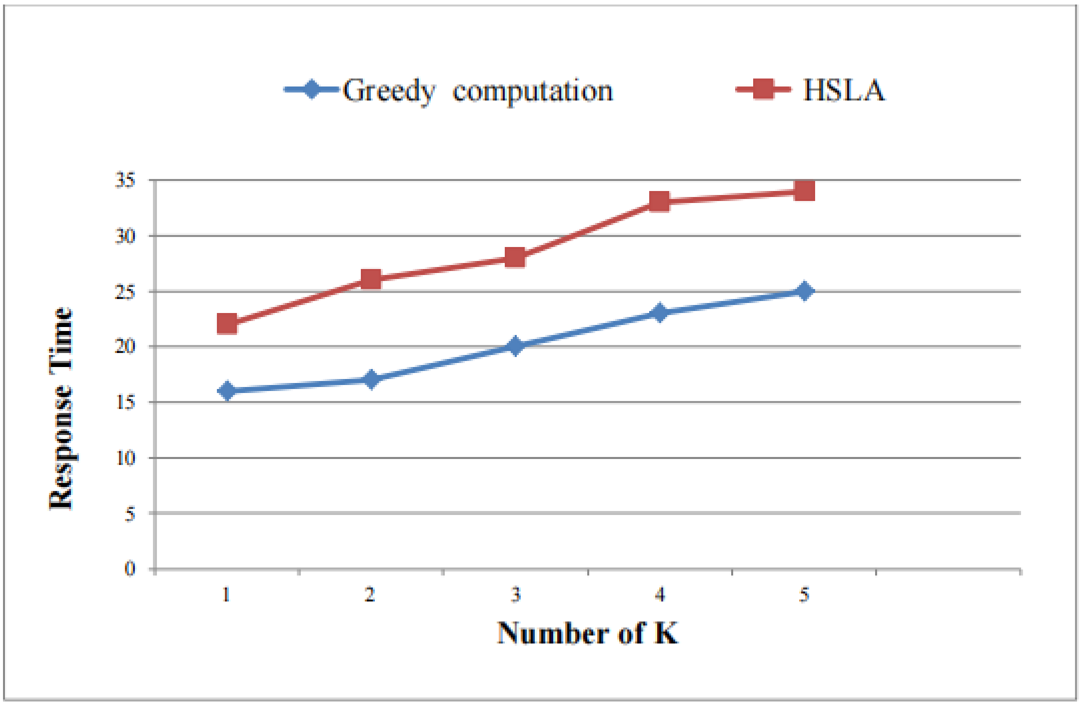

Figure 5 : Mean Response time for k subset of 50 SRAs

Table 5 : Computation time vs number of k subset of 25 SRAs

Number of K	Computation time (ms)	
	Greedy computation	HSLA
1	22	20
2	24	21
3	25	23
4	28	26
5	31	28

Table 5 represented the computation time for number of k. The graphical representation of computation time is shown in Figure 6.

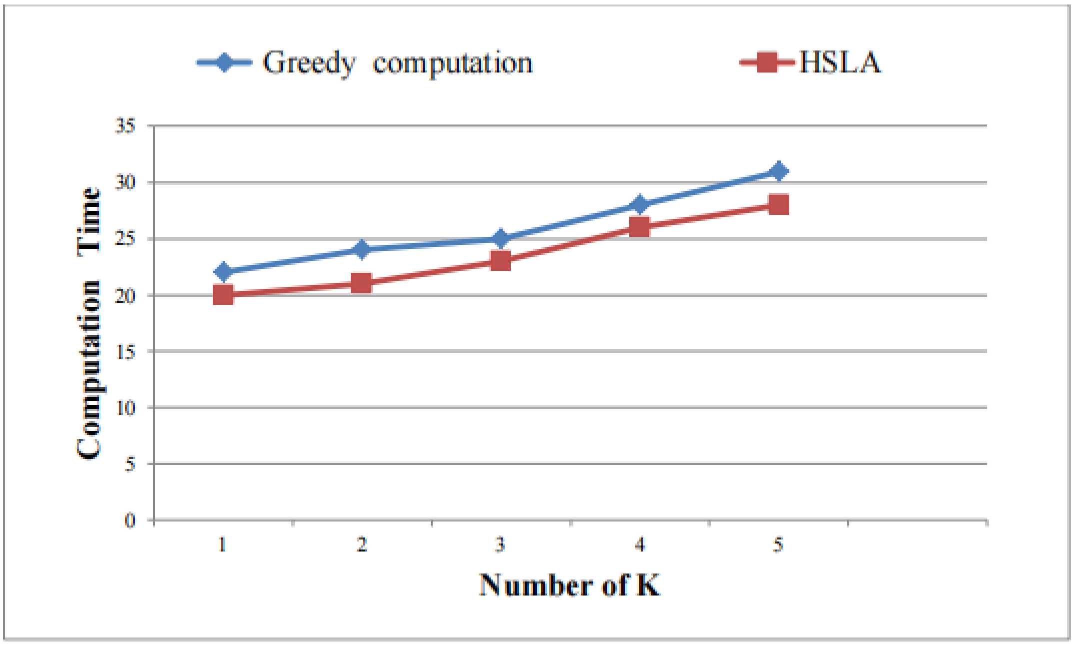

Figure 6 : Computation time for k subset of 50 SRAs

Table 6 : Packet delivery ratio vs number of k subset of 25 SRAs

Number of K	Computation time (ms)	
	Greedy computation	HSLA
1	22	20
2	24	21
3	25	23
4	28	26
5	31	28

Table 6 represented the PDR for number of k. The graphical representation of PDR is shown in Figure 7.

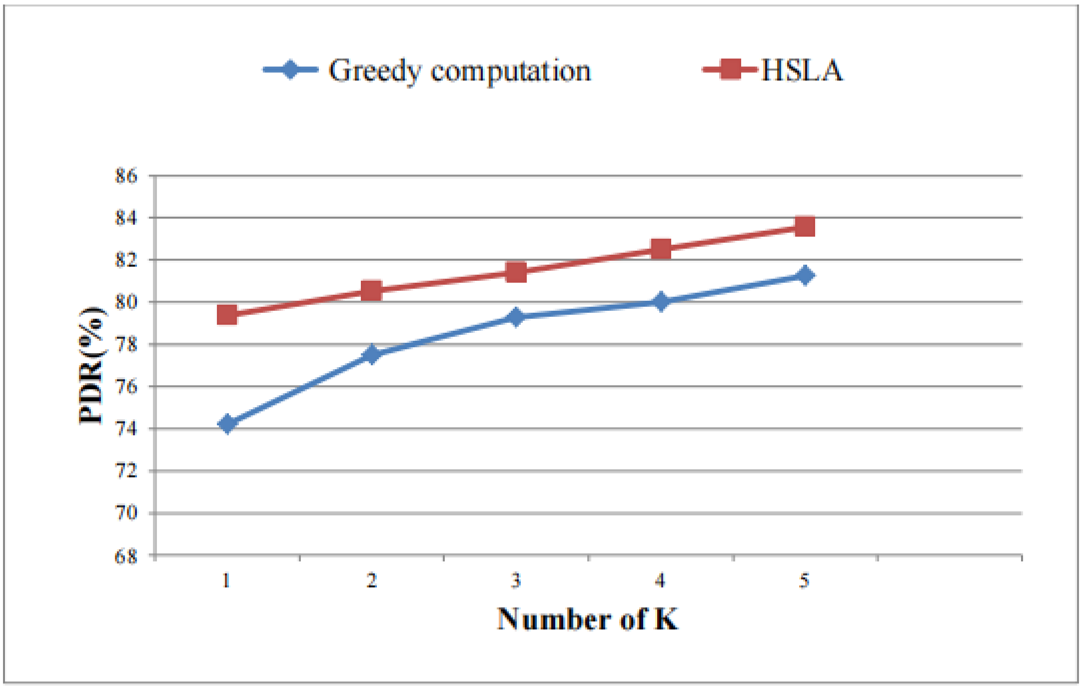

Figure 7 : Packet delivery ratio for a subset of 50 SRAs

Figures 5, 6, 7 show the average response time, computation time and packet deliver ratio of Greedy algorithm and for Hybrid algorithm. From the result the proposed system achieves better performance for a subset of 50 SRAs when compared with existing system.By determining its shortest path, the suggested approach locates the user more quickly by lowering the amount of unnecessary location data based on movement.

4. SUMMARY

In this research work, the HSLA 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.

The query creator in this instance doesn't want to trust anyone, not even the other user nodes or any outside service providers. Even users just display their self-rotated areas rather than their exact positions. The technique described here completely distributes all calculation, including figuring out GRA , which is carried out by peers. Evaluation of the suggested technique with various K-uncertainty level sizes demonstrates good accuracy and produces the best outcomes.

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