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Location Based Advertising Promotions on Mobile Device

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Abstract: The mobile applications are getting popular nowadays and the applications which are using location based service have attracted attention of researchers. These applications use geographical position of a mobile device. Mobile advertising is one of these types of applications that allows an advertiser to promote products or services to targeted customer efficiently. In the proposed application, the mobile client enables the application to get offers or coupons from nearby merchants on mobile device and receives the offers. This application is using the continuous monitoring of moving range queries over static data objects ,i.e. a scenario where the queries are constantly moving whereas the data objects do not change their locations. A distance based circular range query returns the objects that lie within the radius of the query location. It is using the concept of safe zone to compute the results. The safe zone of a query is the area in which the results of the query remain unchanged, while the query remains inside it. Hence, the query does not need to be reevaluated unless it leaves the safe zone. It reduces the cost of query evaluation as well as of data transfer.

Keywords: Continuous range queries, guard objects, mobile advertising, safe zone, location based services

I.INTRODUCTION

As the prices of mobile devices with computation and storage capabilities are getting low and inexpensive position locators and network bandwidth is available at affordable cost, location based services are in demand. Location based services refer to 'a set of applications that exploit the knowledge of the geographical position of a mobile device in order to provide services based on that information[1].

Location based services are using a spatial location that can be represented in the used latitude-longitude-altitude coordinate system. Latitude is defined as 0-90 degrees North or South of the equator and longitude as 0-180 degrees East or West of the prime meridian, that passes through the Greenwich, England. Altitude is represented in meters above sea level [1].

The proposed application is client-server application. In this application the mobile client is considered as query and wherever it will go, the nearby advertisers will provide the coupons or offers on mobile. The location of mobile client is continuously changing and because of that the cost of monitoring and tracking the location of a mobile client which has issued query is very high as recomputation is required. So the technique of safe zone is used. When the query remains inside it, the results of the query are unchanged. Hence the query does not need to be reevaluated unless it leaves the safe zone [2]. Since the queries are considering the result as the objects in the range around itself ,such queries are circular range queries.

For the mobile user, the examples of location based services can be:

- To determine the nearest business or service, such as an bank or hotel.
- Receiving alerts, such as notification of sale in shopping mall or news of traffic congestion nearby.
- Friend finder or receiving the location of the stolen phone [1].

Client-Server model[2]:

In this model, the clients issue queries and the central server is responsible for the computation of these queries. It may be assumed that the server processes the query in the main-memory, i.e., the data objects are stored in the main-memory along with other relevant information needed to efficiently update the results. However, such systems require that the server continuously maintains this information in the main memory in order to provide the service. It neither requires that the data objects are stored in the main-memory nor do it maintains any query information in the main-memory. One advantage of this is that the service can be run on demand. Since the objects are stored in the secondary memory and no main-memory information is maintained, the server can go to sleep mode if there is no query. When a query arrives, the server computes the results and the safe zone, which are then sent to the client. The safe zone is an area such that the reported results are valid as long as the client (i.e., query) remains within the safe zone. A query that leaves its safe zone sends an update request. The server updates the safe zone and the results, and sends them back to the client.

II.MOTIVATION

Location-based services aim to offer personalized mobile transactions for targeted individuals in specific locations at specific times using the knowledge of the location of an object and/or

individuals [3]. The growth of mobile phones has provided an opportunity for such services. Mobile phones are the most popular personal communication devices. And as new multi-function mobile phones such as smart phones are widely adopted, they have emerged as a popular media platform for marketers. The reason is that they are personal, accessible anytime and anywhere, and location-aware. However, the most vital problem for merchants is how to reach their valuable targeted audience. That is, how best to deliver an advertisement or offer to the right mobile user in the right context effectively and efficiently remains an issue to be solved.

Currently, the most common mobile advertisement formats are Short Message Service (SMS) and Multimedia Message Service (MMS).These are push-type technologies that send messages proactively to mobile users. Typically, push marketing is better for companies who have an established relationship with users, who have granted permission to receive such messages. This is referred to as permission-based marketing. However, the mobile phone can be used as a user-driven media device to enhance the dynamics of business-to-consumer relationships. It can be used for pull-type marketing that sends information based on consumer requests. This mode is most suitable for merchants with simple, time-limited, and location-related advertisements. Advertisements can even be restricted by quota, such as the promotion of a regional company, coupons in a local mall, and so on.

Moreover, future customers with smart phones can actively demand promotional information. Compared with push-based advertising, this pull-type approach, which allows customers to have greater involvement, is getting popular [3, 4].

The purpose of providing targeted advertisements is to increase the effectiveness of advertising by ensuring the right person receives the right message at the right time. There is need of a platform where merchants can promote a product to consumers in a timely, effective, and low cost way. Similarly, consumers would prefer to receive relevant and useful promotions.

III. Literature Review

Continuous monitoring of spatial queries:

Continuous monitoring of spatial queries have been studied in the recent past. The work [5, 6] examine the monitoring of static range queries over moving clients on a road network. The work [6] requires moving clients to send their latest locations to the server periodically. It focuses on efficient maintenance of query results at the server side. Pesti et al. [5] aims at reducing the communication cost of moving clients. Both [5, 6] consider static range queries and take the object dataset D to be the moving clients. In contrast, our problem scenario takes a mobile client as a moving query, and the object dataset D as static advertisers. Cheema et al. [2] focuses on the safe region approach in which the server reports a safe region to the client in addition to the result set. While the client moves within the safe region, the result set remains unchanged.

Al-Khalidi et al.[8,10,11] has proposed a linear model to monitor the moving range query inside a safe region for mobile navigation. This approach predicts when the query will leave the safe region based on its current location and velocity. The method is used by the query whenever the server allocates it to a new safe region.

Location based advertising:

Russell et al.[9] has mentioned the advertiser proposition, that they could send marketing messages, targeted by age and gender, to consumers who were close by and therefore more likely to act on them. To take advantage of this proposition, the advertiser obviously needed a physical presence in a mall where the service was running. In practice, this would be a retailer or service provider in the mall, such as a clothes shop or coffee vendor. But it could also include a company running a temporary promotion in the mall, or a brand selling via one of the retailers.

Existing LBA applications:

There are different applications available like Google offers, AdXplorer etc. The Google offers application helps user discover relevant offers from local businesses and big brands, and keeps track of offers. User can use them straight away, or the application will remind user next time user is near the store. No printing is needed. AdXplorer is the application which is to provide consumers the ability to easily search local advertising on their mobile phones and provides local businesses with cost-effective mobile advertising.

IV. Problem Statement

The proposed work is a client-server application in which the mobile client receives the promotional offers/coupons on his mobile device of his interest depending on his geolocation from the nearby merchants. No need to search for these coupons. The safe region is calculated and the result is computed accordingly. The result is updated only when the mobile client leaves the safe zone. It is using continuous monitoring of distance based circular range queries.

A set O of objects, a query point q, and a positive value r is considered here. The distance $dist(o, q)$ is used to denote the distance between an object $o \epsilon O$ and the query q. A distance-based range query returns every object $o \epsilon O$ that lies within distance r of the query location q, i.e., every object such that $dist\ (o, q) \leq r$.

V. Objectives

The objective of this application is that the mobile users are moving, they can get the promotional offers on their mobile device from their nearby merchants. This can be achieved by following way:

The advertiser will register on the server and submits the coupon details along with the location. The administrator approves the coupons. The mobile client issues the query.

The server computes the safe zone using guard objects and results and returns back to the client. The safe zone and results will be recomputed only when the client leaves the safe zone.

VI. PROPOSED WORK

In the proposed work, there is client-server application. The server is hosted on Heroku PaaS cloud platform. It provides the advertiser the facility to upload the coupons with the details like coupon description, expiry date, type and the location etc. It also provides the map to mark his location. The map is provided using Google maps JavaScript API version 3. In this application, the clients issue queries and the central server is responsible for the computation of these queries. For example, a person walking down the street may issue a query on his mobile to continuously report the shops providing offers within 1 km of the issuer's location. Location of the client is available using GPS.

When a query arrives, the server computes the results and the safe zone, which are then sent to the client. The safe zone is an area such that the reported results are valid as long as the client (i.e. query) remains within the safe zone. A query that leaves its safe zone sends an update request. The server updates the safe zone and the results, and sends them back to the client.

To compute the safe zone for the circular range queries, guard objects are used on which the safe zone depends. Checking whether the query lies within the safe zone takes k distance computations, where k is the number of guard objects. The server considers the radius r to find the internal and external guard objects. The safe zone S can be defined as the intersection of the circles of internal objects minus the circles of external objects.[2]

That is, $S = \cap_i C_i - \cup_j C_j$ for every internal object O_i and every external object O_j.

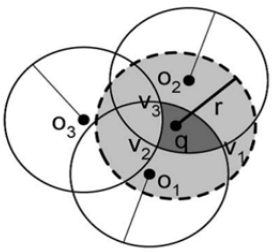

Figure 1 : Range query q and safe zone

The objects that contribute to the shape of the final safe zone are called guard objects (e.g., O_1, O_2 and O_3). An internal and external object that contributes to the final safe zone is called an internal and external guard. In figure 1 internal guards are O_1 and O_2 whereas O_3 is an external guard.

If the $maxdist(e,q) < r$, it is internal object and if $mindist(e,q) > r$,then it is an external object.

The objects which are neither internal nor external are used to trim the safe zone. The entry with object which has $mindist\,(e,q) \leq r \leq maxdist\,(e,q)$ are those objects. The guard objects and answer list are computed and sent to the client.

To trim the safe zone, with respect to an object O it is need to update the guard objects and the vertices of the safe zone and for each guard object O_i, the intersection points of the circles of O and O_i are computed. If the intersection point lies on the boundary of the safe zone, the point is added as the vertex of the safe zone. All other intersection points lie outside the safe zone and are deleted.

Then, the object O is added as the guard object. The existing vertices that are no longer in the safe zone are removed and the objects that no longer have any associated vertices are removed from the list of guard objects. When the query leaves its safe zone, it sends its current location and current guard objects to the server. The server updates the answer list, computes the new safe zone and sends it to the client. An effective approach to update the safe zone and the answer list, called smart update is used. The smart-update utilizes the previous safe zone of the client and avoids searching the area that was visited before.

Instead of computing and sending all the objects lying within the range, the smart-update sends a list of objects called delta list that contains two types of objects. An object O_i^+ indicates that object O_i that was previously external is now internal. So, it must be added it in answer list. An object O_i^- indicates that the object O_i that was previously internal is now external. Hence, it must be removed from answer list.[2]

VII. EXPERIMENTAL RESULTS

The web application is hosted as queryads.herokuapp.com on Heroku PaaS cloud platform. The user can sign up and upload the coupons. The map is provided to mark the location. The text boxes are given to input the text. The administrator approves the user and coupons. The coupons can be modified or deleted. The points and coupons are stored with the latitude and longitude in database.

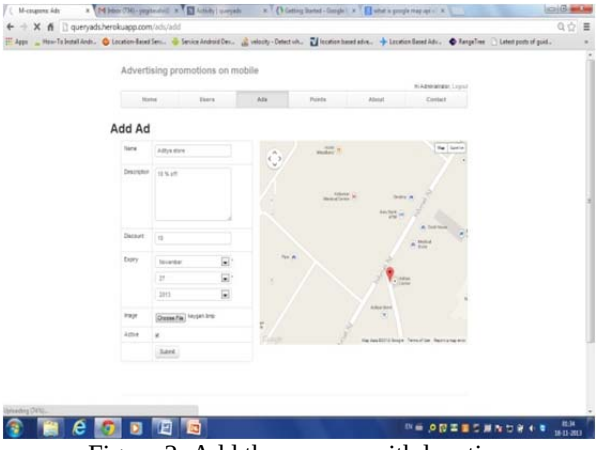

Figure 2: Add the coupon with location

Figure 2 shows the map on webpage and the advertiser can mark his location and upload the coupon details.

The list of available coupons as per the location of mobile client is displayed on mobile device as shown in figure 3.

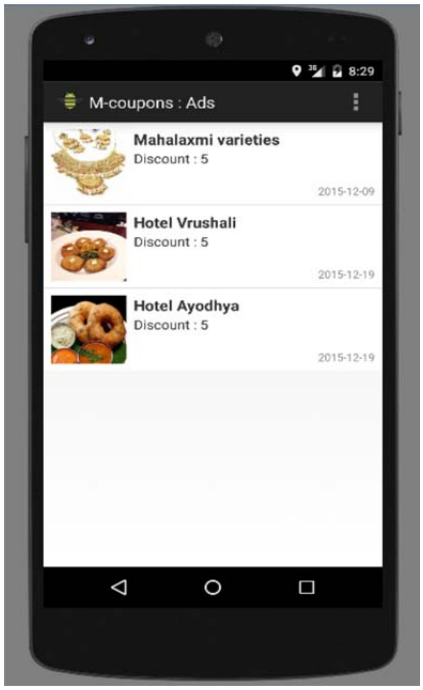

Figure 3: The list of coupons on mobile device

VIII. Conclusion

The set of static advertisers is considered and the moving queries q issued by the client are executed. The moving queries are continuously monitored. The queries are circular range queries and distance-based. The concept of safe zone and smart update reduces the amount of data transmitted from the server to the clients. The cost of computing the safe zone is small compared to the cost of the range query. The server is hosted on Heroku PaaS cloud platform. Using Google map advertiser marks his location and uploads the coupons. The database of coupons is maintained at server. The coupons from the nearby locations are displayed on mobile device using safe zone and smart update.

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