Location Based Ad Service for Super Stores

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Abstract

The paper described the architecture of a location based service for super stores; analyze the issues identified during implementation including network load and user experience. The location based service discussed here is to deliver advertisement relative to user's location in a super store which can help in order to improve target marketing for advertisers.

Keywords: Location based service, target marketing, retail industry, RFID, location identification

1. Introduction

The rapid development in wireless technology and availability of low cost handheld devices provides opportunity to develop new kind of ubiquitous applications. Such kind of applications have been developed and widely used in different industries including healthcare, travel, retail and other industries. But still there is room to introduce new kind of services in various industries. This paper is an attempt to introduce a location based Ad service for a supermarket. This will allow different vendors to a new paradigm of marketing and deliver their ad according to user location in a super store. Such kinds of target marketing techniques are very low cost and most efficient as users will receive only relative ads according to their current position.

This paper is organized as Section 2 describes the location based services and different techniques in order to identify location of a user. Section 3 describes a scenario where such service can be utilized and section 4 discuss the architecture of system for such service.

2. Related Work

The major problem in location identification in indoor environment is that GPS does not work efficiently in indoor environment. In [1], they used Infrared in order to track the location of users. Each area/section equipped with infrared transmitter where each user has its own Smartphone with infrared receiver. Whenever a user enters into an area, he/she must make line of reference with infrared transmitter in order to application detects his/her location, then application respond according to user's current location.

In [2] they used RFID in order to identify user location for indoor environment with wireless sensing network. In this case, each RFID reader attached with a Millennial Net end point, to create a wireless network. Each user tagged with a RFID tag and whenever a user enters into any area/section, reader detects the tag and sends this data to store into a database via a gateway application. Later, application uses this data to identify the location of a user and respond accordingly.

In [3] implement indoor guidance system by using Radio Frequency. In this architecture, instead of tagging users, each location is tagged with a unique tag. An application deployed on laptop equipped with RFID reader can provide guidance and shortest path to the user. Whenever, user moves around and come across to any tag, reader detects the tag and

reads information stored inside the tag. By using this information system can suggest shortest path for predefined destination and can also provide alternate routes, if it detects that user is not following shortest path.

Another alternate solution other than RFID and Infrared is Wi-Fi network to identify location for indoor environment. But the capabilities of Wi-Fi are limited and costly too. One of the solutions for this is issue is to integrate RF with Wi-Fi. In this approach we divide large areas into smaller pieces, for example in floors, and also different locations with RFID tags. A central server collects location information from Mobile Stations (MSs) and Access Points (APs), or at least logical link to information describing their properties, location etc. Organizing position data within a central server, also called location server does not imply the data should be stored and managed in a centralized way, but suggest acting like a broker among different clients. [4]

Delivering services according to user location, preference and interest is another challenging job. In [5] they purpose Historical Graph based Similarity Measurement (HGSM) framework to identify user with similar interest or preference with the help of data mining. This data can also use to find the location where someone can find people with similar interest. In [6] they proposed an architecture for location based services by using mobile agents. Such architecture is very efficient where user move from one place to another place and wish to utilize the anonymous services available on different locations. Because of mobile agents, it also enables to transfer code on user's device and hence resultants into better performance.

There are number of examples available where such location based services deployed and utilized successfully. In [7] demonstrate the application of location based services in a hospital in order to track patients and machineries. A patient can track by its location and as well as system can determine that whether the patient is it in right place for treatment or not. In [8] proposed an idea of common location identification system for different service subscriber and discussed feedback mechanism in order to provide better services for consumers. In [9] they proposed usage of location based services in education sector, where each student and faculty equipped with handheld device like PDA or Smartphone and a location identification system integrated with a learning management system. This allows user to receive different learning objects according to their locations.

3. Location Based Services and Location Identification

Location based services (LBS) are wireless services provide information according to user's location when user move from one place to another. Number of such services has been developed and widely used like finding restaurant around you [8] or finding location of a person inside a building, vehicle tracking system etc. Location identification is the core component of any such services but along this other performance parameters for any LBS are availability, accuracy, reliability, integrity and continuity.

We can divide location identification services into two categories: internal location identification and external location identification. In external location identification we have GPS (Global Positioning System) which uses satellite and works by calculating the time it takes a signal to receive from a satellite to a receiver. In order to find accurate location, GPS receiver must need to communicate four satellites and must make line of sight with the satellite. Therefore, this approach is not appropriate for indoor environment. For indoor environment we can use Bluetooth, infrared, Wi-Fi and Radio Frequency for location identification. But there are several issues attached with each kind of techniques. Bluetooth is limited to range of 10m around Bluetooth device but it needs 5 to 10 sec in order to create connection with device. Such delay could lead towards identification of incorrect location when

user moves from one location to other location in short period of time. With infrared, devices are needed to be lined up in order to start communication which seems impossible in ubiquitous environment where services are needed to deliver as invisible services. Wi-Fi seems to be good option as system can use this as data delivery medium too but in order to find accurate position we would need to deploy multiple access point and must position in such a way that coverage is provided to each three access point overlap at entrance of each section which seems to be costly solution. However, it has been observed that RFID is appropriate solution for indoor environment as it is light weight, low cost, high communication speed and without requirement of line of sight.

Table 1 Comparison of Indoor Location techniques

	GPS	Bluetooth	Infrared	RFID	Wi-Fi
Accuracy	Low	Medium	High	High	Medium
Signal Error Ratio	High	Low	Low	Low	Low
Power Consuming	High	High	Low	Low	Low
Penetration	Bad	Good	Bad	Good	Good
Cost	High	Medium	Low	Low	High

4. Methodology

The propose system works with wireless network and RFID technology. Each section in which we need to track a user will be equipped with RFID reader. The type of reader can vary on the basis of dimension of area. For example, a large section may need high frequency reader. Each user will be equipped with passive RFID tag and Wi-Fi enable device in order to access location based service. Each Passive tag can be identified by a unique number assigned by Electronic Product Code (EPC) and same as each Wi-Fi device can be identified by predefined IP address assigned to a device. The reasons to choose Passive tags are lower cost and low energy consumption. A central database will be containing information of all tags and corresponding IP addresses of their Wi-Fi devices. Similarly, each reader can also be identified by a unique number and this will also be stored in central database. Whenever, a user entered into any specific area, the reader will detect the RFID tag and store in database with date/time stamp along with reader id. Later, whenever user requested for any location based service the current location of user can be found by using IP address from which request received and the last location where RFID tag found associated with this IP adders.

5. Scenario

As it is a usual sight that super stores are divided into different sections/departments. These sections/departments are categorized on products or items categories. For example, all the electronic items are placed and displayed in Electronic section/department or all kind of stuff related to games in Game Section. A user moves from one section/department to another section/department carrying a trolley. Usually, these trolleys made by any metallic material and consist nothing else but the items which the user has selected to buy.

Our idea is to use these trolleys as information tool and provide location based ads on a touch screen LCD connected with Wi-Fi connectivity, placed on front panel of each trolley. Development of such devices is in process and we expect such devices in market soon.

6. System Architecture

The propose system architecture works with wireless network and RFID technology. Each department or section of super store will be equipped with RFID reader and its unique ID will be stored in database. In order to locate user, each shopping trolley will also be tagged with a passive RFID tag and Wi-Fi enabled touch screen device. The device will be having a browser based application in order to retrieve ads from server. The complete system's architecture can be depicted in Fig 1.

Whenever a user enter in any section / department of superstore, reader will detect the tag placed on shopping trolley and will update the database accordingly. This information will later use to retrieve

the latest location of any user. The database model for this location identification system is shown in [Fig 2] PromoFile table stores the list of flash multimedia files which can be associated to any department/section of store.

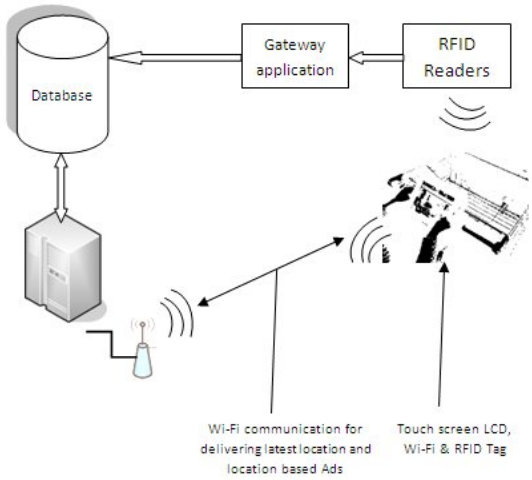

Figure 1: High Level Architecture

For example, Garment section can be associated to a flash file 'garmentAd.swf' which may contains advertisement of vendors belong to garment industries. The reason to use flash is due to its rich providing capability of both graphics and sound. Location table stores all RFID reader with unique IDs. MobileUnit table consist of details of shopping trolleys including EPC code of their RFID tag and IP address of device placed on trolley. MovementLog table stores the all movement for all shopping trolleys. Whenever a client request for latest location of any shopping trolley, it can retrieve from this table by using a simple query.

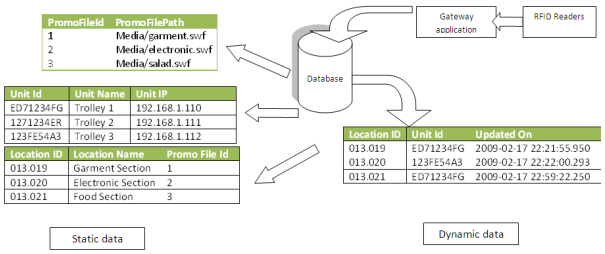

Figure 2: Data Model

The application deployed on device will request for latest Ad and server will response according to user's current location. As said earlier that each trolley equipped with a touch screen device connected with Wi-Fi network. Therefore each shopping trolley can also be identified by its IP address. So, location of a shopping trolley can be identified by combination of IP address of device and tag id placed on trolley.

Initially it was decided to achieve this by just refreshing the page after a period of time. But it has been observed that this approach not only increased the load on network but also causes a bad user experience as refreshing the page with all its content took considerable time. In order to resolve this issues, Ajax incorporated in application and two kinds of services formed; one to get latest location of user,

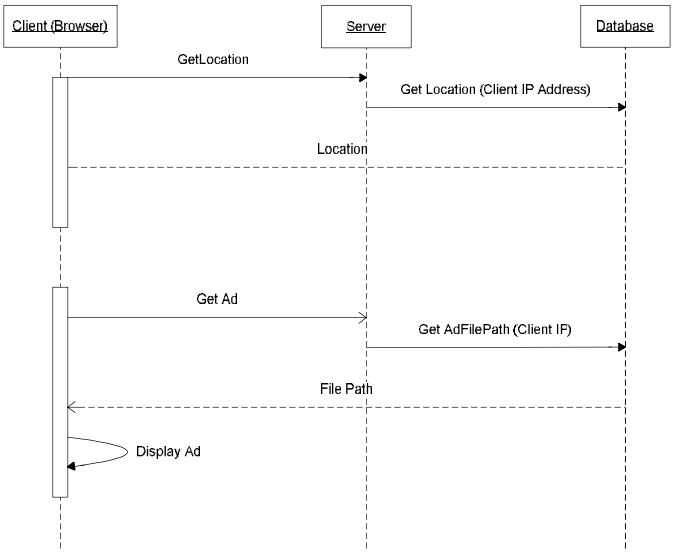

Figure 3: Sequence Diagram

second to ask latest ad according to latest location. So, now client application will be responsible to track whether new location has arrived or not. Client will only ask for ads in case of arriving in a new location. The sequence of messages between client and server are given in Fig 3.

7. Prototype

A prototype developed for proposed system on .Net framework 3.5. Two different web based application developed in order to demonstrate same concept presented earlier in this paper except no hardware interfacing tested during this implementation. Two different web application developed; one for delivering advertisements [Figure 2: Data Model] and second to change the user location [Figure 4: Prototype]. Whenever, user select a location from page the advertisement updated according to user selected location.

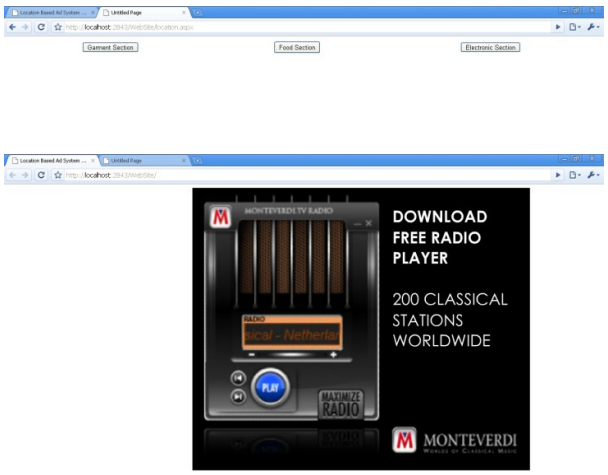

Figure 4: Prototype

8. Conclusion

This paper demonstrates the application of location based services in one of the areas of retail industry. We found that there are enough opportunities to utilize such kind of services in this industry other than just maintaining inventory of items. Our proposed architecture is capable to deliver advertisements according to user location by using RFID technology. There are still some issues which need considerations; such as communication between reader and gateway application etc. We are planning to extend this architecture to allow user to make inventory by device available on their shopping trolleys and assist them to find the location of any specific item during their journey of shopping.

9. Reference

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