A System for detecting the Stray of Objects within User-defined Region using Location-Based Services

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Abstract

There are many applications using LBS such as navigations, location tracking, the whereabouts of a friend or employee. Most of these applications have the feature of active service mechanism. In this paper, we propose a system for sensing the stray of any objects within user-specified region as passive service mechanism. The proposed system has been initially authenticated the target objects and then matched between smartphone and a target object using LBS in smartphones. After a period of time, if the object has been break away from the specified boundary region, it is that the smartphone detects the straying status of the object. This system presents a virtual barrier such as a geofence. Therefore, the proposed mechanism will can be used of many applications such as anti-theft/anti-lost of any objects, preventing of stray children. Especially, it will be more opportunities combining with active service mechanism.

Keywords: Geofence, Sensing System, LBS, Active service, Passive service, Smartphone

1. Introduction

LBS(Location-Based Services) are an information service and have a number of uses in social networking today as an entertainment service, which are accessible with mobile devices through the mobile network and which use information on the geographical position of the mobile device such as smartphone, Tablet PC, etc.

LBS are used in a variety of contexts, such as health, indoor object search, entertainment, work, personal life, etc [1-8]. LBS include services to identify a location of a person or object, such as discovering the nearest banking cash machine or the whereabouts of a friend or employee [1, 4-8]. Most of these existing applications have the feature of active service mechanism [9].

On the other hand, geofencing service can be one of passive service mechanism [9]. Geofencing is a feature in a software program that uses the GPS(global positioning system) or RFID(radio frequency identification) to define geographical boundaries[10, 14]. Geofence programs allow an administrator to set up triggers so when a device crosses a geofence and enters (or exits) the boundaries defined by the administrator, an SMS or email alert is sent [9, 12].

Therefore, this paper proposes a system which looks like geofencing service. The proposed system is detecting the stray of any objects within user-specified region as a passive service mechanism. To do this, the target objects are initially authenticated and then the system has been matched between smartphone and an authenticated object.
using LBS in smartphones. After a period of time, if the object has been break away from the user-specified boundary region, it is that the smartphone detects the straying status of the object. As a result, the proposed system presents a virtual barrier such as a geofence.

This paper is organized as follows. In Chapter 2, we will investigate the research background. The framework design of the proposed system is presented in Chapter 3 which consists of a server-side and client-side frameworks. The experimental results are described in Chapter 4. Finally, Chapter 5 provides concluding comments and suggestions for further research.

2. Related Work

LBS have become more and more important with the expansion of smartphone and Tablet PC markets as well[1-8]. LBS are used in a variety of contexts, such as health, indoor object search, entertainment, work, personal life, etc [1, 4-8, 14].

Especially, the term “geofence” or “geofencing” using LBS is popping up all over discussions of location-based services, with a special focus on its use in retailing [11].

A geofence is a virtual perimeter for a real-world geographic area [9, 10, 12]. A geofence could be dynamically generated - as in a radius around a store or point location. Or a geofence can be a predefined set of boundaries, like school attendance zones or neighborhood boundaries. Custom-digitized geofences are also in use.

When the location-aware device of LBS user enters or exits a geofence, the device receives a generated notification. This notification might contain information about the location of the device. The geofence notice might be sent to a mobile telephone or an email account. For example, geofencing or targeting shoppers near the point of sale is also catching on. Express offers coupons to those in and near its stores with its mobile app. The North Face offers deals not only to those near its stores, but also to those in recreational areas, via its VIPeak program. Its app offers lots of product info and great videos that the company's shoppers can engage with even when they are not shopping. Examples of their usage are shown in Table 1[7-9, 12].

Many geofencing applications incorporate Google Earth, allowing administrators to define boundaries on top of a satellite view of a specific geographical area. Other applications define boundaries by longitude and latitude or through user-created and Web-based maps.

Recently, according to Google Co., Android location services now support geofencing from Google I/O 2013. With the new geofencing API an app can define geographic boundaries around specific locations and then receive notifications when a user enters or leaves those areas.

Even in the hardware field as well as software, there are emerging new devices such as Broadcom Corporation’s GNSS(Global Navigation Satellite System) location chip with geofence capabilities, Philips’ Hue light bulbs[14, 15].

<table>
<thead>
<tr>
<th>Use</th>
<th>Example</th>
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<tbody>
<tr>
<td>Mobile device management</td>
<td>When a hospital Tablet PC leaves the hospital grounds, an administrator receives notification so the device can be disabled.</td>
</tr>
<tr>
<td>Fleet management</td>
<td>When a truck driver breaks from his route, the dispatcher receives an alert.</td>
</tr>
<tr>
<td>Human resource</td>
<td>An employee smart card will send an alert to security if an</td>
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Table 1. Usage Examples of Geofencing Service
<table>
<thead>
<tr>
<th>Management</th>
<th>Employee attempts to enter an unauthorized area.</th>
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<tbody>
<tr>
<td>Compliance</td>
<td>Network logs record geofence crossings to document the proper use of devices and their compliance with established rules.</td>
</tr>
<tr>
<td>Marketing</td>
<td>A retail business can trigger a text message to an opt-in customer when the customer enters a defined geographical area.</td>
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<tr>
<td>Asset management</td>
<td>An RFID tag on a pallet can send an alert if the pallet is removed from the warehouse without authorization.</td>
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<tr>
<td>Law enforcement</td>
<td>An ankle bracelet can alert authorities if an individual under house arrest leaves the premises.</td>
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3. The Proposed System Design

In this paper, the proposed system is sensing any breakaway objects within user-specified region as a passive service mechanism. This system is divided into a server side for recognition modules and service of smartphone, and a client side for an Id(identification) management module for recognizing the target object.

3.1. The Server-side Framework

The server consists of a framework structure as shown in Figure 1. This server framework is responsible for authentication, naming and network mediation services between any objects and smartphone.

![Figure 1. The Server-side Framework](image)

(1) Network Manager
- Sender & Receiver for Objects’ Ids - Sending and receiving for objects’ IDs
- Sender & Receiver in App - Sending and receiving Ids for App service of the smartphone
(2) Objects Manager
   - Id Checker - Processing to match between the registered objects’ Id and the
     requested objects’ Id from App for security
   - Naming Service Handler - Processing to create and register, authenticate the
     unique Id for new objects

(3) Service Manager
   - Notification Handler – Processing to push service of messages or events

(4) ID Repository - Constructing database for Ids that are requested by the Data
  Manager

3.2. The Client-side Framework

The client-side framework consists of a target object framework and an app
framework of smartphone. As shown in Figure 2, the object framework has holding
authenticated Id via networks such as Wi-Fi, Bluetooth, RFID, TCP/IP. The app
framework as shown in Figure 3 detects the registered objects breaking away from user-
specified location using LBS in smartphone.
● Location Monitor - Deviation detection module that periodically checks the specified boundary of a target object
● LBS Handler - Monitoring range setting of the target object using the Google Map
● Notification Handler - Processing the message alert

3) Id Repository - Constructing local database for the targeted objects’ Ids

4. Experimental Results

For the implementation of the proposed system as a passive service mechanism, an experimental model is assumed that the target object is set to a USB memory and how to detect the object through Android platform-based smartphone.

First of all, the server is started and ready to any events. Figure 4 shows current location of the smartphone to detect an object using Google map. Figure 5 shows that the server generates and registers a unique Id ‘USB_Client@ad8659’ for the USB memory by the naming service handler, and the smartphone is connected to the server. Next, the server sends target object’s Id to the smartphone. The matching between the USB memory and smartphone is done by the registered and same Id value. The following Figure 6 shows sensing status of the registered object within pre-defined boundary such as 5 meters, 10 meters, 100 meters radius such as a geofence.

Also as shown in Figure 7, we can limit sensing range by changing the radius of 100 to 10 meters. After a certain period of time if the object or the smartphone has been break away from the user-specified boundary region, it is that the smartphone detects the straying status of the object. As shown in Figure 8, the user-specified boundary region was set up to notify the push alarm if the smartphone or the USB will be break away from the radius. When a user with smartphone get out of the user-defined region, the push alarm will continuously notified to the user.
5. Conclusion

LBS are used in a variety of contexts, such as health, indoor object search, entertainment, work, personal life, etc. LBS include services to identify a location of a person or object, such as discovering the nearest banking cash machine or the whereabouts of a friend or employee. Most of these existing applications have the features of active service mechanisms. On the other hand, geofencing service is one of passive service mechanism. Geofencing is a feature in a software program that uses the GPS to define geographical boundaries. Geofence programs allow an administrator to set up triggers so when a device crosses a geofence and enters (or exits) the boundaries defined by the administrator, an SMS or email alert is sent.

Therefore, in this paper, we proposed a system which looks like geofencing service. The proposed system is detecting the stray of any objects within user-specified boundary region as passive service mechanism. As a result, the proposed system presents a virtual barrier such as a geofence. The proposed system can be applied to more applications in conjunction with indoor LBS such as WPS (Wi-Fi Positioning System), HPS (Hybrid Positioning System). Especially, it will be more opportunities combining with active service mechanism.

Acknowledgements

This work was supported by the IT R&D Program of MKE/KEIT [10035708, "The Development of CPS (Cyber-Physical Systems) Core Technologies for High Confidential Autonomic Control Software"].

References


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