A Service Platform for Rapid Development of Beacon-based Applications

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Abstract. We present a service platform, which supports the basic functionalities for beacon-based services with the RESTful Web service technology. The platform provides RESTful Web services for beacon/user management, beacon data update/filtering, beacon data searching/monitoring, and alarm notification. Using the Web Services, service developers can rapidly build their simple services using BLE beacons.

Keywords: BLE Beacon, Beacon-based Service, Service Platform, RESTful Web Service

1 Introduction

Recently, as the use cases of BLE beacons[1] are increasing in wide area and specially in the O2O(Online-to-Offline, Offline-to-Online) services, BLE beacons are considered as one of key technology revolutions to provide object identifications and trajectories of objects with low energy[2, 3, 4]. As we know, as such services get more attention, easy and rapid development of such services becomes more useful. But building such services usually requires considerable time and costs.

To address this issue, in this paper, we present a service platform, which supports the basic functionalities for beacon-based services with the RESTful Web service technology. In general, beacon-based services include the identification service using the data broadcasted by beacons and the location-based service using the locations of beacons. Basically, the platform provides the RESTful Web services for managing beacon data such as updating, filtering, searching, monitoring, and alarm notification. Using these Web Services, service developers can rapidly build their simple services using BLE beacons.
2 Beacon-Based Service Platform

2.1 BSmart Service Platform

In this section, we describe a service platform named BSmart, which provides the basic functionalities usually required for beacon-based services through the RESTful Web service technology. In addition, BSmart receives specifications for BLE beacon formats created from the beacon format specification editor [5] and specifications for beacon services created from the beacon service specification editor[5]. These specifications are stored into the database for further services. The platform stores the real beacon data from BLE beacons in the fields into the OpenStack cloud storage. Figure 1 shows the structure of the BSmart platform.

![System Architecture of BSmart Service Platform](image)

**Fig. 1.** System Architecture of BSmart Service Platform

From the stored specifications of beacons and services, the platform extracts the needed parameters for providing the RESTful Web services to applications. The platform supports monitoring facility of the field beacons in associated with the stored specification and application. In addition, the values from beacons can be filtered by the filters designated when specifying the related services, being stored into the cloud storage managed by the platform. The extracted parameters are used for generating the complete HTML5 application incorporated with the template service application[5].
2.2 Web Services of BSmart Server

Basically, the platform provides the RESTful Web services which can be composed by the real applications. Using these Web Services, service developers can easily build their custom services based on BLE beacons. Each of these applications can be identified by the ID of the application, which is registered to the platform in advance. Table 1 describes the Web services supported by the platform.

Table 1. RESTful Web Services of BSmart Service Platform

<table>
<thead>
<tr>
<th>Category</th>
<th>Prefix</th>
<th>Method</th>
<th>Params</th>
<th>Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beacon Format Specification</td>
<td>/formatSpec</td>
<td>POST</td>
<td>userId, formatJson</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>GET</td>
<td>userId</td>
<td>formatList</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PUT</td>
<td>userId, formatId, formatJson</td>
<td></td>
</tr>
<tr>
<td>Beacon Service Specification</td>
<td>/appSpec</td>
<td>POST</td>
<td>userId, AppJson</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>GET</td>
<td>userId</td>
<td>appList</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PUT</td>
<td>userId, appId, appJson</td>
<td></td>
</tr>
<tr>
<td>User/Beacon Registration</td>
<td>/beaconReg</td>
<td>POST</td>
<td>userId, beaconInfoJson</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>GET</td>
<td>userId</td>
<td>beaconInfoList</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PUT</td>
<td>userId, beaconInfoId, beaconInfoJson</td>
<td></td>
</tr>
<tr>
<td>Beacon Data Search</td>
<td>/BSSearch</td>
<td>GET</td>
<td>userId, serviceId, fromTerm, toTerm</td>
<td>[{output1, output2, output3}, […]]</td>
</tr>
<tr>
<td>Beacon Data Management</td>
<td>/beaconManage</td>
<td>POST</td>
<td>userId, signalData</td>
<td></td>
</tr>
<tr>
<td>Beacon Data Alarm</td>
<td>/appAlarm</td>
<td>GET</td>
<td>userId, serviceId</td>
<td></td>
</tr>
</tbody>
</table>

2.3 Method of Developing Beacon-based Services

In corporation with the beacon format specification editor and the service specification editor, the BSmart platform can be used to generate typical beacon-based applications in an automatic way. The following is the steps for building these typical applications.

1) Specification: The service developer specifies the beacon format of the beacons to be used through the beacon format editor. The related beacon service is also specified through the beacon service specification editor.

2) Generation: Analyzing these specifications, the platform generates the desired HTML5 application, which uses the Web services provided by the platform. The generated application is based on the template application previously built in the platform.
3) Registration: The service developer registers each beacon to be used in the application and each user related with the beacon into the platform via the User/Beacon Registration Web service.

4) Monitoring: Through the generated application, the users and the service developer can monitor the position of beacons and user, retrieving the past beacon data during a certain time period with the meaningful names and descriptions obtained from the related specifications.

3 Conclusion

In this paper, we described the structure of the service platform for easy and rapid development of applications based on the BLE beacon technology. Since most of beacon-based applications require location-based functionality such as monitoring locations and trajectories of objects, the functionalities provided by the developed platform would be sufficient for developers to generate simple beacon-based applications. Since all of the functionalities of the platform are supported by the RESTful Web services, developers can easily integrate the beacon-based service into their target services in versatile application domains. In addition, the platform can be used as a tool for automatic generation of an application in association with the information on the beacon data format used in the application and the information on the functionalities needed in the application.

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References