Development of Smart-CITY Based Convergent Contents Platform Using Bluetooth Low Energy Beacon Sensors

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Abstract. Currently, based on hyper-connected society, thanks to the development of information technology, the utilization of diverse Internet of things communication services and big data is increasing. With regard to the information society infra of the modern society, as the value of data is evaluated to be high, big data based storage, processing, management, and analysis technologies and IoT based integrated operating systems have been constructed and the huge city connection computing termed smart city has been extensively studied. Global enterprises, in order to occupy the market preemptively and be in the leading position, are consolidating their technological developments and restructuring their organizations to be adaptable to the big data-oriented schemes. However, the management and processing standards for fragmented data collected through sensing devices built in urban areas have not been sufficient, and studies on the establishment of classification models and standardization models suited to data characteristics have been lacking. Therefore, this study intends to construct a user-oriented Beacon application convergent contents platform that integrates the fragmented large-volume data collected from the Beacon sensing devices so that the data can be conveniently managed.

Keywords: Beacon, Application, Internet of Things, Bluetooth, Database, Smart CITY.

1 Introduction

As composure in people's life has been increasing and demands for app contents for culture, arts, humanities, engineering, and education have been exponentially increasing thanks to the rapid national economic development and increases in individuals' incomes, IT technologies have been rapidly developed so that South Korea is now ranked as an IT powerhouse. In addition, thanks to the development of network technologies and increases in smartphone prevalence rates, diverse near field communication network services have been rapidly increasing and diverse near field communication network technologies ranging from RFID/USN and Bluetooth technologies to smart embedded NFC have become issues now [1][2]. Recently,

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Smart-CITY that can manage data in the entire city and provide IoT technologies through the construction of systems in entire society has been actively researched and developed and has been rapidly emerging as the next generation core technology aiming at the future city in the 21st century. Therefore, this study aims to present a model for construction of a platform that can support integrated contents services for urban environment for users through applications using the Bluetooth Low-Energy Beacon technology and can conduct big data statistical analyses through the accumulated data transmitted to the Beacon sensor through app interlocking We also propose a platform construction model that can perform analysis. This study will enable personalized marketing through big-data analysis by upgrading existing contents by applying Beacon technology and emphasizing diversity of utilization and contribute to the creative urban marketing convergence service strategies of the national business model.

2   Related Work

The beacon service works in a way where the smartphone app receives beacon signals and transmits the signals to the dedicated server and the server identifies the information and displays the information on apps. In addition, the beacon is advantageous for the creation of diverse services because location information services can be provided by entering latitude and longitude information into the beacon. Since the beacon automatically locates customers to provide information or services, it has been increasing users' convenience in use, and has been attracting attention as a new core technology in the mobile payment market. Thus far, NFC has been the representative technology in the mobile payment market. NFC provides high levels of security and safety because it enables payments to be made only when the terminal and the payment device have come into contact with each other within a range of 10cm but it has a disadvantage of requiring the installation of expensive NFC readers. On the contrary, the beacon is much more advantageous from the standpoint of shops in terms of costs because it does not require 'contact' as payments are made through customer information registered by the user in smartphone apps and the beacon, which is relatively cheaper, can be installed in place of the expensive NFC-dedicated reader [3].

3   Proposed Method

The method proposed in this study consists of the implementation of an application as a platform for provision of information to users' smartphones using Bluetooth low energy beacon sensing devices and for provision of consumer analysis through the collection of the service patterns of users registered in the main server and the area of a CMS (Content management system) server that can store and manage the data collected by beacon sensors.

3.1 Application Systems to be Interlocked with Bluetooth Beacons

In this study, the U-CITY type application contents that can be interlocked through Bluetooth sensors were divided into three areas; life contents, cultural contents, and medical contents.
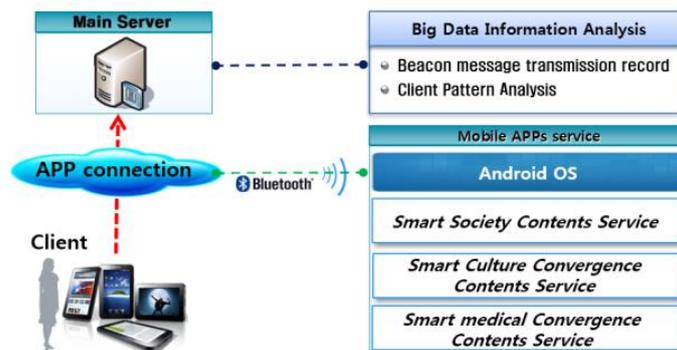

Fig. 1. Entire system block diagram

When the application has been authenticated, the user will receive data when he/she accesses the network area where the beacon has been established and can be provided with services for contents. In addition, the information on the users provided with the services is recorded in the main server so that pattern analysis can be performed based on the recorded data of the stored unique users.

3.2 Unique Identifier Authentication

The Bluetooth low-energy beacon technology used in this study has a service constraint because it has only the function of unilaterally transmitting the beacon message to the other party due to the characteristics of the Bluetooth devices. However, in this study, the authentication mode is applied to attempt the transmission of beacon messages only to those users who wants to receive the messages, and the transmission data are managed through a separate server.

3.3 Application system's activities by function design model

The application applied in this study was constructed as an Android based application because it is a system that transmits information from a user who accessed the Beacon sensor through mobile-oriented mobility. Excluding the login authentication system and main activities, the information system was designed into the following configuration.

- **Smart Society Contents:** Through configuration of product information, coupon information and admission information that can be utilized in

U-CITY based daily life, the system is configured into an integrated system that can broadcast the information when the user accesses the beacon sensor.

- **Smart Culture Contents:** These are culture and arts convergent contents consisting of integrated elements that enable users to be provided with information services for stadiums, fairs and performances, etc. through Beacon transmission systems. The users can also receives data such as food corner information, seat information, and ticket information.
- **Smart Medical Contents:** The system is configured into an integrated system that enables the user to receive data such as indoors based location information and medical worker information that can be utilized in medical systems and inside the hospitals.

3.4   Construction of Bluetooth beacon management system

To operate a Bluetooth beacon management system, beacon sensing is installed in the selected new area and on-boarding is performed to generate contents campaigns and event processing. In this study, seven beacon sensors were installed inside the building of I university to conduct an experiment with the beacons.

4   Experiment and Result

4.1   Implementation and management of beacon contents

The development environment in this study was Windows OS 7 and ODROID-C2, which has built-in Ubuntu 16.04 on Kernel 3.14 and Android 5.1x on Kernel 3.14, was used as the experimental equipment for the application. The specifications of the Bluetooth Module are High Speed v3.0 and Low energy v4.0. As for the performance of the Beacon device, the battery life is one year and the scope of application in which objects can be recognized is 40m.

The initial user must access the application through the authentication mode. If there is no authentication mode, the initial user should access by signing up for membership through e-mail information. As for the management of beacon devices, beacon devices can be checked in CMS, and the signal communication status, UUID, Major, and Minor of the beacon devices installed at the site can be checked through Token ID authentication. The proximity can be monitored by dividing the distances of beacon devices into 'near, far, and unknown.' In addition, the relevant beacon devices' battery capacity can be checked in real time, which provides convenience for management.

Fig. 2. Authentication procedure and demonstration of main activities

5   Conclusion

In this study, convergent contents were developed that will enable the performance of marketing and pattern analysis based on collected data transmitted from beacon sensors through the integrated application functions that enable users to utilize diverse services in Smart-CITY environments utilizing beacon devices and the management system constructed in the main server. Currently, although diverse beacon services are in progress, data are fragmented due to unified services in certain areas and systems that can integrate such sensing data to enable the analysis and utilization of meaningful data have not been universalized. This study is expected to enable users to simultaneously utilize their life contents, culture arts contents, and medical contents so that beacon device business can be expanded and the practical value of the times of IoT can be enhanced.

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