

iBeacon-based Notification for Subway Arrival Application

Hyunhee Jung*, ChoonSung Nam**, DongRyeol Shin*

*Sungkyunkwan University, Korea, **Yonsei University, Korea, *Sungkyunkwan University, Korea

E-mail : gusgml7041@gmail.com namgun99@gmail.com, drshin@skku.edu

1. Introduction

Today, smart device user in the information society is rapidly increasing. In addition, in the subway of public transportation, user gets information or enjoys leisure using the smart device. However user is too focused on the smart device, he/she passes by the station to get off. Especially, user is so discomfort not to get off at the station because he/she don't hear arrival announcement using an earphone within the smart device. Therefore, this paper proposes the notification for subway arrival application using the smart device.

Nowadays, in the smart device, a lot of applications using location-based services (LBS) are being developed [1-3]. Most of the location-based services are being developed using GPS (global positioning system), Wi-Fi, and NFC (near field communication). Location-based services using Wi-Fi limited the grasp of the position, because it requires new connection when user moves another place using the smart device. On the other hand, GPS can search out the relatively accurate location on the outside, but it can't search out the location on the inside. And also NFC disconfirms to search out the grasp of the position, because it can transmit and receive the data within distance of 10m. Therefore, this paper proposes the notification for subway arrival service using iBeacons based on Bluetooth 4.0 LE that can be used in the both outside and inside.

2. Related work

iBeacons technology is that search out user's location using iBeacon transmitter [4]. It is low battery consumption due to using Bluetooth 4.0 LE, and can search out relative location. And also it has the recognition distance up to 49m. So if user has the iBeacon transmitter and smart device supported over Bluetooth version 4.0, he/she can use it after installing the application. If user approaches iBeacon transmitter area, he/she know proximity how close from iBeacon transmitter.

iBeacons technology advantages are as follows: first of all, it can search out location of inside but GPS can't do it. That's geo-location with a very high level of granularity, conventionally known as Micro-location.

The location of inside is that iBeacons-enabled on smart device can search out relative location according to the change of proximity when user approaches iBeacon transmitter area. Or it can search out user's accurate location using triangulation method. And it operates in the smart device's background for responding automatically from iBeacon transmitter. And also it's not necessary to pairing like another general Bluetooth device due to receiving in background. iBeacons don't spend a data fee due to it is not necessary to access Internet.

iBeacons is can be monitored three ranges: immediate, near, far. Immediate is the recognition distance up to 50cm. Near is the recognition distance from 50cm to 5m. Far is the recognition distance from 5m to 49m. it can transfer the difference signal of each area.

Thus, this paper proposes method for supporting notification for subway arrival service after receiving the destination station's signal using iBeacons.

3. iBeacon-based notification for subway arrival application

This paper proposes development of iBeacon-based notification for subway arrival application. This application provides the notification via smart device when the subway is arriving to the destination station. Our proposed service architecture is as follows Figure.1.

As shown in Figure. 1, user smart device can response the signal on the distance from 5m to 49m because iBeacon transmitter are installed each subway station. If received signal is the signal of destination station, application can notify the alarm via smart device.

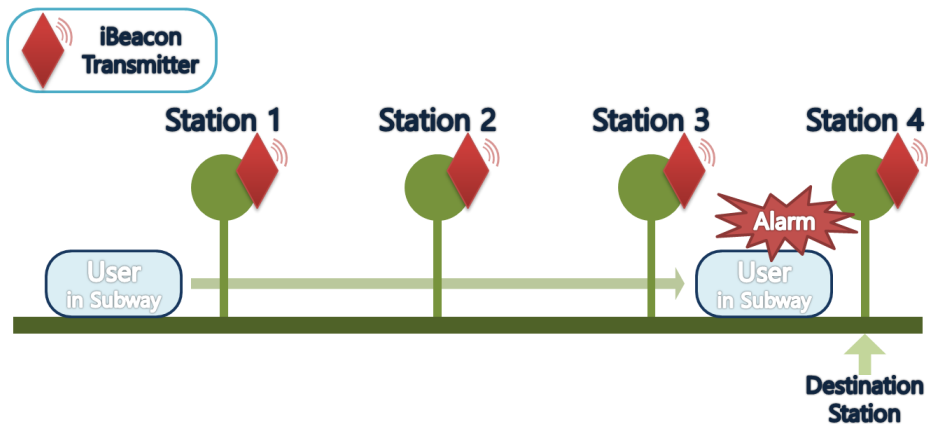


Fig.1. Proposed service architecture

For our proposed service in this paper, application must process as follows: Setting of destination station, Receiving the location data in real-time, Notification for arriving destination station.

- **[Setting]** User starts this application and sets the destination station. If user completes setting it, application provides the estimated time from departure station to destinationstation.
- **[Receiving]** While user uses other operation using the smart device or rests, this application receives the GPS location and waits to receive signal of iBeacon transmitter. GPS is excellent precision in the outside. But it can't work in the inside. So this application receives location information using iBeacon. iBeacon canreceive the signal on the distance from 5m to 49m. If it receives the signal of destination station, it notifies the alarm, or not receives the signal continually.
- **[Notification]**If this application receives the signal of destination station, it operates the notification. Arrival notification stops other operation and displays the arrival message in the smart device. Alarm consists of vibration mode, sound mode, and vibration and sound mode. User can change it in the setting menu. User can turn off the notification screen with the button.

4. Conclusion

This paper has proposed the iBeacon-based notification for subway arrival service using smart device supported Bluetooth 4.0 LE. Research result is that our proposed service is excellent precision of location information using GPS technology and receives location information using iBeacon technology. Therefore we can notify the arrival of destinationstation.

But we find weakness security of iBeacon technology. That issues cause that the adversary can perform the impersonation attack, reply attack, man-in-the-middle attack. So strengthening security for iBeacon technology is our subject of the research in the future.

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