A Localization Method for a Smartphone Application in the Underground Trains

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1. INTRODUCTION

While the number of smartphone applications support our life in various situations, there is still a place/situation unsupported: the underground trains. Because there was no wireless communication nor GPS signal in the underground, it had long been impossible to create a mobile service that assume underground train passengers as users. However, the situation has been changing in the last few years. For example, you can use wireless communication almost every underground railway in Japan since 2013.

There is, however, still no practical Localization method for underground trains. For example, [3] is one of the preliminary research in this field which utilizes accelerometer and gyroscope to determine the location of underground trains using a smartphone. This technique requires continuous measurement of acceleration to find stop and start of the train, which drains batteries.

2. LOCALIZATION IN THE UNDERGROUND TRAINS

This paper aims to develop a localization method that is applicable for ordinary smartphone application. It means that the method does not use either special facilities or external sensors as well as not to waste batteries. With this localization method, various services for passengers of public transportation such as [1] will be possible for underground trains.

Instead of trying to find the exact location directory in an underground train, what we think of is to have the application find the exact station and the time the user takes the train first, and then estimate the current location by refereeing to the timetable of the train. In order to reduce battery consumption, the geofencing feature supported by a mobile OS and a motion coprocessor that is always recording a user's activities including number of steps with minimum battery consumption are used. The application records subway stations every time a user passes there with the geofencing feature in background. When a user requests a location in an underground train, the system finds the exact time he/she stopped walking from the records of the pedometer in the past one hour as a candidate time to take a train, then finds the station he/she was at when he/she stopped walking, finally determine the train from the train timetable. Based on the timetable, the system infers the current location of the user.

3. A PROTOTYPE APPLICATION

We designed a prototype application for the Apple iPhone 6 which has M8 coprocessor with a pedometer, and developed an iOS application called "Smart Kompano"[2]. Figure 1 is the screen shot. When a user starts the application, it gives a list of the future stations and the scheduled arrival times of the exact train that the user is in. Even when a user rushes into the train, he/she can localize himself/herself and send a message to a friend to inform the arrival time by using the application. Since we published the application in Dec. 2014, more than 50 users have downloaded the application.

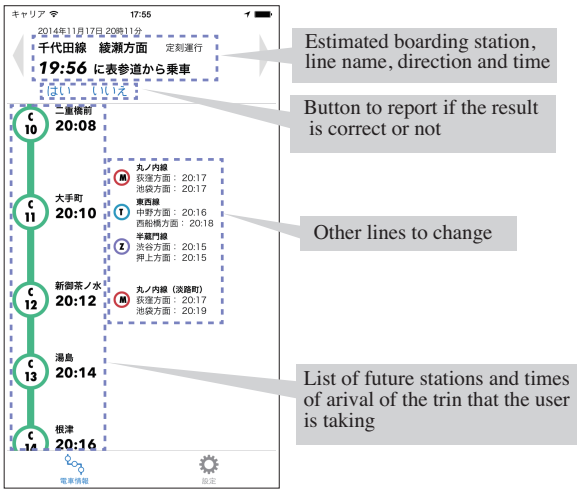

Figure 1: A screen shot of the application.

4. SUMMARY AND FUTURE WORK

This paper proposes a new localization method for underground trains, and developed an iOS application. We are still working on it to improve the localization method. In the current settings, there might be two ore more candidates in finding underground trains from the schedule, because some station have several lines and trains run very often. We are planning to utilize a barometer in addition to eliminate the candidate train.

5. REFERENCES

[1] S. Foell, G. Kortuem, R. Rawassizadeh, M. Handte, U. Iqbal, and P. Marron. Micro-navigation for urban bus passengers: using the internet of things to improve the public transport experience. In *Proceedings of the First International Conference on IoT in Urban Space*, pages 1–6, 2014.

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