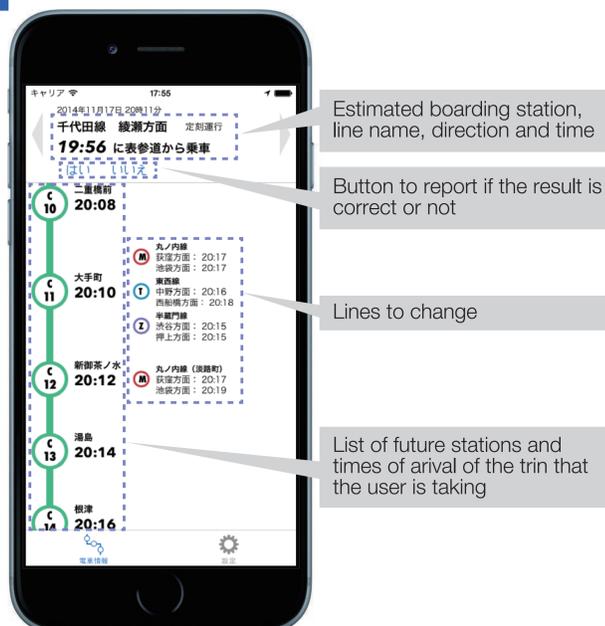# A Localization Method for a Smartphone Application in the Underground Trains

Masaki Ito, Genki Kenjo, Kaoru Sezaki
The University of Tokyo

The Application

We propose an application that automatically recognizes current location and future stations with estimated arrival time when you open the app in the underground train. Even when you rush into the train, you can send a message to a friend to inform the arrival time with the application.

Estimated boarding station, line name, direction and time

Button to report if the result is correct or not

Lines to change

List of future stations and times of arival of the trin that the user is taking

No need of GPS

Because there was no GPS signal in the underground, this application doesn't request location information when a user open the app. Instead, the app traces the behavior when he/she took the train, and identifies the exact train referring to the timetable.

Energy saving

We developed the application under the regulation of iOS to save battery consumption. It means, we don't use background process. Instead, we utilize M8 coprocessor, a built-in context recognition mechanism and geofencing API, which calls back the application when the device enter and leave from certain region.
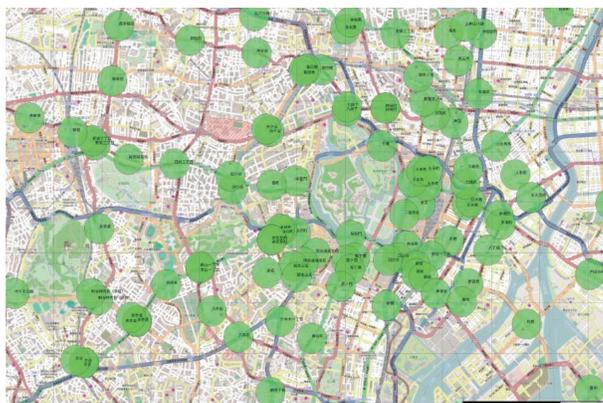
How It Works

1. Record stations a user passes with geofencing

This lapplication records subway stations in background every time a user enter/exit there with the geofencing API. The app dynamically updates list of stations to observe when a user moves since the maximum number of points to observe in iOS geofencing API is limited.

2. Find the time to take a train using a pedometer

Apple iPhone 5S or higher have a coprocessor that analyzes and records output from sensors for 24 hours. Every application can access to the record of past 7 days via the API. Our app sees the record of pedometer in the past one hour, and estimates the time a user stopped walking to be the time to take a train.

3. Identify the train he/she took in the timetable

Based on the estimated time to take a train and the station the user was in at the time, the application identify the train in the timetable which is provided by Tokyo-Metro, an underground railway agency with real-time delay. Now the app gives you current location and future arrival times at the stations.