Indoor WiFi Positioning System for Android-based Smartphone

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***Abstract*—WiFi positioning system has been studying in many fields since the past. Recently, a lot of mobile companies are competing for smartphones. Accordingly, this paper proposes an indoor WiFi positioning system using Android-based smartphones.**

Keywords- Wi-Fi, Wi-Fi Positioning System, Android, smartphone

I. Introduction

Wi-Fi positioning system (WPS) [1] is widely being studied in many fields. WPS usually uses Wi-Fi signals from already-installed private and public WiFi APs in order to provide the location based service (LBS). WPS complements the measurement error of global positioning system (GPS) in the center of the city or indoor.

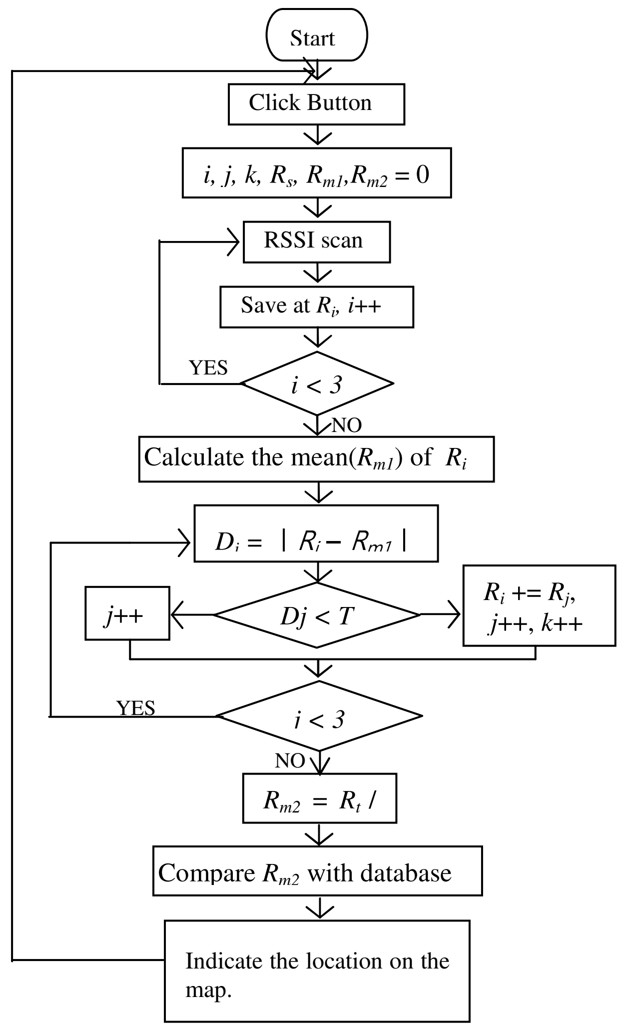
There have been several studies about WPS. RADAR [2] has the position calculation using the WiFi signal strength and has an average of three meters error on the coordinate of two dimensions. In another WPS [3], KF (Kalman Filter) stabilizes Wi-Fi signals and is used to calculate the position. In [4], a method to calculate the position by combining Wi-Fi with the GPS is proposed. However, the Wi-Fi signals provide a low precision for tracking the locations. Therefore, in order to acquire more accurate location of a target, Wi-Fi APs dedicated for localization should be installed in the target area.

In this paper, we propose a personal indoor/outdoor WPS system on the smartphone using RSS (Received Signal Strength) of signals from dense Wi-Fi access points dedicated for localization. In Section 2, the proposed algorithm for tracking the position is presented. In Section 3, the implementation of the algorithm and the results of experiments are described. In section 4, we conclude the paper.

II. Positioning algorithm

RSS from each AP is measured three times and the mean value of three RSSs is calculated. We use the difference between the mean value and each training value. If the difference is below a threshold (T), the training value is withdrawn and then the mean of filtered training values is calculated again. Finally, the mean value is compared with the value of database and a proper location on the map is found.

Figure 1 shows the flow chart of the proposed algorithm. We decided a threshold that gives the lowest error rate through experiment.



R_{m1} : The mean of Ri
Rs : Sum of available data Rj
R_{m2} : The mean of available data Rj
i, j : The number of iterations
D : Difference between Rj and Rm1
T : Threshold of difference
k : The number of available data Rj
R : Training values of RSS

Figure 1. Flow chart of positioning algorithm.

III. Implementation and Experiment

A. *Experimental Environment*

The experiment was performed in a room, which locates in Choongmoo building, Sejong University. An area of 6m by 12m was used for the experiment. The area is divided by 8 cells and each of them is named 1~8 as shown in Fig. 2. Four WiFi APs were installed for the experiment and all of them are N104i made by IPtime. The smartphone is Galaxy-S made by Samsung and has Android 2.1 O/S. Figure 2 shows the floor plan and AP mounted in the ceiling for the experiment. The threshold for the filtering is set to be 16 dBm.

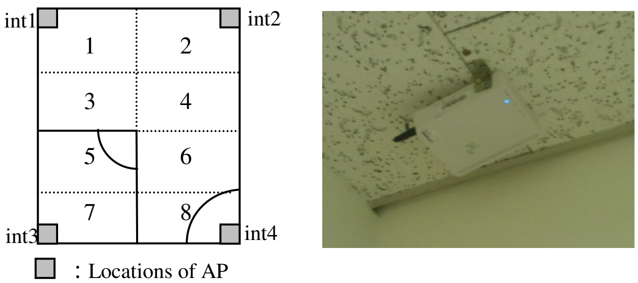


Figure 2. Floor plan and installed WiFi AP.

B. *Database construct*

RSS is measured at each point from the cell 1 to 8 and saved at the database. AP's SSID is AP1, AP2, AP3, and AP4 (see Figure 2). The measured RSSs are stored at the database with the cell ID and SSID.

Table 1. Example of RSS database.

SSID / Cell ID	AP1	AP2	AP3	AP4
1	-41	-48	-63	-64
2	-49	-46	-66	-65
3	-47	-50	-63	-56
⋮	⋮	⋮	⋮	⋮
8	-69	-65	-69	-41

C. *Implementation*

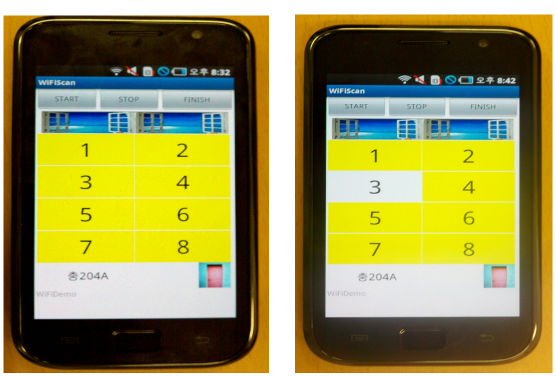


Figure 3. User interface of WPS for smartphone.

Figure 3 shows the user interface of WPS developed for the Android-based smartphone. There are three buttons on top of the screen : the first one is the start button that makes the smartphone scan WiFi AP and calculate location and display location on the screen. The second one is the stop button that ceases the operation. The last is the finish button that quits the application. There are eight cells to display the location of smartphone. When displaying the smartphone at a certain cell, the color of cell is changed to white. The number indicated in the cell means the cell ID.

IV. Conclusion

We developed an indoor WPS for Android smart phones. Positioning using Wi-Fi signals is easy to implement and requires lower cost than other localization systems. We installed APs dedicated for localization at specific locations to improve positioning accuracy. We proposed a new algorithm to filter error signals and find the location of the smart phone. It acquires a proper scan time and threshold thereby yielding a low error rate. We expect the indoor WPS for smart phones to be used at various places.

Acknowledgment

This research was supported by the MKE (The Ministry of Knowledge Economy), Korea, under the national HRD support program for convergence information technology supervised by the NIPA (National IT Industry Promotion Agency) (NIPA-2010-C6150-1001-0013), and was also supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (2009-0065891).

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