Basic of Wi-Fi based positioning system

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Wi-Fi Based Positioning System

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***Abstract*—In today's era position of any outdoor element can be determine precisely using GPS. But in the indoor environment like house, colleges, underground construction site GPS does not work well. As now-a-days all house and colleges are equipped with Wi-Fi access point, precise position can be found out using Wi-Fi using method name Received Signal Strength Indicator (RSSI). A series of experiment were carried out at different place which gives position with maximum error of 5m.**

I. Introduction

Global Positioning System is well known means of outdoor positioning. It fails to do so in indoor environment. It is important to acquire position in indoor environment because it can be used as navigation system in any library or colleges[3] or it can be used to keep a track of labour and goods in underground construction site like tunnel[1]. Nearly all modern buildings are equipped with Wi-Fi access points, indoor positioning using IEEE 802.11 standard has now become a realistic alternative .Moreover, recent smartphones are commonly equipped with Wi-Fi sensors, which make them adequate devices to implement such an indoor positioning system.

II. Wi-Fi Positioning Technique

A. *Cell ID*

It is a basic wireless positioning system solution. It matches the target's position with its connection to an Access Point (AP). It does not require complex operations such as time synchronization and multiple APs. However, its low positional accuracy is the pitfall of its simplicity (figure-1).

B. *Trilateration*

Trilateration is a method that computes a node position by intersecting 3 circles. The position of the 3references nodes must be known and the distance to each of them (figure-2).

C. *RSSI*

Received Signal Strength Indication (RSSI) measures the distance from a sensor to a transmitter using the distance to signal–strength relationships As per figure-3.

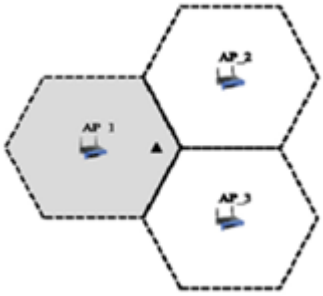

Fig. 1 Cell ID[1]

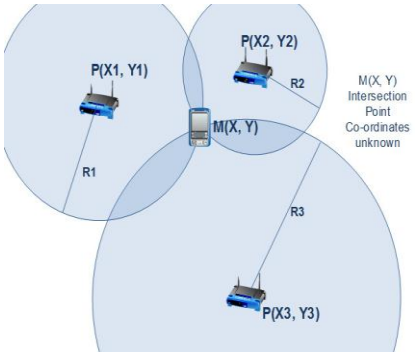

Fig. 2 Trilateration[5]

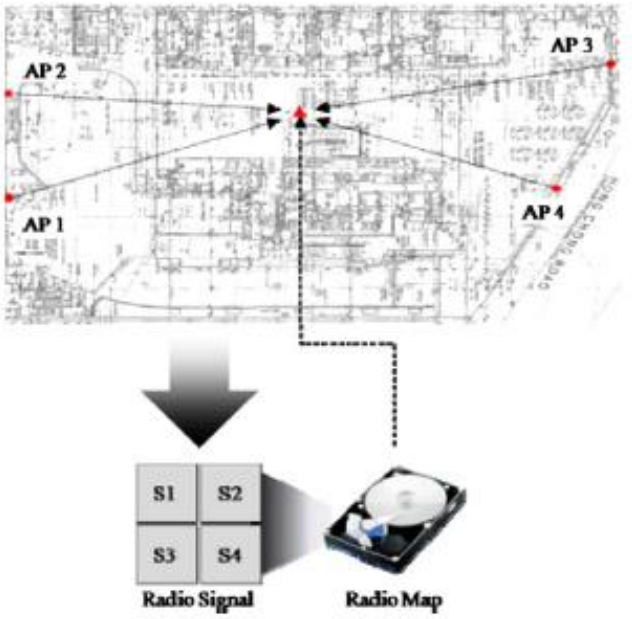

Fig. 3 Fingerprint or RSSI [1]

III. *Fingerprint Method*

One of the RSSI–based systems is the fingerprint method. In this there are 2 phase. 1. Training phase. 2. Tracking Phase.

A. Training Phase

In training phase RSSI from different places is calculated. For this first of all received signal is passed through kalman filter to remove noise due to multipath effect and environment. Then after interpolation is applied to detect intermediate point and make graph continuous. Since received signal depends on orientation and direction of receiving antenna, measurement is taken in all direction and different orientation. This process is repeated for all AP available at particular place and data is sent to server computer. This computer stores signal strength at each point from different APs (Figure-4). This data is known as Radio Map of that particular area or building which is used in tracking process.

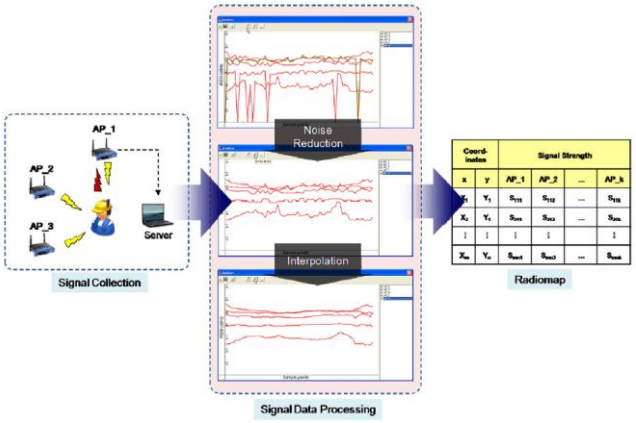

Fig. 4 Training Phase[1]

B. Tracking Phase

In tracking phase same process is carried like signal collection, filtering and Interpolation. But instead of feeding data into server, it will compare data into the database and based on comparison result optimal result is given. For this Bayesian classification or another classification is used to determine particular received signal strength belongs to which position. As per given in Fig. 5.

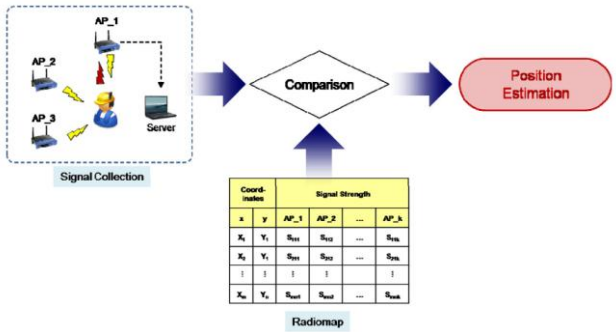

Fig. 5 Tracking Phase[1]

IV. Experiment Result

Experiments were conducted at a shield tunnel construction site in Guangzhou, China[1]. One objective of the study was to check the feasibility of a Wi-Fi-based positioning system at an actual construction site. In the results for all of the experiments, it was proved that the Wi-Fi-based positioning system has a positional accuracy within 5 m of error at a real construction site [1]. Other experiment was carried out at KTH Royal Institute of Technology by Nicolas Le Dortz and Florian Gain, Per Zetterberg [3]. This experiment was performed in the floor located next to lab which area has a dimension of 65m by 25m. During the offline phase they collected measurements at 62 offline positions located 3 meters away from each other. For real time application when a person is moving across and want to update location frequently, they used sliding window protocol. The position is estimated from last 5 samples stored in buffer. When latest sample comes into buffer at that time oldest sample is dropped and position is recalculated. The empirical tests showed very good results using this method since we were able to track our position very accurately (positioning error <3m) when walking across our building. Furthermore, the positioning accuracy was not affected much in a noisy environment (walking people nearby, opening and closing doors, etc.)[3].

V. Conclusion

From different experiment it can be shown that indoor positioning system can be used using Wi-Fi since it gives high accuracy compare to other technology. Since Wi-Fi based equipment are increasing rapidly and all buildings are Wi-Fi covered, it is very useful to navigate through building and tracking labour in construction site.

References

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