

# Geomagnetism and WIFI Fingerprint Fusion Based Indoor Location

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## ABSTRACT

In the indoor environment, the WiFi signal can help users to distinguish between buildings and floors without manually selecting. However, the accuracy is about 3~5M if we only use the WiFi signal for positioning. The magnetic field based positioning accuracy can reach centimeter level, but it is very difficult for users to identify buildings using the geomagnetic localization. The user has to select the building location, which is a poor user experience. In this paper, we combine the advantages of both the WiFi data and the high accuracy of the positioning of the geomagnetic data. The whole system includes data acquisition software, indoor positioning server and positioning APP. First, the acquisition staff needs to initialize the indoor map, and then collects WiFi and geomagnetic data by using acquisition software. After the acquisition, all data will be uploaded to the server, our server will automatically build index and provide services, and then users can experience positioning services by using our position APP with mobile phone. Through the strict technical evaluation and effect test, the system can achieve positioning accuracy of less than 3M, and reach 2M within the good shopping environment. At present, the system has been put into commercial use, which is mainly used to provide high-precision indoor positioning services for large transport hubs, hospitals and shopping malls.

## 1. INTRODUCTION

With the progress of wireless communication network technology and popularization, types of handheld devices are increasing, and the function has been improved

[4]. Mobile phone, iPad and other handheld devices have become an indispensable part of people. All kinds of business and new demands which emerge in an endless stream of location aware computing and location based service (LBS) are more and more important. For businesses, through mobile devices, you can achieve point to point business promotion while product marketing is increasingly being taken seriously. Business wants to quickly attract consumers, so that consumers can find their brand position. For users, consumers also want to quickly reach a destination in a complex environment in accordance with a certain guidelines. Therefore, for complex indoor environments such as airports, hospitals, parking lots, mines, exhibition halls, indoor positioning technology is the basis of location aware computing and location-based services, which is of great significance.

At this stage, there have been a lot of indoor positioning technology in the world. According to the requirements of the configuration hardware, the technology can be divided into two categories. One is to use the installation of hardware facilities. This kind of technology is mainly based on Bluetooth, ultrasonic, infrared, wireless signal RFID, typical schemes include Active Badge, Spot On and so on, but these technologies are subject to the signal transmission distance is short, need to install a lot of equipment covering the entire room area, so the installation and maintenance costs are high. Another solution is no need for additional installation equipment, or on the existing devices to locate the program. WiFi wireless network technology has the characteristics of high speed communication, convenient deployment and low cost, which is in line with the needs of the users for mobile entertainment and mobile office. At present in each city, a large indoor environment (such as office buildings, schools, shopping malls, hotels and airports etc.) layout is equipped with widely WiFi hotspots (Access point). Therefore, the indoor positioning technology based on WiFi do not need to install additional equipment. Due to the complexity of the indoor environment such as the thickness of the wall, doors and windows material, furniture layout

and personnel flow, the wireless signal transmission may be affected heavily, such as refraction, scattering and diffraction. So that WiFi Positioning can not achieve the satisfactory positioning accuracy. [1]

In the modern life, modern buildings are mostly built of reinforced concrete, metal structure of the building would interfere with the earth's magnetic field, so that each floor, channel and isolated space has a unique geomagnetic anomaly field. They have a long period of stability, and a wealth of features and easy access to information. At present, there are a lot of literature to analyze the characteristics of the geomagnetic field in the laboratory, which proves that the indoor magnetic field can be used to reach the centimeter level accuracy. [3] Due to the magnetic field data is not only global, in the absence of artificial regulation under the condition that the positioning method based on geomagnetic field is to accurately identify the user of the building, and not matching the corresponding data, resulting in the effect of positioning disorder.

Therefore, regardless of the use of wireless networks or other positioning means for positioning, any single positioning scheme has its technical and cost limitations, it is difficult to achieve a wide range of popularity. The future trend of indoor positioning technology is bound to a variety of technologies, multiple methods of integration and collaboration. [2] This system combines the advantages of WiFi and geomagnetic field, combines the advantages of the two, and puts forward a new low cost and high precision indoor positioning solution.

## 2. SYSTEM STURCTURE

As shown in Figure 1, our system uses SaaS service model, and it consists of three parts:

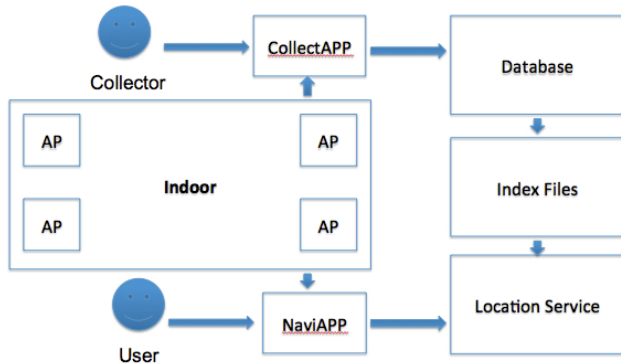


Figure 1: System model.

1. NaviAPP: It adapts to the Android intelligent terminal equipment, provides the interactive platform with the user. When the user opens the APP in the mall, the app can automatically identify the user's building and floor, according to WiFi, while providing users with indoor maps, location information labeling, navigation and other functions.

2. CollectAPP: It is used by the collector to collect WiFi signals and geomagnetic signals at each position in the room, and then upload it to the server to update location data.
3. Location Service features:
  - (a) store indoor map, and establish the mapping relationship between the actual map coordinates and the map coordinates of mobile device app;
  - (b) storage of WiFi and geomagnetic field data collected, the establishment of fingerprint database;
  - (c) by analyzing the user request, the server will carry on the complex algorithm computation, obtains the user the position, and returns to the user.

## 3. DEPLOYMENT REQUIREMENTS

While the system provides precise indoor localization by incorporating WiFi and geomagnetic fingerprinting, it needs only the WiFi network in the test buildings, and no extra equipment or infrastructure is required. [5]

## 4. REFERENCES

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