Abstract

WiFi-Based Indoor Navigatioin System using AR

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1. Introduction

1.1 Background

In recent years, various navigation systems using AR have emerged. AR stands for Augmented Reality, a technology that visualizes the real world by adding digital information such as voice, images, and text. An example of its application is Google Maps. It has a feature called "Live View" that visualizes the direction to a destination by superimposing guide arrows on images of the surroundings taken by a smartphone camera. However, many of these applications cannot be used indoors because they use GPS to track your location. This is because GPS signals cannot be received well inside buildings, making it difficult to track locations accurately indoors.

　On the other hand, various methods for indoor location tracking have been proposed in previous research papers. Examples include pedestrian independent navigation, WiFi positioning, geomagnetic positioning, and visible light positioning. We decided to use WiFi positioning, which is a combination of two methods: a map-matching algorithm that identifies walking routes based on location information obtained by positioning using RSSI signals from APs, and an AP, which stands for Access Point. AP stands for Access Point, a device that transmits and receives Wi-Fi signals and acts as a bridge between terminals and routers.　By focusing on this method, we thought we could develop a navigation application that could be used indoors without relying on GPS.

**1.2 The goal of the thesis**

The objective of this research is to develop a practical indoor navigation application for smartphones using these methods introduced above. In addition, we aim to provide more intuitive and understandable guidance than general navigation applications by using AR methods to provide visual support for route guidance.

1. Related Work
2. Development
   1. Application details

In this study, we developed an Indoor navigation application that guides users through the research quadrangles of the University of Aizu using a smartphone. This application is designed to guide the user through the various rooms in a building, allowing the user to reach the desired room without getting lost, even in buildings with complex internal structures.

* 1. Development Environment
  2. Indoor Position Tracking

In this section, we will discuss two approaches: trilateration and fingerprinting. Both approaches rely on RSSI measurements, which consist of the received signal strength of the radio waves transmitted from an RF device (Wi-Fi access point). To calculate the user's location, the distances from three or more access points, calculated using RSSI, are evaluated.

* + 1. Scaning WiFi APs

The distance from the AP to the user is calculated using the following equation, defined as the free path loss in decibels:

* + 1. Wi-Fi positioning

The distance from the AP to the user is calculated using the following equation, defined as the free path loss in decibels:

where *d* is the distance in meters and *f* is the frequency in MHz [1].

After calculating the distances from three or more APs, the user's position can be estimated by finding the center of gravity of a polygon consisting of the intersection of circles with those circles as their radii. If the position (xi, yi) of each AP is known, the user's position (x, y) can be obtained as follows.

The center of gravity of a polygon can be found by calculating the sum of the centers of gravity of the triangles that are divided into multiple pieces.

* + 1. Map- matching Algorithm

1. Result
2. Discussion
3. Comparison
4. Conclusion
5. Future Works
6. References