# *MazeIn: An Indoor Localization Engine*

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***Abstract*— *MazeIn is a complete navigation system that achieves indoor localization and navigation on Android smartphones. Using inertial data from a variety of smartphones' sensors and RSSI readings from Wi-Fi access points. A machine-learning algorithm is used to fuse the data and predict the user's location given a previously built model of the location.***

***Keywords—component; Indoor Localization, Wi-Fi Fingerprinting, Magnetic Fingerprinting, Navigation***

## I. Introduction

After significant achievements in outdoor navigation applications, the challenge in positioning and navigating outdoors shifted to indoors. The ability to pinpoint people inside buildings remains a substantial challenge; compared to an outdoor environment the system performance differs drastically since the environment has substantial distinctions. Most approaches for indoor positioning systems rely on one technology for localization or need special infrastructure. Modern smartphones offer a variety of sensors that can be utilized for indoor positioning. MazeIn is an attempt to make use of sensors available in a modern smartphone to fuse readings of multiple nature such as Wi-Fi, Geomagnetic fields, and human walking patters using a machine-learning algorithm to increase the accuracy of prediction.

## II. Positioning Techniques

### A. *WiFi Fingerprinting*

This technique relies on forming a vector of Wi-Fi RSSI, BSSID value pairs which are then compared to a database of previously calculated values. An algorithm is used to predict the user's position given the list of known labeled locations.

### B. *Magnetic Fingerprinting*

Similar to Wi-Fi fingerprinting, however this technique relies on the disturbances in the Earth's geomagnetic field. Research has shown that geomagnetic fingerprinting especially indoors gives the most promising results [1]. Readings are obtained from the smartphone's magnetometer. Some normalization must be made in order to compensate for the device's orientation.

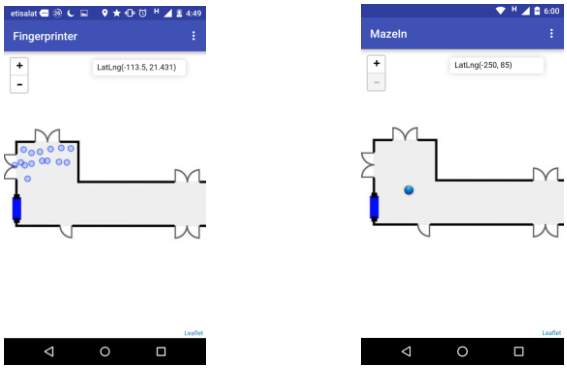
### C. *Dead Reckoning*

The accelerometer and gyroscope readings of the smartphone make it possible to count the number of steps a person has walked. Readings from a compass sensor add heading information so we can deduce how long a user has walked and in which direction. Over time, errors accumulate and ultimately decrease the tracking accuracy. This is overcome by regularly querying for a new location using the magnetic or Wi-Fi fingerprints or using a Kalman Filter (KF). KF is a very common algorithm used in the process of fusing of both Dead Reckoning and Absolute position updates, its goal is to maximize the conditional probability of the state x given the past history.

### D. *Sensor Fusion Algorithm*

In this step, data received from the phone's different sensors are combined into a single feature vector with different weights and fed to a Machine Learning algorithm in order to predict the user's current position.

## III. Application Demo




(a) Fingerprinting Stage (b) Navigation Stage

Figure 1: Application Screenshots.

## IV. Deployment Requirements

MazeIn requires no special additional infrastructure deployed at the site. However, a "site survey" step is required prior to

the navigation phase in order to build a fingerprint model to be used in localization and navigation.

## REFERENCES

[1] G. Berkovich, “Accurate and reliable real-time indoor positioning on commercial smartphones.