Chapter I

Introduction

1.1 Overview

Tracking is a process that used for observing objects on the move over time[5]. One of the examples of the tracking process is when we are using Google Maps to navigate from one point to destination point then the system will start to observe the moving object of the motorcycle or car or footstep in real time. The result of tracking is supplying a timely ordered sequence of location data for further processing. The data of tracking is utilized for the Google to develop the path history in the Timeline feature which called trajectory. Figure 1.1 is Navigation Feature on Google Maps, we can use this feature to guide or help to find a place that wants to visit. Figure 1.2 is Timeline Feature on Google Maps, one example of the application that uses GPS for movement tracking.

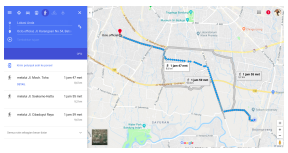
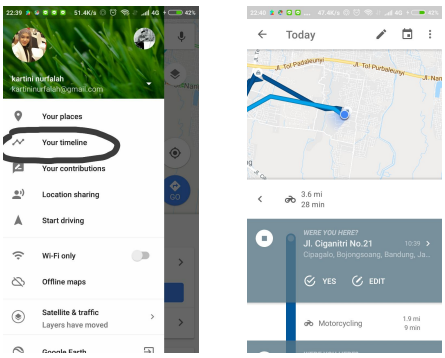


Figure 1.1: Google maps navigation using GPS



(a) (b)

Figure 1.2: Timeline Feature on Google Maps

A trajectory is a path that a moving object follows through space as a function of time[27]. The trajectory can be formed in an outdoor or indoor environment. In an outdoor environment, we can use the Global Positioning System (GPS) technology. Most of the people use Google Maps to help search a place, a guide to get there, or other. So, when we are using Google maps

then we should turn on the GPS of the mobile device. The examples benefit of developmental trajectory can be felt by the users and Google maps. The benefit for the users are we can know the history of our walking activity, we can remember the path when we lose something and others. While for the Google, the trajectory of the users can be used for research such as Google can know the new route because many of the users pass by that street, Google can recommend the user the fastest route because of the data saved by timely ordered, Google knows the most place that the users visited, Google get the users to trust because of the features, and others. So, the tracking process is closely related to the trajectory.

Nowadays, people also spend large parts of their lives in indoor space such as home, office building, campus, shopping center, station, airports or other indoor building. There are so many activities in an indoor environment, like passing along the corridor, moving from one room to another or gathering somewhere[18]. These activities will create a trajectory pattern. So, there is a similarity between an outdoor environment and an indoor environment. Indoor environment is consist of dozens of floors, so that the nickname "skyscraper" appears[18] and also consist of multi-building called "inter-building"[9]. The problem is when we are in an indoor environment GPS accuracy's are approximately 5 m in open sky, 7 m in forest condition, and 10 m under the closed canopies [18], [22]. Many things that can affect the accuracy's. For example, when human or object is under the canopies or inside the building. The building can block the signal of GPS. That is why GPS can't apply to an indoor environment. Figure 1.3 is illustrates how signal blocked due to building. Also, there is a limitation of activities that can make a trajectory in a multi-floor, example the use of bicycle can not pass through the stairs. The other way to detecting the human or object movement in an indoor en-

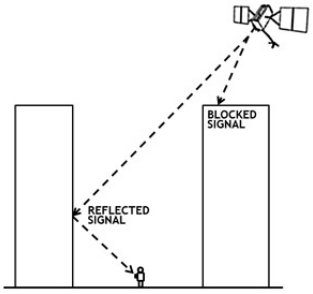


Figure 1.3: Blocked Signal GPS[10]

vironment is using mobile device. The reason mobile device is suitable for an indoor environment are: (1) There are many set of embedded sensor[12]. (2) Mobile phone's ubiquity, ease of use, low cost[12, 14]. (3) People's attachment to their phones[12, 15]. So, the embedded sensor on the mobile device can be

the alternative way to change the GPS technology. Based on the benefit that can we get from the trajectory outdoor then in an indoor environment there is a benefit too. The benefit examples of trajectory in an indoor environment is when people found the cave, then they want to change the cave into the tourist spot. They need to found the route way for in and exit way. The other example, when human in the shopping center which crowded, someone forgot the wallet. The trajectory on the mobile device can be used to know the path of visited place and then the path is used to re-record the incident before the wallet is forgotten. Figure 1.4 illustrates how trajectory in multi-floor indoor building. [18] has been reconstructed the trajectory in an indoor environment,

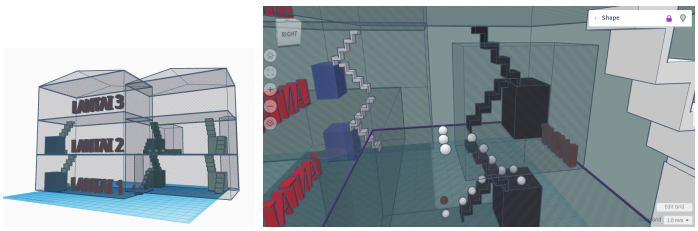


Figure 1.4: Trajectory pattern in F multi-floor building at Telkom University

the focus is on the single floor and its using accelerometer and magnetometer sensor. While in the real live, indoor environment is consist of multi-floor even multi-building called inter-building. The aims of this paper is trying to reconstruct the trajectory in an indoor environment consist of multi-floor by adding a barometer sensor on the mobile device. The indoor environment that will be used to implement the trajectory reconstruction is Kultubai Selatan (F) building at Telkom University which consist of multi floor. The implementation of trajectory reconstruction will utilize the embedded sensors on the mobile device. The sensors will be involve are the accelerometer sensor to measure acceleration force in the mobile device for detecting motion of the device, magnetometer sensor to measure , and adding a barometer sensor to calculate the ambient air pressure, with the expectation by the value of ambient air pressure it can be transformed into the number of floor of the building.

This paper is organized as follow, in Chapter II describes related works. In Chapter III describes system model and algorithm, Chapter IV describes result and analysis. Finally, in Section V, the conclusion is given.

1.2 Statement Problem

Based on the background described above, problems can be formulated as follows:

1. How can indoor trajectory implemented in multi-floor buildings?

2. How to transform the result of barometer reading sensor into the number of floor in the building?

1.3 Objective

The objectives to be achieved in this minor thesis based on the statement is :

1. To implement and prove that by adding barometer sensors utilization on a mobile device can be used to reconstruct indoor trajectory multi-floor buildings.

2. To analyze how accurate system recognized the step.

1.4 Scope

The scopes of this final project based on overview above are:

1. The data set used is the Faculty of Computer Science, Telkom University's spatial data (only F building of Telkom Engineering School building).

2. There is no buildings movement.

3. Using a mobile device based on the Android system.

4. There is an internet connection to save the data from the reading sensor value to develop the path

5. Reconstruction is conducted in computer based on real-time

6. In this experiment only consist of two activities. There are walking activities and stop activities.

7. Evaluation is conducted by comparing the number of actual step with the recognized step.

1.5 Hypothesis

The hypothesis from this experiment is the floors can be detected by barometer sensor so that can reconstruct the trajectory. By utilizing the embedded sensors in the mobile device and the method of trajectory reconstruction in single-floors can be applied in multi floor.

1.6 Summary

This chater is about what this final project about. From the problem stated previously, the final project offer a solution. The main problem is how to build trajectory in multi-floor indoor environment. This final project offers the the utilization embedded sensors on the mobile device to record step, angle and height of the floor and reconstruct the trajectory of three dimensional Cartesian diagram.