Mobile-Based Voice Guidance System for Escape Guide in Case of Emergency

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Abstract – Evolving technologies lead to the development of new applications that can be useful during worse case scenarios. In our project we developed a mobile-based voice guidance system to assist the user to escape from a building in case of fire and to provide an adequate fire escape indoor navigation. Our study utilized beacon sensors and mobile phones. Beacons are installed on a certain floor in the building. A voice guide from the mobile application gives direction to the user to guide them to the nearest escape or fire exit area. The installation and tagging of the sensors would determine the path leading to the fire exit area.

Keywords - Beacons, Beacon sensor, escape guide, voice guide, indoor navigation, android mobile, Estimate Proximity Beacons

I. INTRODUCTION

Fire and earthquake are the biggest threats that can kill hundreds of people when occurred. In this age of modern technology, it is best that one becomes familiar with the latest products and technologies available that can guide and save people in case of sudden accident or calamity.

In case of fire, we are almost like blind due to heavy smoke. It is difficult to find the nearest fire or emergency exit amidst the clouds of smoke. The smoke coming from fire affects the visibility of emergency lights, signs and maps in the wall.

The mobile application named Beacon Scanner can send and receive data to and from the beacon and can provide voice guide to direct user to the nearest fire or emergency exit. Using the Android Beacon library, the application scans for beacons and detects their proximity or distance. It determines the closest or nearest beacon installed on fire or emergency exits and provides voice guide on how to get there with estimated travel time in seconds using the Android’s text to speech capability.

The user will be guided by the mobile application to the nearest exit or beacon either in correct or opposite direction because of the application’s continuous scanning capability until you reach a specified destination.

A. Background of the Study

Beacon technology provides a new way of connecting computing devices. A beacon is a tiny low-powered and low-cost wireless device, which emit signals to smartphones. A beacon signal is classified as radio wave that can activate an app from a smartphone. A beacon has a battery life of more than one year. It can transmit messages based on how close you are to a specific location. Beacons broadcast packets of data, which contain information about the beacon, as well as telemetry readings commonly used in distance calculations.

The Android beacon library is used in the development of mobile application to send and receive data to and from the beacon. The API provides an estimated distance between the beacon and the mobile device in meters. A formula was used to get the estimated time of travel from the user’s position to the beacon or exit in seconds.

B. Objectives

The objective of the study is to create an Android mobile application that can guide the user to the safety place or in the escape or exit area in case of fire and heavy smoke. Specifically, the study aims to achieve the following specific objectives:

a. To install and test beacons in a particular area or building.
b. To design a mobile application that can scan and detect beacons.
c. To create a mobile application using Android that can provide voice guide to user
d. To develop a mobile application that can estimate distance and time to reach the nearest beacon
e. To test the accuracy of the application in guiding the user to the nearest fire or emergency exit.

C. Scope and Limitations

Mobile-based voice guidance system for escape guide in case of fire is a mobile application that scans for beacons in a specific area or floor of the building. In this study, the beacon sensors were installed in the 15th floor of FEU Tech building which serves as the test environment. The beacon design map in figure x shows where the beacons were installed. This identifies the safest path in escaping the building in case of fire or heavy smoke. The beacon sensors
will be the main source of data for tracking the user’s current position. The mobile application named Beacon Scanner detects the proximity or distance of the beacons and selects the closest one. From the current position of the user, the Beacon Scanner will provide a voice guide that gives the distance in meter for every meter interval until the user reaches the closest beacon or emergency exit. An estimated time of travel in seconds will also be provided along the way. The mobile application is capable of continuous scanning of beacons and selecting the closest one until the user reaches the emergency exit of the building. The user can recognize if he is in the right direction going to the nearest exit because the voice guide is providing diminishing distances as the user moves in a specific direction. The application utilized the Android Beacon library and the Android’s text to speech feature. The application must be closed after its use. The study does not cover identifying the cause of fire and the obstacles along the way out. The mobile application does not provide visual guide as well.

D. Conceptual Framework

Below is the floor plan of the 15th floor of the FEU TECH building. Beacons were installed on both sides of the floor at the emergency exits. This beacon design map will be the basis on how the mobile application will provide voice guide to user leading to emergency exit based on the user current position.

![Beacon Design Map](image)

**Fig. 1.** The paradigm used to formulate solutions to escape in case of emergency using mobile phone.

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II. RELATED STUDIES AND LITERATURES

Over the last few years, different approaches have been proposed [1] in order to provide a reliable and accurate indoor positioning, guidance, and navigation system.

In the published article Road and Bridges by Juho Kostiainen [2], beacons can also be used to augment other positioning technologies (e.g., GPS in urban canyons) and to determine a more exact user location. Based on the location, users can be guided through a subway station and an application can keep track of status of the journey (e.g., at a station, entering the subway or being in the subway) to either confirm progress or to suggest corrective actions.

The proponents were engaged in the utilization of beacon technology.

Based on the published article entitled Proximity-based Communications by Mark Boidman and Peter J. Solomon, [3] Beacon technology solutions are helping to create an ecosystem that connects brands, advertisers, mobile apps, retailers, and venues to facilitate the delivery of contextually relevant content and advertising. Moreover, beacons bridge the digital and physical worlds. Given the range of its applicability as well as its ability to drive sales and content delivery, Beacon technology is poised to transform how companies interact with consumers.

We decided to utilize the BLE [4] technology as the main medium for tracking the user’s location.

An existing mobile app named VIGS(VoiceYE Indoor Guidance System) has followings functions:
- It can give a voice guidance of building information with a beacon service in a smart phone.
- It has mobile touch map service so the user can confirm the structure of the building through the vibration and sound generated by the finger touching the phone screen.

The proponents used this as the basis for the designs and functionalities of the proposed system.

Based on the study of Milan, H. V (2016) [5] about Indoor Navigation using Bluetooth Low Energy Beacons, fingerprinting uses the RSSI values of a group of devices to create a signature of a specific location.

The proponents were able to match the closest current location of the user.

As stated in the study An Indoor Positioning Algorithm using Bluetooth Low Energy RSSI by Song Chai et al (2016) [6] most indoor positioning are implemented based on Received Signal Strength Index (RSSI). Mobile device receives signal from wireless node (or beacon) with known location. The distance between mobile device and beacon is calculated using RSSI of received signal. Once mobile device knows the distance between three beacons, its coordinates are triangulated.

This will support the appropriate methods that can be used in the user’s localization process.

III. METHODOLOGY

The proponents used applied research to find solutions to give guiding instructions for building evacuation. This integrates and applies the actual map of the testing environment. The applied research uses heuristic approach to analyze the situation. This directly applies to the formulation of the solution.

The development of the application is divided into three modules. The first module is for the detection and scanning of beacons. The study utilized the android beacon library to detect the installed beacons. The Beacon Manager class is used for the interaction and continuous scanning of beacons.

The second module is for the detection of proximity. Each beacon broadcasts its Bluetooth signal. The mobile device is receiving this signal. The signal is being used to make a rough estimation of how far the beacon is. The third module is for the selection of the closest beacon. The comparison of the distances of all beacons detected determines the closest beacon. The text-To-Speech class of android is used to convert the generated values into speech.

IV. RESULTS AND DISCUSSION

The proponents conducted two types of test, the indoor and the outdoor tests. In both tests, two phones were used, one from one side going to the other side and vice versa. The proponents noticed that one set of distance and time values generated is increasing while the other is decreasing with reference to one beacon. Same test was conducted outside the building were beacons were placed from certain locations. The same characteristics of values were generated. Comparing the results generated indoor and outdoor, the set of values generated indoor has significant difference compared to actual distance. Meaning, the proximity detected outdoor is closer to actual distance. But regardless of the signal strength and accuracy of proximity, the estimated time and distance values generated by the mobile application can serve as guide to know whether or not you are going closer to the nearest beacon or emergency exit.

V. CONCLUSION

It is clear that the signal strength of the beacon affects the accuracy of the proximity. The stronger the signal, the more accurate the proximity estimation; the weaker the signal, the less accurate the distance and time calculation. Beacons must be well placed inside the building in such a way that they can establish a line of sight to mobile devices to achieve accurate results. Narrow corridors and other situations inside the building can affect the distance and time reading of the mobile application.
REFERENCES
