NAVIGATION STUDY BY USING RFID NETWORK FOR VISUALLY IMPAIRED PERSON

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“I hereby declared that I have read through this report entitled “Navigation Study by Using RFID Network for Visually Impaired Person” and found that it has comply he partial fulfilment for awarding the degree of Bachelor of Mechatronic Engineering”

Signature : .....

Supervisor’s Name : .....

Date : .....

I declare that this report entitle “Navigation Study by Using RFID Network for Visually Impaired Person” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : .....

Date : .....

To my beloved Mother and Father

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ABSTRACT

Navigation is the most concern for the visually impaired person. It is very hard for them to travel independently from one to another destination without the proper navigation tools. The advanced technology developed nowadays help visually impaired people travelling safely and independently. There are many ways to help visually impaired people such as guide dog, white cane and tactile paving. RFID technology is introduced in this project to guide visually impaired people at indoor. In order to provide an efficient and user-friendly navigation tools, it is proposed to design and develop a navigation device using RFID network to guide visually impaired person walking properly via verbal navigation. The idea of positioning or localization with compass and direction guiding though voice commands is implemented in this project in order to guide navigation such as moving straight forward and turn corner. The A* algorithm is then implemented in this project to determine the shortest path. The navigation device is connected to the laptop through wireless connection in order to obtain the travel guidance from the map system. The real-time test will be held inside the FKE building of Universiti Teknikal Malaysia Melaka (UTeM). The research focuses on the calibration of the compass and relocates the visually impaired back to normal route before them out of the direction. Data analysis will be done during the evaluation of the navigation device and improvement will be made to improve the performance of the device. The blind navigation device developed is able to guide the visually impaired people to reach destination with the shortest path. This project is beneficial to visually impaired person because the navigation device developed with sound navigation will be integrated with the electronic cane as it helps them to have a better, safer and comfortable travel.

Keyword
RFID(Radio Frequency Identification) , Navigation , visually impaired people

ABSTRAK

Navigasi adalah kebimbangan yang paling untuk orang yang cacat penglihatan. Ia amat sukar bagi mereka untuk perjalanan bebas dari satu ke destinasi lain tanpa alat navigasi yang sesuai. Teknologi canggih yang dibangunkan pada hari ini membantu orang cacat penglihatan perjalanan dengan selamat dan bebas. Terdapat banyak cara untuk membantu orang cacat penglihatan seperti panduan anjing , tongkat putih dan jalan sentuhan. Teknologi RFID diperkenalkan dalam projek ini untuk membimbing orang cacat penglihatan di dalam bangunan. Dalam usaha untuk menyediakan satu alat navigasi yang cekap dan mesra pengguna, ia adalah dicadangkan untuk mereka bentuk dan membangunkan peranti navigasi menggunakan rangkaian RFID untuk membimbing orang cacat penglihatan berjalan dengan betul melalui navigasi lisan. Idea mengenalpasti kedudukan atau penyetempatan dengan kompas dan arah membimbing melalui arahan suara dilaksanakan dalam projek ini untuk membimbing navigasi seperti bergerak lurus ke hadapan dan belok kiri kanan. A * algoritma kemudiannya dilaksanakan dalam projek ini untuk menentukan laluan terpendek . Navigasi peranti disambungkan kepada komputer riba melalui sambungan tanpa wayar untuk mendapatkan panduan perjalanan dari sistem peta. Ujian sebenar - masa akan diadakan di dalam bangunan FKE di Universiti Teknikal Malaysia Melaka (UTeM). Kajian ini memberi tumpuan kepada penentukuran kompas dan menempatkan semula orang yang cacat penglihatan kembali dengan jalan biasa sebelum mereka keluar dari arahan itu. Analisis data akan dilakukan semasa penilaian navigasi peranti dan penambahbaikan akan dibuat untuk meningkatkan prestasi peranti. Navigasi peranti dapat memberi petunjuk kepada orang cacat penglihatan untuk sampai ke destinasi dengan jalan yang singkat. Projek ini memberi manfaat kepada orang cacat penglihatan kerana peranti navigasi dibangunkan dengan navigasi bunyi akan disepadukan dengan tongkat elektronik kerana ia membantu mereka dalam perjalanan yang lebih baik , lebih selamat dan selesa.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Motivation

According to the World Health Organization, there are 285 million people are visually impaired worldwide; 39 million are blind while 246 million have low vision. The causes of blindness are due to eye-sighted problem, 43%, disambiguation of eyes, 33% and glaucoma, 2%. There are two categories of people who are at risk, they are people aged 50 and over and children below aged 15. About 65% of all people who are visually impaired are aged 50 and older; this group comprises about 20% of the world's population [1].

Outdoor and indoor pedestrian mobility are very difficult and dangerous for visually impaired people. They usually rely on a cane or guide dog to assist them in reaching desired destination safely. However, this approach is successful if only if the path to the destination is already familiar or known by the blind people or the guide dog. It becomes difficult once the destination is new and the orientation is difficult especially the environment is not designed for blind people [2].

Public locations such as crowded shopping malls, airports, train stations, and bus stations can be difficult to navigate and can be become disorienting for those with visual impairments. These public spaces contain various sensory distractions such as traffic noise and other people. For a visually impaired people, it can be difficult to determine what direction to travel without some form of guidance. Navigating through unfamiliar public locations has long been source of difficulty for the blind [3].There is some contributions done by researchers to design the navigation system to help visually impaired and blind people for travelling purpose.

S.Wills and ***S.Helal et al.*** proposed RFID tag grid on the navigation and location determination system to guide the visually impaired people during travelling. RFID tags that contain the coordinate's information in being installed on the floor, therefore user can walk on the footpath easily [4]. ***Yuriko***, ***Yoshiaki*** and ***Kenji et al.*** developed navigation systems that help the visually impaired people to walk independently at indoor. The navigation system uses RFID reader and color sensor attached on the white cane to detect the color navigation line and the RFID tags [5].

Furthermore, ***Andrew*** and ***Satish et al.*** proposed navigational system using RFID network. They designed the system using PDA device stored in pocket that have RF reader antennas to receive the navigation information from the RFID tags that are mounted at the ceilings or wall. Until now, the research of the navigation system for the visually impaired people is more focusing on the indoor navigation. The uses of GPS system is not available implemented in the indoor navigation due to some reasons like signal interference and blocking [6].

1.2 Problem Statement

Nowadays although visually impaired people have white cane as their main travelling tools, sometimes they will lost their direction at the end. They face problems like avoiding obstacles, sensing environment and determining current location. They tend to seek help from the pedestrian and this will make them feel uncomfortable from keep asking for direction. Besides, the tactile of the white cane is work as obstacle detection but it not fully guides the proper navigation as it does not give feedback to the user. For example, the blind people might turn left and right or might be go far away from the tactile paving and hence they lost their way back to previous location.

Visually impaired people need to navigate in their nearby environment like normal sighted peoples. We are as normal sighted humans do need visual cues or detailed source of information during our travel. In this case, the way-finding becomes challenges and difficult for visually impaired people. Even though they have conventional navigational aids, these assistances are not feasible or possible all the times. For example, obstacles like door and elevator nearby with direction and distance or presence of human in motion [8].

The problem of indoor navigation remains unsolved. The safety issue addressed by the navigation aids is less useful for indoors. Traveling by visual impaired people during indoor tend to be dangerous because of its homogenous environment. Besides searching or touch –sensing for certain unique, the visually impaired people have to count doorways and intersections to differentiate between the indoor facilities such as offices or doorways and this seems extremely difficult for them and time-consuming [7].

1.3 Objectives

The purpose of this project is to develop a navigation device by using RFID network for visually impaired people. This can be addressed by the following objectives:

1. To design and develop navigation device using RFID network to guide visually impaired people for travelling.
2. To navigate the visually impaired people about the walking and turning.
3. To evaluate the performance of the developed navigation device in terms of lab test accuracy and validity of algorithm.

1.4 Scope

1. The device developed is only a lab prototype to guide navigation for visually impaired people.
2. The device is designed for visually impaired people to walk independently only for indoor purpose.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This literature review of the project focuses on the types of navigation device used in helping the visually impaired person on walking independently and path finding algorithm for the navigation device. There is a need to build a navigation device to guide the navigation for the visually impaired through RFID network due to many difficulties faced by them. There are few parts will be discussed in this literature review which are theoretical background, performance criteria and design challenges, navigation device for visually impaired person, comparison indoor navigation system, navigation study of path finding algorithm, comparison of path finding algorithm. Conclusion are made at the end of this chapter about what navigation device is chosen and the path finding algorithm is studied to solve the problem when the user is out of guided path in order to lead the visually impaired people a safe and comfortable travelling.

2.2 Theoretical Background

Navigation is the important needs in daily life. Independent travel of visual impaired person is difficult. A navigation device designed should be consistent and accurate providing navigation is both indoor and outdoor navigation. Outdoor navigation system successfully guides the user however indoor navigation applications are still improving the consistency factor.

Global National Satellite Systems (GNSS) or GPS cannot be reached into the buildings because these signals are disturbed or scattered by walls and roofs of the buildings. Indoor navigation faces the following challenges:

- Location identification of the user
- Navigation once the initial position is determined
- Map creation for indoor travelling

- Adaptability with environment changes

In order to get the solution of navigation, there is a need to reproduce GPS signals inside the buildings using the outdoor navigation techniques. These techniques can be classified into three techniques; kinematic navigation techniques, wireless navigation techniques and visual navigation techniques [9].

2.2.1 Kinematic navigation techniques

This technique use smartphone built-in sensors like accelerometer, gyroscope and magnetometers to determine position, orientation and velocity of a moving project using kinematic equations. Dead reckoning algorithm is used for navigating a moving device relative to unknown start point, orientation and velocity [9].

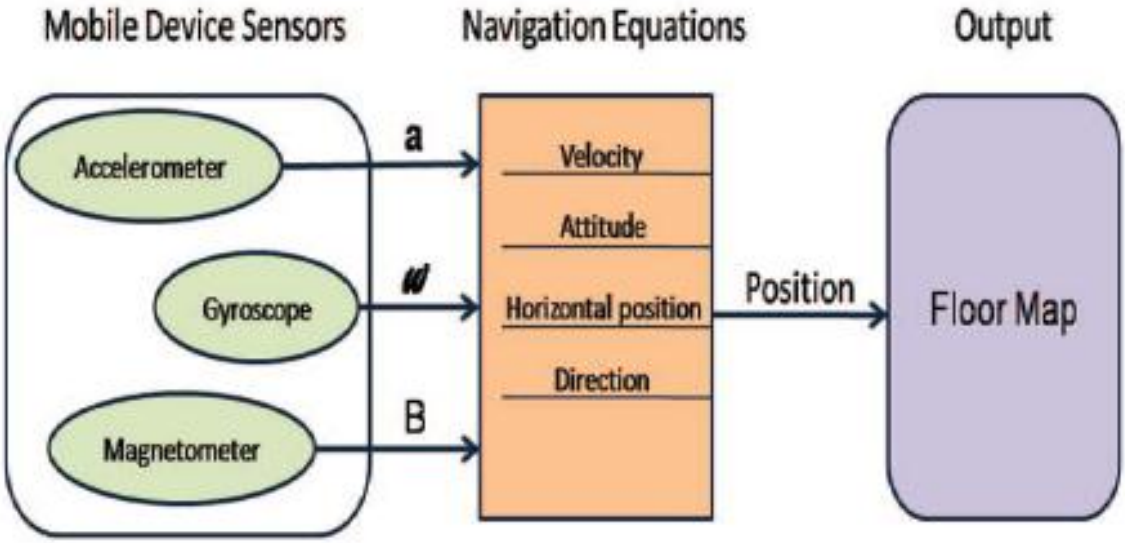

Figure 2.1: Kinematic navigation-based indoor navigation

2.2.2 Wireless navigation techniques

This techniques use radio waves or light waves to determine user's position. This approach is same as mobile phones is capable of transmitting and receiving signals inside the buildings based on Bluetooth, RFID or Wi-Fi. Principles like Cell of Origin, Least Square or Triangulation is used to determine the position of the user while Trilateration, Bancroft's method is used to track the position. Direction of the user can be detected by

methods such as Received signal strength (RSS), Angle of Arrival (AoA), Time of Arrival and Time Difference of Arrival (TDoA) [9].

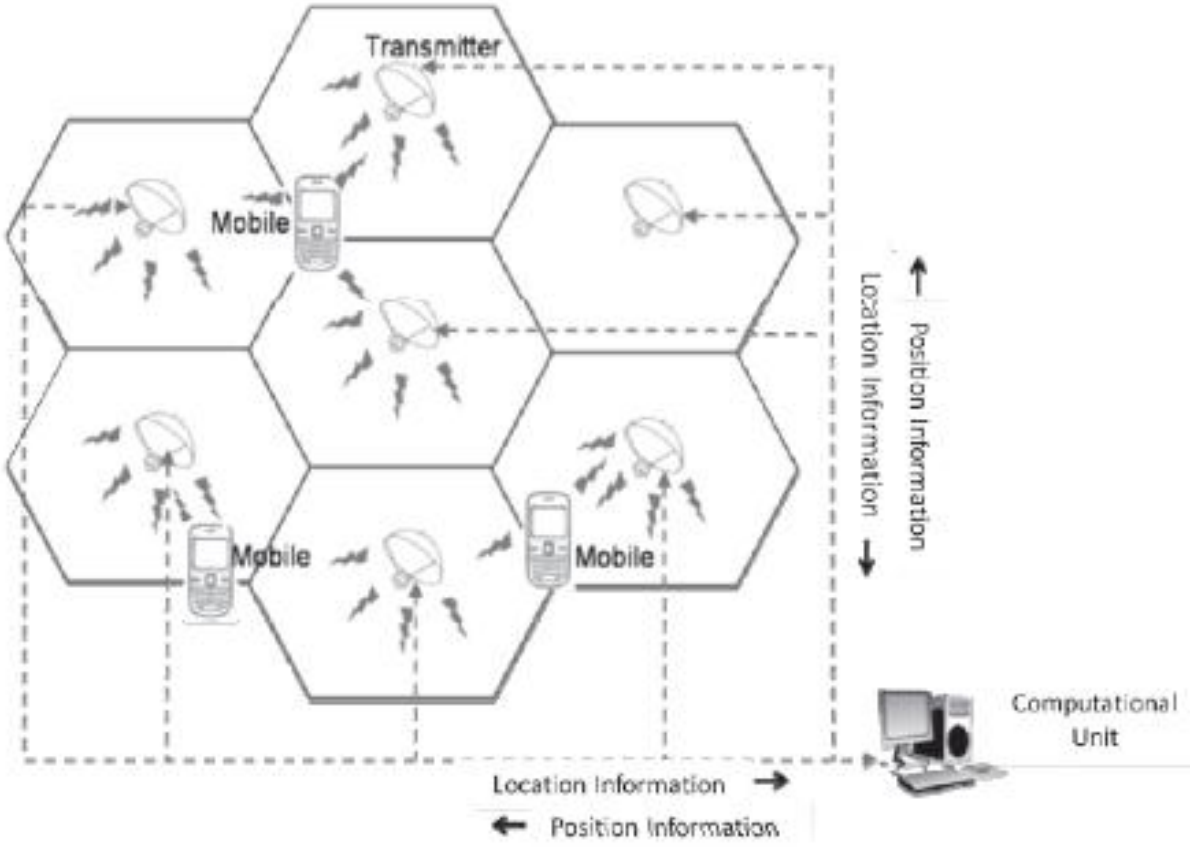

Figure 2.2: Wireless techniques for indoor navigation

2.2.3 Visual navigation techniques

This technique is like camera-based positioning techniques focuses on determining the objects which are visible. Location information can be in encoded form (barcode or QR-code).These code contains the information regarding the location and made this technique more accuracy in positioning. The image as information can be digitized and checked for location matches in database [9].