



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT OF A REAL-TIME FOG-BASED HUMAN TRACKING AND
MONITORING SYSTEM**

This report is submitted in accordance with the requirement of the Universiti Teknikal
Malaysia Melaka (UTeM) for the Bachelor of Electronics Engineering Technology
(Telecommunications) with Honours

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APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfillment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours. The member of the supervisory is as follow:



ABSTRAK

Di sektor perindustrian, jumlah pekerja meningkat dari semasa ke semasa. Oleh itu, mustahil untuk mengesan lokasi semua pekerja di bangunan yang sama pada masa yang sama kerana mereka ditempatkan di bahagian yang berbeza. Sebenarnya, memantau semua pekerja pada masa yang sama boleh mengganggu kemajuan kerja, sehingga menurunkan produktiviti. Objektif projek ini adalah untuk membangunkan Sistem Pengesanan dan Pemantauan Manusia Berasaskan Kabut Masa Nyata untuk menentukan lokasi pekerja dalam pelaksanaan masa nyata. Berdasarkan tinjauan literatur, komunikasi Long Range (LoRa) menggunakan kuasa rendah dengan jangkauan liputan tinggi selain memerlukan kos rendah untuk digunakan. Dalam karya ini, kaedah penentuan kedudukan Indikator Kekuatan Isyarat Diterima (berdasarkan RSSI) digunakan untuk mengukur tahap daya pada penerima untuk menentukan lokasi pekerja. Senario yang berbeza telah dilakukan untuk menunjukkan ketepatan dan kebolehpercayaan sistem yang dikembangkan dengan mempertimbangkan ukuran pelaksanaan tempat tidur ujian, lingkungan pelaksanaan tempat tidur uji yang berkaitan dengan halangan di dalam ruangan, dan lokasi pekerja yang terkait dengan ketinggian di mana nod berada. Hasil kajian menunjukkan bahawa sistem yang dibangunkan mempunyai kebolehpercayaan dan prestasi yang tinggi dari segi ketepatan.

ABSTRACT

In the industrial sector, the number of employees is increasing from time to time. Therefore, it is impossible to track the location of all employees in the same building at the same time as they are placed in different sections. In fact, monitoring all employees at the same time may disrupt the progress of the work, thus decreasing productivity. The objective of this project is to develop a Real-Time Fog-Based Human Tracking and Monitoring System to determine the location of the employees in a real-time implementation. Based on the literature review, Long Range (LoRa) communication consumes low power with high coverage range besides requires low cost for deployment. In this work, a Received Signal Strength Indicator-based (RSSI-based) positioning method is used to measure the power level at the receiver to determine the location of the employees. Different scenarios have been conducted to demonstrate the precision and the reliability of the developed system considering the size of the test-bed implementation, the environment of the test-bed implementation related to the obstacles in the room, and the location of the employee related to the height of where the nodes are located. The results show that the developed system has high reliability and performance in terms of precision.

DEDICATION

“If you don’t make mistakes, you’re not working on hard enough problems. And that’s a big mistake”...

- F. Wikzek



I dedicated this thesis to myself for all the ups and downs to finish this thesis and thanks to Allah for giving me the strengths as well as my family who have been very supportive throughout my studies.

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CHAPTER 1

INTRODUCTION

1.1 Background of study

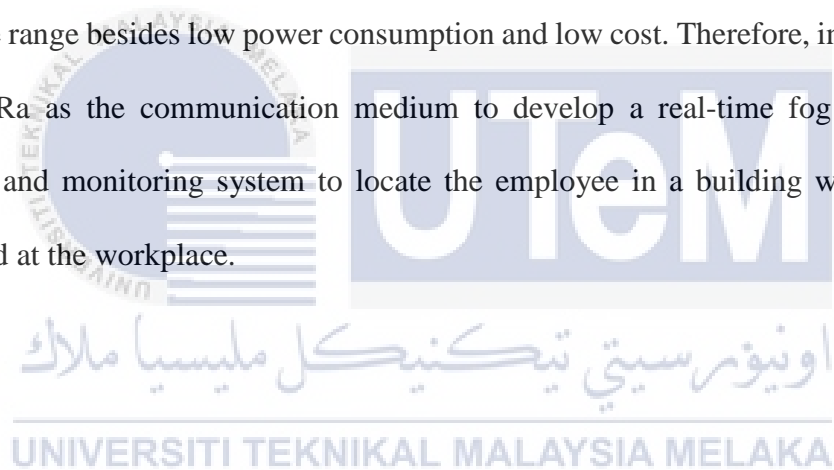
The advancement of technology brings the most-efficient application in the industrial and to the daily lives routine. Workplace safety is very important for every employee in the industry as they have the right to work in a safe and healthy environment. In the industrial, the employee will be exposed to an unexpected dangerous situation at the workplace such as emergencies, fire accidents, or natural disasters. For instance, a natural disaster such as floods, earthquakes, and hurricanes can cause huge damage to human property such as houses and cars and even loss of life. Long Range (LoRa) is a new networking system that emphasizes the low power usage that can handle several transmitters at different locations within a region by using a single receiver on the LoRa network [1], [2]. Besides, LoRa can also be used in a monitoring system to track objects or human presence inside the buildings such as offices, shopping complexes, schools, etc. Although Global Positioning System (GPS) has a high accuracy of up to five meters and very easy to be implemented for high-performing localization, however, the GPS is not an advisable option for indoor localization [2], [3].

Internet of Things (IoT) is a physical device that is connected to the Internet to develop interactive applications such as smart homes, smart parking systems, smart cities, and many more. The IoT is also able to share the data and control the system using

smartphones or laptops. Many wireless technologies have been used to support the development of IoT networks such as Wi-Fi, Bluetooth, Zigbee, FM signal, RFID, and, etc. Additionally, these devices are also used to support the development of an indoor localization system. Meanwhile, Long-Range (LoRa) technology has been developed for Low Power Large Area Networks (LPWAN) to support the M2M (Machine to Machine) and IoT application [3]. Besides, LoRa has a large coverage radius of up to 15 km for both the indoor and outdoor environments. As in [4], the authors developed an indoor localization system using Wi-Fi to improve the localization system. Meanwhile, the work in [1]- [3] uses the Receiver Signal Strength Indicator (RSSI) to measure the strength of the signal of the LoRa technology at the power receiver for the localization system. The RSSI value helps to indicate the signal strength of the transmitter inside the manufacturing. RSSI is the most popular signal propagation method to estimate the power level at the access point or receiver. Due to its simplest technique which also does not requires additional hardware, the cost to develop a system using LoRa is low. In this study, we developed a real-time fog based human tracking and monitoring system. To determine the location of the employee using LoRa, we use RSSI to determine the location of the employee by indicating the signal strength between the transmitter and receiver (i.e. devices attached to the employee) of LoRa modules.

1.2 Problem Statements

In industrial, the number of employees is growing from time to time. Therefore, it is hard to monitor all employees at the same time as they are located in different sections although in the same building. Furthermore, monitoring all employees at the same time may disrupt the progress of the work, thus decreasing productivity. The wireless technology such as Wi-Fi, Bluetooth, and Zigbee is not applicable to cover the large area in the building. Besides, they have their limitations in terms of accuracy, transmission range, and cost. For example, Wi-Fi has high accuracy but it consumed high power. Meanwhile, Bluetooth has a low transmission range. LoRa has the main features of high coverage range besides low power consumption and low cost. Therefore, in this work, we used LoRa as the communication medium to develop a real-time fog based human tracking and monitoring system to locate the employee in a building when a disaster happened at the workplace.



1.3 Objectives

There are three objectives in this study as follow:-

1. To develop a Real-Time Fog-Based Human Tracking and Monitoring system.
2. To analyze the performance of the developed system in terms of reliability in a real-time implementation.
3. To analyze the performance of the system in terms of precision.

1.4 Project Scope

This project focuses on the ability to determine the location of the employees in case of emergencies such as natural disasters which may cause the building to collapse. An experiment is conducted to test the performance of the developed indoor localization tracker system in terms of reliability and precision. The experiment will take place in a house located in Taman Semenyih Impian, Semenyih Selangor considering two employees located in different rooms.

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1.5 Thesis Organisation

This study focuses on the Development of a Real-Time Fog-Based Human Tracking and Monitoring system. The performance of the developed system in terms of reliability and precision will be evaluated through the experiment in real-time application. Chapter 1 discusses the introduction of the study that includes the background of the study, problem statement, objectives, scope of work, and the expected outcome. Chapter 2 present the literature review of the related topics, the comparison of the microcontroller, communication devices, and Internet of Things (IoT) platform. Chapter 3 explains the methods that include the hardware, block diagram, flowchart of the system development. Chapter 4 discusses the result includes the code and hardware development, project analysis, and discussion of the study. Lastly, chapter 5 discusses the conclusion and future works of this study.

