

**PERFORMANCE ANALYSIS OF LONG RANGE SENSOR
SYSTEM**

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PERFORMANCE ANALYSIS OF LONG RANGE SENSOR SYSTEM

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DECLARATION

I declare that this report entitled “Performance Analysis of Long Range Sensor System” is the result of my own work except for quotes as cited in the references.

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DEDICATION

A special dedication to my parents, Mr. Anuar Bin Sahir and Mrs. Kalsom Binti Kasmin for giving me a moral support, for my supervisor En. Fakrulradzi Bin Idris for supervises teaching me during my final year project studies and thanks to my dearest friends.

ABSTRACT

The wireless sensor network is one of the emerging technologies that will give impact on the environment, technology, and society. The main technology nowadays must have a purpose on using the Internet of Things (IoT). This IoT will make all the jobs easier because it can be accessed anywhere around the world. The LoRa Bee is one of the Semtech technologies devices that can transmit the data in the long range. The focus area of implementation for this project when there is no line of sight and line of sight area. This project will describe the performance of Long Range sensor system. This involves on building the prototype of LoRa based sensor node and also analyze the performance of this sensor system. This project using Arduino and LoRa Bee as a sensor node while Raspberry Pi and LoRa Bee as a gateway. The data of a certain parameter is collected and already analyze in this thesis.

ABSTRAK

Rangkaian sensor wayarles adalah salah satu teknologi baru yang akan memberi kesan kepada alam sekitar, teknologi, dan masyarakat. Teknologi utama pada masa kini mesti mempunyai tujuan menggunakan Internet of Things (IoT). IoT ini akan menjadikan semua pekerjaan lebih mudah kerana ia dapat diakses di mana sahaja di seluruh dunia. LoRa Bee adalah salah satu alat teknologi Semtech yang dapat memancarkan data dalam jarak jauh. Bidang tumpuan pelaksanaan projek ini apabila tidak ada garis penglihatan dan garis penglihatan. Projek ini akan menerangkan prestasi sistem sensor Long Range. Ini melibatkan membina prototaip nod sensor berdasarkan LoRa dan juga menganalisis prestasi sistem sensor ini. Projek ini menggunakan Arduino dan LoRa Bee sebagai nod sensor manakala Raspberry Pi dan LoRa Bee sebagai pintu masuk. Data parameter tertentu dikumpulkan dan telah dianalisis dalam tesis ini.

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Many thanks to my family members for helping me survive all the stress, for not letting me give up and for the continuous support. Also, many thanks to the UTeM lecturers that had been teaching me all the programming and understand the circuit skills which had brought me to this level. Lastly, my appreciation to my friends, because helped me in order to complete this project.

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LIST OF SYMBOLS AND ABBREVIATIONS

LoRa	:	Long Range
BW	:	Bandwidth
CR	:	Coding Rate
SF	:	Spreading Factor
WSN	:	Wireless Sensor Network
IoT	:	Internet of Things
ISCP	:	In-Circuit Series Programming
SKMM	:	Suruhanjaya Komunikasi dan Multimedia Malaysia
CPU	:	Central Processing Unit
GPU	:	Graphics Processing Unit
USB	:	Universal Serial Bus
RPi	:	Raspberry Pi
OS	:	Operating System
LoS	:	Line of Sight
Non-LoS	:	Non Line of Sight
IP	:	Internet Protocol

RSSI	:	Receiving Signal Strength Indicator
SNR	:	Signal-to-Noise Ratio
ISM	:	Industrial, Scientific and Medical
FCC	:	Federal Communication Commission
NB-IoT	:	NarrowBand – Internet of Things

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CHAPTER 1

INTRODUCTION

This chapter will discuss the background of this project. Problem statement, objective and scope will be explained in this section. Structure of the report will explain deeply in this chapter as well.

1.1 Project Background

Nowadays, the wireless sensor could play a central role in the Internet of Things (IoT), especially in the low-power long-range network. The self-configuring tiny sensor nodes that could communicate wirelessly among themselves once deployed and it was called as a wireless sensor network is made up. The low power communication had evolved until reach multi-kilometer ranges and have a bit-rate approach such as LoRa. LoRa is a wireless telecommunications system that has a

long-range, low-power and low bit-rate for the Internet of Things (IoT). There is just “less of everything” available in a network device which is less memory, less processing power, less bandwidth, and the important thing is less available energy. This “less of everything” could be an essential difference between “the Internet” and “the Internet of Things” (IoT). The scope of the project will involve a design LoRa based sensor system which consists of the sensor node and gateway node for agriculture application. When the design has done, the detailed analysis of power consumption as well as packet loss and the signal strength will be covered. The performance of analysis will be cover for indoor and outdoor.

1.2 Problem Statement

- i. The current communication device system has a limited range. Basically, every sensor only limited up to 100 meters.
- ii. The frequency of the current system is too congested such as Bluetooth, WiFi and ZigBee are using the same frequency which is 2.4GHz.

1.3 Objective

The aim of the study is to analyze the performance of Long Range sensor system. In order to achieve that, the objective had been drafted as below:

- i. To design and develop a prototype of LoRa based sensor system
- ii. Study the performance of the LoRa system in term of range, SNR and receiving signal strength indicator (RSSI).

1.4 Scope of Project

The scope of this project is to develop the design of the long-range sensor system based on LoRa for agriculture application. This project will use the sensor and Arduino Uno as the sensor node to incorporate with LoRa and also the Raspberry Pi as a LoRa gateway. This project will include the analysis of the performance of Long Range sensor system in term of RSSI and SNR. The IoT platform also will be described in this project.

However, there are some limitations to this project. The first limitation is the current antenna cannot be used in long-range thus it is not working at their optimum performance. The second limitation is cost. Since this project using LoRa Bee, Arduino Uno and Raspberry Pi, so the cost is quite expensive because the allocation for this project must be below that RM200.

1.5 Methodology

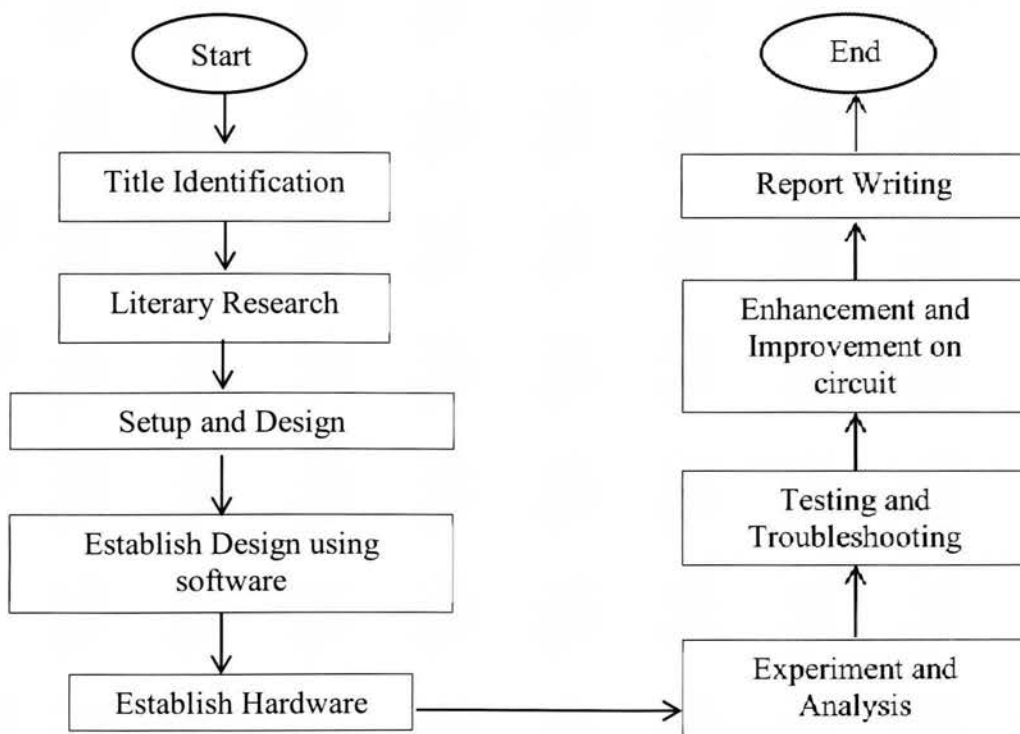


Figure 1.1: The flowchart for overall project

1.6 Thesis Outline

The thesis consists five chapters to elaborate on performance analysis of Long Range sensor system which is starting with Introduction, Literature Review, Methodology, Project Requirement, Design Analysis, and Conclusion.

Chapter 1 – Introduces the project as a whole. The early and basic explanations are mentioned in this chapter. The introduction has discussed the background of the project, problem statement, and the purpose of developing this project. It also mentions the importance of this project.

Chapter 2 – This chapter contains the literature review on theoretical concept applied in this project. It contains the information gathering of the project in order to complete the whole project.

Chapter 3 – Methodology described the methods used in solving projects. Among the main content of this chapter are Initial Planning, Planning, Requirements, Analysis and Design, Implementation, Testing, Evaluation, and Deployment.

Chapter 4 – Concentrates on the result and discussion of this project. The methods start design which is flowchart and function of this system.

Chapter 5 – Conclusion consists the summary of the project. After the project is complete, recommendations are made for the improvement of this project or any expansions or upgrades that might be done in the future.

CHAPTER 2

LITERATURE REVIEW

This chapter will explain and discuss several journals and articles related to this case study. All former researches which provide any type of information towards this work are analyzed and compared to get the necessary data needed. The analysis of the previous projects is being done in this segment to give a clearer idea towards this study.

2.1 Overview of wireless sensor network

During this modern era, wireless communication and microelectronics technologies have been growing rapidly. The facilities on developing a multi-functional sensor node have been well implemented in the tiny size. The implementation of data flow by collecting, processing and transmitting can be categorized as the working principle of WSN [1].