



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE DEVELOPMENT OF PET GPS TRACKER USING

LORA

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

By

LEE LI YIN

B 071610483

960727 – 06 - 5154

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING

TECHNOLOGY

2019

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: The development of pet GPS tracker using LoRa

Sesi Pengajian: 2019

Saya **Lee Li Yin** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (X)

SULIT*

Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.

TERHAD* Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.

TIDAK
TERHAD

Yang benar,

Disahkan oleh penyelia:

.....

.....

Lee Li Yin

EN. MOHD FAIZAL BIN ZULKIFLI

Alamat Tetap:

Cop Rasmi Penyelia

No, 54 TANJUNG LIPIS

27200 KUALA LIPIS

PAHANG

Tarikh:

Tarikh:

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini

DECLARATION

I hereby, declared this report entitled The development of pet GPS tracker using LoRa is the results of my own research except as cited in references.

Signature:

Author : Lee Li Yin

Date:

APPROVAL

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

Signature:

Supervisor : EN. MOHD FAIZAL BIN ZULKIFLI

Signature:

Co-supervisor: EN. FAREES EZWAN BIN MOHD SANI

@ ARIFFIN

ABSTRAK

Terdapat banyak kes hilang yang dilaporkan oleh Persatuan Amerika untuk Pencegahan Kekejaman untuk Haiwan (ASPCA) baru-baru ini. Sistem pengesanan haiwan kesayangan telah ditindas oleh pemilik haiwan untuk menjaga haiwan kesayangan mereka hilang. Walaupun tracker haiwan peliharaannya sangat popular di kalangan pemilik haiwan peliharaan, tetapi sistem penjejakan haiwan kesayangan selalu mengalami hayat bateri yang pendek dan sukar untuk menerima lokasi haiwan peliharaan dalam jarak jauh. Cadangan projek ini adalah untuk mengkaji dan membangunkan sistem pengesanan haiwan untuk mencegah masalah kehilangan haiwan kesayangan. Teknologi LoRa dan teknologi GPS digabungkan untuk membangunkan sistem penjejakan haiwan dengan kos yang rendah. Sistem penjejakan haiwan kesayangan yang dilengkapi dengan LoRa, yang membenarkan pelacak untuk memantau lokasi haiwan kesayangan apabila haiwan kesayangan dijalankan jauh dari pemiliknya. Sistem penjejakan haiwan ini juga dilengkapi dengan GPS yang akan sentiasa memantau haiwan kesayangan dengan output koordinat ketepatan yang tinggi di bawah semua keadaan. Hasil yang dijangkakan dari projek ini adalah penjejak haiwan kesayangan yang mempunyai jarak jauh yang membolehkan pemilik haiwan peliharaan memantau haiwan mereka walaupun haiwan kesayangan mereka berjalan jauh atau haiwan peliharaan hilang. Penjejak haiwan kesayangan akan dapat mengesan haiwan peliharaan dalam tempoh masa yang singkat dengan output koordinat ketepatan yang tinggi dan mempunyai penggunaan kuasa yang rendah. Sistem pengesanan akan membolehkan pemilik haiwan peliharaan melihat lokasi haiwan kesayangan mereka dalam telefon pintar menerusi aplikasi tanpa menggunakan Wi-Fi dan GSM. Penjejak dilampirkan kepada haiwan peliharaan kerana saiznya yang kecil. Sistem pengesanan ini dapat menjejaki lokasi haiwan kesayangan secara terus menerus di kawasan jarak jauh atau luar bandar dengan penggunaan kuasa yang rendah.

ABSTRACT

There are many cases of pet lost reported by American Society for the Prevention of Cruelty to Animals (ASPCA) recently. The pet tracking system has been demanded by pet owner in order to keep their pet from lost. Although the pet tracker is popular among the pet owner, but the pet tracking system always suffer from short battery life and difficult to receive the location of pet in long distance. The propose of this project is to study and develop pet tracking system to prevent pet lost problem. LoRa technology and GPS technology is combined in order to develop the pet tracking system with low cost. The pet tracking system equipped with LoRa, which allowed the tracker to monitor the location of pet when the pet is run far away from their owner. This pet tracking system also equipped with GPS that will continuously monitoring the pet with high accuracy coordinate output under all condition. The expected outcome of this project is the pet tracker have long-range distance that enable the pet owner to monitor their pet even if their pet run far away or the pet is lost. The pet tracker will be able to track pet in short period of time with high accuracy coordinate output and have low power consumption. The tracking system will allow pet owner to view the location of their pet in smartphone through an apps without using Wi-Fi and GSM. The tracker is attachable to pet due to its small size. This tracking system is able to track the location of pet continuously in long distance or rural area with low power consumption.

DEDICATION

This thesis is dedicated to my parents and family members who give moral support and encouragement during completing this report. I also would like to dedicate to my friends and supervisor that always possibly help me when I have trouble with this project.

ACKNOWLEDGEMENT

I would like to take this opportunity to express my deepest gratitude to all the wonderful people who given me continuous support, guidance, experience, understanding and commitment to the success of this venture. Besides that, I would like to express my sincere appreciation for the support, advice, suggestion and motivation of my supervisor, En. Mohd Faizal Bin Zulkifli to complete this project. Finally, I would like to express my gratitude to my parents and friends that had given me support and encouragement during completing this project.

TABLE OF CONTENTS

ABSTRAK	iii
ABSTRACT	iv
DEDICATION	v
ACKNOWLEDGEMENT	vi
TABLE OF CONTENTS	vii
LIST OF TABLES	xi
LIST OF FIGURE	xii
LIST OF APPENDICES	xv
LIST OF SYMBLO	xvi
LIST OF ABBREVIATIONS	xvii
CHAPTER 1 INTRODUCTION	1
1.1 INTRODUCTION	1
1.2 PROBLEM STATEMENT	2
1.3 OBJECTIVE	3
1.4 PROJECT SCOPE	4
1.5 EXPECTED RESULT	4
1.6 THESIS ORGANIZATION	5
1.7 SUMMARY OF CHAPTER 1	5

CHAPTER 2	LITERATURE REVIEW	7
2.1	INTRODUCTION	7
2.2	RELATED WORK	8
2.2.1	The IoT LoRa System Design for Tracking and Monitoring Patient with Mental Disorder	8
2.2.2	Design and Implementation of Object Tracking System Based on LoRa10	
2.2.3	Energy Efficient LoRa GPS Tracker for Dementia Patients.	11
2.2.4	GPS-free Geolocation using LoRa in Low power WANs.	12
2.2.5	Long-Range Wireless Sensor Networks for Geo-location Tracking: Design and Evaluation	15
2.2.6	A Cloud Based Bluetooth Low Energy Tracking System for Dementia Patients.	16
2.2.7	Animal Situation tracking Service Using RFID, GPS, and Sensor.	17
2.2.8	GPS Based Automatic Vehicle Tracking Using RFID.	19
2.2.9	Efficient, Real-time Tracking of Public Transport, Using LoRaWAN and RF Transceivers.	21
2.2.10	IoT Devices and Application based on LoRa/LoRaWAN.	24
2.3	HARDWARE	25
2.3.1	Microcontroller	25
2.3.2	Tracking System	28
2.3.3	Communication Devices	30

2.3.4	IoT Platform	32
2.3.5	Transceiver Module	34
CHAPTER 3	METHODOLOGY	36
3.1	INTRODUCTION	36
3.2	PROJECT WORKFLOW	36
3.3	HARDWARE	38
3.3.1	Arduino Pro Mini	38
3.3.2	RFM95W LoRa Module	40
3.3.3	Neo 6m GPS Module	41
3.3.4	Supply	42
3.4	TRANSCEIVER CONNECTIVITY	44
3.5	TROUBLESHOOTING	45
3.6	PROJECT SYSTEM ARCHITECTURES	46
3.6.1	Operational Flow	49
3.7	BLOCK DIAGRAM	49
3.8	SOFTWARE IMPLEMENTATION	51
CHAPTER 4	RESULT AND ANALYSIS	53
4.1	INTRODUCTION	53
4.2	THE DEVELOPED GPS TRACKING SYSTEM	53
4.3	RESULT ANALYSIS	55

4.4	DISPLAY OF RESULTS	57
4.4.1	Arduino IDE	57
4.4.2	Blynk Map Widget	60
4.4.3	Notification and Email	60
4.5	SUMMARY	62
CHAPTER 5	CONCLUSION AND RECOMMENDATION	63
5.1	INTRIDUCTION	63
5.2	CONCLUSION	63
5.3	RECOMMENDATION AND FUTURE WORK	64
5.3.1	Tracking System	64
5.3.2	Communication Device	64
5.3.3	Microcontroller	65
5.3.4	Power Supply	65
5.4	PROJECT POTENTIAL	65
	REFERENCES	67
	APPENDIX	68

LIST OF TABLES

Table	Title	Page
Table 2.1:	Comparison Between Arduino	28
Table 2.2:	Comparison Of Communication Devices	31
Table 2.3:	Advantages And Disadvantages For Thingspeak	32
Table 2.4:	Advantages And Disadvantages For Google Cloud Platform.	33
Table 2.5:	Shows Advantages And Disadvantages For Blynk Platform.	33
Table 3.1:	Function And Application For Component.	38
Table 3.2:	Arduino Pro Mini Details	39
Table 3.3:	Arduino Pro Mini Pinout Function	40
Table 3.4:	Pin Description	40
Table 3.5:	Pin Configuration	44
Table 3.6:	Pin Configuration	47
Table 3.7:	Pin Configuration	48
Table 4.1:	Pin Configuration	56

LIST OF FIGURE

Figure	Title	Page
Figure 2.1:	Showed The Proposed Design For Tracking System Using Lora Technology.	9
Figure 2.2:	Lora Architecture	11
Figure 2.3:	Lora Gps Development Platform	12
Figure 2.4:	Elements In Lorawan System	13
Figure 2.5:	Algorithm Structure	14
Figure 2.6:	Flow Diagram Of The Tracking System.	17
Figure 2.7:	The Mark Of Animal Cages On Map.	18
Figure 2.8:	The Animal Location Tracking On Map	19
Figure 2.9:	Automatic Vehicle Tracking	20
Figure 2.10:	Transmitter Of Gps Based Automatic Vehicle Tracking & Controlling Device	21
Figure 2.11:	Model Of Proposed Solution.	22
Figure 2.12:	Transmission Model	23
Figure 2.13:	Received Model	23
Figure 2.14:	Arduino Uno	26
Figure 2.15:	Arduino Nano	26
Figure 2.16:	Arduino Due	27
Figure 2.17:	Arduino Pro Mini	28
Figure 2.18:	Neo-6m Gps Module	29

Figure 2.19: Neo-M8n Gps Module	30
Figure 2.20: Esp-01 Wi-Fi Module	34
Figure 2.21: Hc-05 And Hc-06 Bluetooth Module	35
Figure 3.1: General Flow Chart For The Project	36
Figure 3.2: Arduino Pro Mini Pinout	39
Figure 3.3: Rfm 95w Lora Module	41
Figure 3.4: Neo 6m Gpd Module	42
Figure 3.5: Lipo Battery	43
Figure 3.6: Tp4056 Lipo Battery Charging Board	43
Figure 3.7: System Overview Of Gps Pet Tracking System	46
Figure 3.8: The Wiring Diagram Of Lora Gps Pet Tracker	47
Figure 3.9: The Wiring Diagram For The Receiver.	48
Figure 3.10: General Flow Chart For Tracking System	49
Figure 3.11: Block Diagram For Transmission Model	50
Figure 3.12: Block Diagram For Receiver Model	51
Figure 3.13: System Overview Of Controlling Arduino With Blynk App	52
Figure 4.1: Transmitter Of The Lora Gps Tracker	54
Figure 4.2: Receiver Of The Lora Gps Tracker	54
Figure 4.3: Blynk Map Widget	55
Figure 4.4: Time Respond For Lora Gps Tracker	55
Figure 4.5: The Serial Monitor Tool Of Arduino Ide.	57
Figure 4.6: The Transmitter's Data Shows In Serial Monitor Of Arduino Ide	58
Figure 4.7: The Receiver's Data Shows In Serial Monitor Of Arduino Ide	58
Figure 4.8: Blynk Successful Connect With The Arduino	59

Figure 4.9: The Current Location Of The Pet	60
Figure 4.10: Coding For Calling Notification And Email	60
Figure 4.11: Email	61
Figure 4.12: Notification	61

LIST OF APPENDICES

Appendix	Title	Page
Appendix 1:	Gantt Chart Of The Project	68
Appendix 2:	Coding For Transmitter	69
Appendix 3:	Coding For Receiver	71

LIST OF SYMBLO

MHz	Mega Hertz
km	Kilometre
mA	Mile Ampere
kbps	Kilo bit per second
kHz	Kilo Hertz
V	Voltage
mm	Mile metre

LIST OF ABBREVIATIONS

GPS	Global Positioning System
GSM	Global System for Mobile Communication
LoRa	Long Range
IoT	Internet of Things
ISM	Industrial, Scientific and Medical
WAN	Wide Area Network
BLE	Bluetooth Low Energy
WiFi	Wireless Fidelity
LPWAN	Low Power Wide Area Network
SNS	Social Networking Service
GCM	Google Cloud Messaging
SNR	Signal to Noise Ratio
GNSS	Global Navigation Satellite System
RSSI	Received Signal Strength
LoRaWAN	Long Range Wide Area Network
TTN	The Things Network
RFID	Radio frequency identification
WSN	Wireless Sensor Network
IP	Internet Protocol
MAC	Medium Access Control
AVL	Automatic Vehicle Location

GIS	Geographic information system
WC	Wireless Communication
USB	Universal Serial Bus
PC	Personal Computer
EEPROM	Electrically Erasable Programmable read- only Memory
GLONASS	Global Satellite Navigation System
HTTP	Hyper Text Transfer Protocol
GCP	Google Cloud Platform
LiPo	Lithium Polymer
CMD	Command Prompt
APP	Application

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The Global Positioning System, or widely known as GPS is a global navigation satellite system that made up of at least 24 satellites. The early GPS technology was designed primarily for military use. The GPS was used to locate the location of enemy in order to prevent the sudden attacked from enemy. In the 1980s and 1990s, the use of the military was obvious, but the public's curiosity about GPS technology was scarce. In 1996, President Bill Clinton determined that the system could become a citizen and military asset and issued a policy directive calling for a public system that would benefit daily users. The policy adjusts GPS technology for ordinary people, such as fleet managers, who can see the advantages of using the technology to monitor their cars. In the 1990s, additional modifications were made to GPS technology and equipment. This includes policies for individual users and easy access to changes.

Nowadays, GPS tracking system is becoming popular in human live. They use GPS tracking system to monitor and track the location of the moving object. The GPS can be work in whole day and function in all the weather condition. The cost for the GPS is lower than others navigation systems. Due to the low cost, GPS can be easily to integrate into many technologies such as tracking system and cell phone. There are many pet lovers take their pet as a part of their family. To prevent pet from lost, most of the pet lovers using the GPS tracking system to monitor and track their pet.

Internet of Things (IoT) technology is a technology that transfers data to an object via the internet in real time. The devices connected to the internet require manual adjustment to exchange data, but IoT can exchange data without any adjustment. LoRa technology is one of the IoT technologies that used in the development of the GPS tracking system. LoRa is stands for Long Range Radio which is a new wireless protocol that provides long range, low power and secure data transmission for Internet of Things (IoT) application. It was developed by Cycleo of Grenoble, France, and acquired by Semtech company in 2012. LoRa can be used for wireless connection to the cloud of sensor, gateways, machines, devices, animals, people and so on. It able to detect an object's location up to 15km until 20km. LoRa uses unlicensed spectrum in the ISM bands with the radio frequency like 169MHZ, 433MHZ, 868MHz and 915MHz. Due to the bandwidth limitation, LoRa- based networks has lower cost than a network based on other protocols. LoRa technology with low energy consumption can make a very cost-effective IoT infrastructure. LoRa technology has also highly security from end devices to application servers, thus it also supports for the outdoor application. According to (Hayati and Lora, 2017), LoRa technology was chosen as the primary communication platform because of its better WAN coverage. LoRa technology has the advantage of scalability feature. This feature enables stakeholders to add or decrease infrastructure as necessary.

1.2 PROBLEM STATEMENT

Recently, people regard pet such as dog, cat and so on as their friends or even family members due to their accompany. Pet lovers care for their pets like children who care for them. However, the problem of lost pets and pets been stolen still happening. This is because pet easily lose their sense of direction once they are far ways from home

and someone stolen the pets to sell it to unsuspecting person. Since 2007, the American Kennel Club has noted that the dog stealing report has increased by 31% in recent years. According to the American Society for the Prevention of Cruelty to Animals (ASPCA) that posted in Newsletters on 2017, there are one out of seven owners lost their pets like dog and cat in the past five years. When the pet has been lost, pet owner will be grieved. To prevent the pet lost, pet owner use GPS tracking system to track their pet's location.

According to the (Hadwen *et al.*, 2017), most of the tracking system has the issue with battery life. This problem brings a lot of inconvenience to pet owner. The pet owners need to charge the tracker before use, but some of the tracker still cannot function for long period although the tracker has fully charge. In addition, most of the GPS ftracker uses BLE or Wifi as the communication device. However, these communication devices do not have long range distance. Pet owner are enabled to bring their pet to field for a walk, but pet owners will difficult to monitor or track the location of their pets.

Pet GPS tracker usually must be small, low power consumption and long-range distance. To develop the tracker with small component is quilt complicated because the component is small and easily misplaced. The component is costly cause to spend much money to buy the component for every session.

1.3 OBJECTIVE

The objective of this project is:

1. To study the functionality and the method used in the Pet GPS tracking system.
2. To develop the Pet GPS tracking system by using LoRa.
3. To analyze about the performance of the tracking system.