Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF PET HEALTH MONITORING COLLAR WITH GPS TRACKER USING LoRa

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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DEVELOPMENT OF PET HEALTH MONITORING COLLAR WITH GPS TRACKER USING LoRa

ASHWINI A/P JAYADEVAN NAIDU

A project report submitted
in partial fulfillment of the requirements for the degree of
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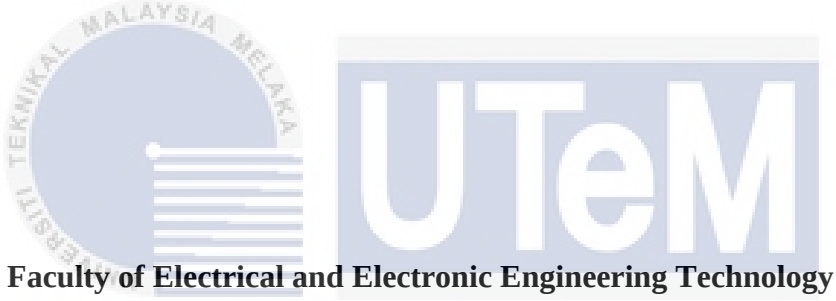

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I declare that this project report entitled "**DEVELOPMENT OF PET HEALTH MONITORING COLLAR WITH GPS TRACKER USING LoRa** " is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

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Date : 11/1/2022

DEDICATION

This project is dedicated to my loved ones and pet owners.

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ABSTRACT

Pet owners have been the subject of 60% of the complaints received by the Veterinary Services Department (DVS) during the previous two years. In recent times, many pet owners have failed to grasp the complexities of pet health issues. This includes the missing pet cases that have gone up a lot. The main cause for the rapidly growing number of reported cases is that, pet owners are experiencing financial challenges as a result of high-priced veterinary costs. In spite of this, many pet owners find it difficult to assume responsibility for their pet's safety. This project was created to monitor the health state of pets and to track their movements safely. Aside from that, the goal of this project is to validate this developed health monitoring collar towards animals in order to track their location and health status by using smartphone. This project embedded in a pulse/heart beat and temperature sensor to detect, GPS module to track location, LoRa module as transmission medium to transmit data and Arduino Nano to process the data. The real time monitoring health status and location can be present on the Blynk application which have been installed by the pet owners in their smartphones. As the results, this project has been successfully developed and is fully validated with the real pet. The condition and location of the pet can be freely monitored through the Blynk application by the pet owner. In conclusion, the project will be very helpful for pet owners to monitor health status and to track the current location of the pet in real time.

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ABSTRAK

Pemilik haiwan peliharaan merupakan subjek 60% bagi aduan yang diterima oleh Jabatan Perkhidmatan Veterinar (DVS) dalam tempoh dua tahun sebelumnya. Sejak kebelakangan ini, banyak pemilik haiwan kesayangan telah gagal memahami kerumitan masalah kesihatan haiwan kesayangan. Ini termasuk peningkatan kes kehilangan haiwan kesayangan yang semakin teruk. Punca utama peningkatan kes yang dilaporkan adalah bahawa, pemilik haiwan kesayangan mengalami kesusahan dari segi kewangan akibat kos veterinar dengan harga tinggi. Walaupun begitu, ramai pemilik haiwan kesayangan merasa sukar untuk bertanggungjawab terhadap keselamatan haiwan kesayangan mereka. Projek ini dicipta untuk memantau keadaan kesihatan haiwan peliharaan dan untuk mengesan pergerakan mereka dengan selamat. Selain itu, matlamat projek ini adalah untuk mengesahkan kolar pemantauan kesihatan yang dibangunkan ini terhadap haiwan untuk mengesan lokasi dan status kesihatan mereka dengan menggunakan telefon pintar. Sistem ini disertakan dengan pengesan nadi/dengupan jantung dan suhu, modul GPS untuk menjejaki lokasi, modul LoRa sebagai medium untuk menghantar data dan Arduino Nano untuk memproses data. Projek memantau status kesihatan dan lokasi semasa boleh didapati di aplikasi Blynk yang telah dimuat turunkan oleh pemilik haiwan peliharaan di telefon pintar mereka. Hasilnya, projek ini telah berjaya dibangunkan dah disahkan sepenuhnya dengan haiwan peliharaan yang sebenar. Keadaan dan lokasi haiwan peliharaan juga boleh dipantau dengan bebas melalui aplikasiI Blynk oleh pemilik haiwan peliharaan. Kesimpulannya, sistem ini dapat membantu pemilik haiwan kesayangaan unutk memantau status kesihatan and menjejak lokasi semasa.

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CHAPTER 1

INTRODUCTION

This chapter will discuss about the background of the project, problem statement, objectives, scope of the project and the project outline.

1.1 Research Background

According to [1] the cases received by the Malaysian's Veterinary Services Department (DVS), an estimated of 60% of our nation households have a pet particularly cats and dogs. Many pet owners have recently struggled to comprehend pet health problems and their own position in detecting and preventing illness. According to research, many pet owners are not responsible for bringing their pets in for a regular checkup to monitor their health status. A heart rate for animal, for instance, the heart rate of a dog will rise for several causes, including anxiety or stress, as well as physical exertion. This is natural, and it will usually get back to normal heartbeat rate level in a short amount of time. If the abnormally fast heart rhythm persists for an extended period, it may be a sign of a medical problem that necessitates veterinary treatment. There are several diseases that caused by rapid heartbeat rate for animals particularly dogs and cats. Tachycardia [2] is a disease marked by an abnormal heartbeat rate in pets.

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Basically, there are two types in of Tachycardia disease which is Superventricular Tachycardia and Ventricular Tachycardia. The differences from these both illnesses are, Superventricular Tachycardia [3] arises from heart illness while Ventricular Tachycardia might be result of heart illness, congenital defects, or other severe conditions. Moreover, other illness that can affect by an abnormal heartbeat rate in pets are dilated cardiomyopathy, drug overdose, gastrointestinal, pancreatitis, depression and etc. On the other hand, abnormal temperature rate also affected a pet's health condition which can cause illness. For instance, low temperature rate in pets particularly cats and dogs can cause Hypothermic disease while high temperature rate cause Hyperthermic disease or depression.

Throughout this research that have been made, shows that not many pet owners are not being concern about their pets' health issues and the illnesses that can affect through

heartbeat and temperature rate. In addition, normal regular medical checkup is very expensive. However, technological limitations remain in terms of pet health monitoring with the majority of veterinarians using traditional equipment in their clinics.

This project will be very helpful for the owners to detect their pet's current location and monitor their pet's health status in real-time. This project will apparently reduce the number of animal cases which received Veterinarian Service Department (DVS) that have been increase for past few years in all around the world. Moreover, The GPS tracker in this project will be able to detect the pet's current position, which will be helpful in tracking the location of the pet by the pet owners.

1.2 Problem Statement

Currently the process to monitor pet's health condition are only done in veterinary hospitals or clinics. According to [1] , pet owners are paying out thousands of ringgit to look after their pets. Although only going for normal regular vet consultations, it costs a very expensive bill.

Adoption fee	RM50
Cat litter	RM100
Carrier	RM17
Collar tag	RM9
Scratching post	RM30
Cat toys	RM15
Feeding bowl	RM30
Spay or neuter	RM100
Cat food	RM50
Vet check-up	RM150
Grooming	RM30
Total	**RM561**

Figure 1.1: Estimation cost for pet's vet check-up [1]

On the other hand, the cases of missing pets are increasing gradually while the found cases are remaining on the constant rate[4]. Pet owners were unable to locate or trace their lost pets. This difficulty occurs due to carelessness of pet owner to be aware their pet. Furthermore,

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vetenarians are recommending microchipping pets to most of the pet owners. Microchipping[5] is a small procedure where a small microchip will be inserted under animal's skin permenantly. This microchip will aid the pet owners to track their pets. There are few side effect arises due to microchipping such as cancer risk, abcesses, microchip migration and hair loss.

By using the advance features of the Internet of Things (IoT), pet owners can keep track and monitor their beloved pets, thus take action when necessary. Therefore, to aid the pet owners to key an eye on their pet's health status and get notified on their location in real time, a pet health monitoring collar with GPS tracker using LoRa is proposed.

1.3 Project Objective

The main purpose for this project are:

1. To study characteristics and functionality of LoRa and Blynk application.
2. To develop mobile based monitoring health system utilizing microcontroller.
3. To validate the developed project towards animals.

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1.4 Scope of Research

The scope of this project focuses mainly on using microcontroller and LoRa to communicate with GPS tracker, WiFi module, pulse/heartbeat rate sensor, temperature sensor and smartphone application which is Blynk application to alert the pet owners their pet's current health status in real time. The presence of GPS tracker and LoRa module will be able to detect the current location of the animal in long range. The detected location will be sent to owner's smartphone application. Moreover, the pulse/heartbeat rate sensor in this project will sensor the heartbeat rate while the temperature sensor will detect the temperature of the animal. Blynk application is used to received notification from the microcontroller. Last but not the least, this project is dedicated to every pet lover. The performance of the project is analyzed by observing the health condition and location detection in a range of distance.

1.5 Project Outline

This report consists of five chapters that are discussed about the implementation of this project, “Development of Pet Health monitoring collar with GPS tracker using LoRa”. According on the objective which have been previously presented and, on the approach, proposed before, this project is made up of five (5) chapters, which contents are summarized as follows:

- Chapter 1 introduces about the background of the pet health monitoring system and GPS tracker using LoRa. A problem statement is stated, and objectives are listed to set as a benchmark to be achieved to solve the problems. Finally, in this chapter it covers the scope of research and the outlines of this project.

- Chapter 2 consist of literature review. In this section, inserted discussion about the related research done by researchers based on the project implementation and functionality. A comparison between the projects is done to discover the main idea, theory and provide a broad view of the essence of implementation which will be satisfactory for this project.

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- Chapter 3 consists of the methodology used to execute in this project. The methodology is done by taking certain steps to develop this project while obeying the objectives stated. Moreover, a flowchart is designed to illustrate the whole function of this project system.

- Chapter 4 are included the details of results obtained from the performance of this project. Furthermore, the discussion on the analysis based on this project results and findings is being concluded clearly in this chapter.

- Chapter 5, basically concludes and summarizes the main ideas and states whether the project output has achieved the main objectives

that have been list out previously. Lastly, in this chapter there will be a section which gives suggestions on further improvement for this project in future with upcoming technology.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discuss the important information and details which are found by several study and research from related previous study. Therefore, the discussion begins with the study of smart animal health monitoring and GPS tracker concepts. It is important to research on these concepts because they are the main objective of this project. Furthermore, as this project involve the LoRa technology, it is vital to study the concepts of the technology to have a clear vision of the scope. In summary, this chapter end with the comparison of the related previous projects and the type of the implementation that will be fit in this project.

2.2 Concept of Smart Animal Health Monitoring

In general, smart refers to technology that is sensor-based, data-driven and more programmable. Moreover, it is also involving artificial intelligence. Animal health monitoring is a method where traditional medical scaling is incorporated with innovative technologies. Animal health monitoring benefit in several ways such as monitoring heartbeat rate, temperature rate, respiratory rate and also helps to get faster medical treatment at nearby veterinary clinic or hospital. Furthermore, it will also useful device for pet lovers to monitoring their pet's health status in real time. Heartbeat rate and temperature of an animal are the main important to identify the current health status. It is much simpler if we create an flexible wearable to automatically detect and perform all these tasks [6]. According to that, this technology has done many changes in the pet health monitoring sector such as:

1. Real-time monitoring system
2. GPS tracking
3. Data from sensor will be transfer to mobile application by using LoRa

According to [7], smart animal health monitoring concept consist of smart devices that are connected sensors that are able to monitor an animal health condition in real-time. With that, smart devices are components that are built in with sensors and intelligence to perform autonomous tasks. Moreover, the sensors will be seen to take part in the control system that

will be aid to monitor animal's health analysis. This show it is capable to detect current health status of an animal.

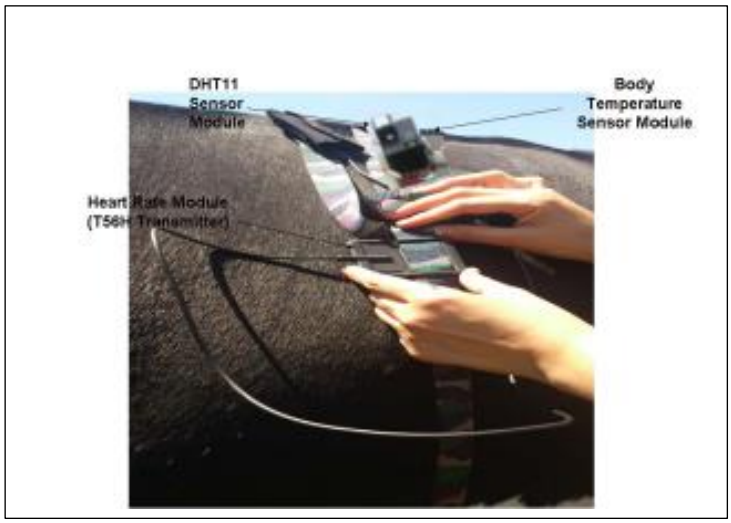

Figure 2.1: The setup of all sensors around the animal body [7]

Y.N.Malek stated that the idea of developing a device of detecting the temperature and be able to transmit the reading to the receiver[8]. Lately, the Internet of Thing (IoT) has widened its scope of accuracy to be used in the pet health monitoring device by adding smart sensors and technologies with low power consumption that are already present in other fields. For instance, this technology has been used widely on home automation, medical field and industrial. This is considered as Smart Health Monitoring which includes, data processing, data collecting and analysis. Data processing can be done through the implementation of IoT frame to assist veterinarian in their field for better actions. Royal Society for the Prevention of Cruelty to Animals (RSPCA) mentioned that a real-time data processing that be develop by using the aid of IoT [9]. This also have been proven by implementing it in collecting healthcare results such as breathing rate, oxygen level and also heartbeat rate. The implementation in this field enables the process of monitoring to be less difficult, reduce the cost and thus could be treated in less time.

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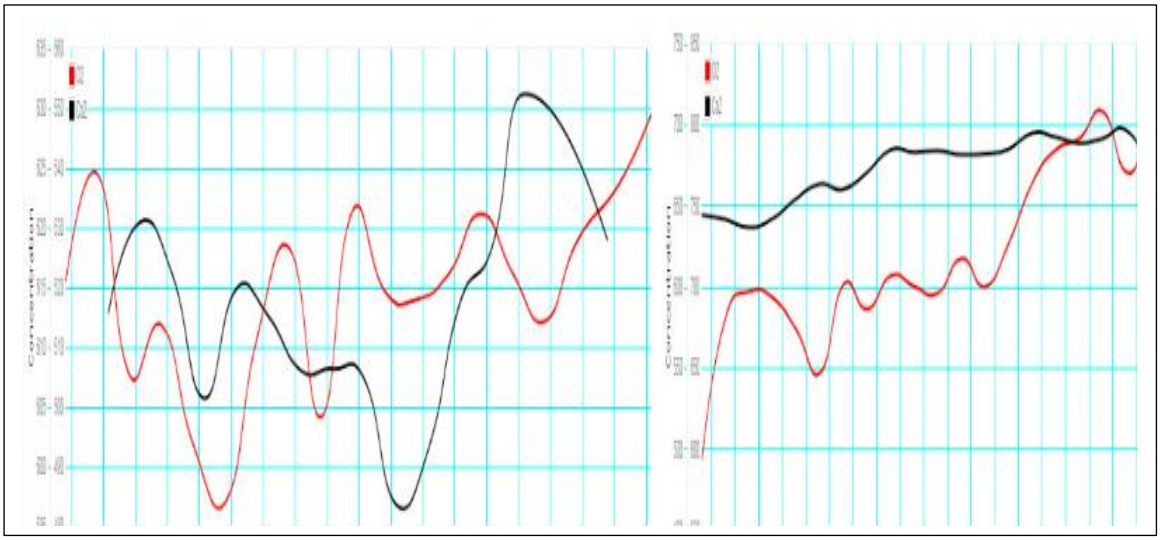

Figure 2.2: Display data for oxygen and carbon dioxide concentration [9]

The usage of a collar for pets especially cats and dogs, has been an identification tag for their safety and protection purpose. Collars were used as protection, identification and restraint pets like cats and dogs [10]. Now, the transition changes to automated and data-centered management. This new evolution is possible to be developed by implementing fundamental technologies such as the Internet of Things and GSM module [11]. Table 2.1 below shows in detail about the fundamental technologies in aiding technologies in smart health monitoring for pets.

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Table 2.1: Fundamental Technologies of Smart Health Monitoring.

Internet of Things (IoT)	Microcontroller	Compressed microcomputer that present in a single integrated circuit. It is enhanced to control electronic devices. This small device consists of memory, input-output pins, microprocessor on a single printed circuit board. This device normally used in industrial application and embedded with other devices to provide control and interfacing. Raspberry Pi and Arduino are one of the instances of microcontrollers.

	Micro sensors	Small device that can be able to measure multiple aspects. Therefore, some of this devices operates also on a nanoscale. For instances, sensors that measure heartbeat rate that gives output in digital format. The data that was previously unapproachable can be now measured and analyzed, such as the oxygen level in blood.
	Networking Technology	The desired output from the sensor must be sent over a network for analysis and processing. The networking technologies have considerably and range while reducing cost and power consumption.
	LoRa	It is a chirp spread spectrum (CSS)-based spread spectrum modulation approach. LoRa is a low-power wide-area network modulation method developed by LoRa Alliance. Low power, low cost, and dependable performance make LoRa Technology ideal for crucial smart healthcare applications.
GPS	GPS tracking unit	It is a technology that will be used for the process tracking any object. It has three separate data sets which is known as timing, navigation and positioning. GPS is used in a variety of operations, including military, first responder, commercial, and personal applications.

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As the emergent population worldwide, it is necessary to improvise the development of health monitoring system especially for animals to the next level. Smart health monitoring for pets has all the chances to be implemented with the aid of fundamental technologies such as Internet of Things(IoT) and GPS trackers. This implementation requires less human involvement and capable of monitoring the current health status for our beloved pets from