UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF WIRELESS CONTROLLED FERTILIZER SPRAYING ROBOT

LOGESHWARAN S/O RAVINDREN

Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

2021

DEVELOPMENT OF WIRELESS CONTROLLED FERTILIZER SPRAYING ROBOT

LOGESHWARAN S/O RAVINDREN

A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : DEVELOPMENT OF WIRELESS CONTROLLED FERTILIZER SPRAYING ROBOT

Sesi Pengajian : 2021/2022

Saya LOGESHWARAN S/O RAVINDREN ..... mengaku membenarkan laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (✓):

☐	**SULIT***	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD***	(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	**TIDAK TERHAD**	

Disahkan oleh:

R.LOGESHWARAN

(TANDATANGAN PENULIS)

Alamat Tetap:
NO 25, LORONG MERAK 15,
TAMAN MERAK,
14110 SIMPANG AMPAT,
PULAU PINANG

Tarikh: 10-01-2022

(COP DAN TANDATANGAN PENYELIA)

TS ZAHARIAH BINTI MANAP
Penyelaras Program BEET
Jabatan Teknologi Kejuruteraan Elektronik dan Komputer
Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik
Universiti Teknikal Malaysia Melaka

Tarikh: 10-01-2022

*CATATAN: Jika laporan ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh laporan ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I declare that this project report entitled "Development of Wireless Conrolled Fertilizer Spraying Robot " 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.

Signature : *R.LOGESHWARAN*

Student Name : LOGESHWARAN S/O RAVINDREN

Date : 10-01-2022

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.

Signature : 

Supervisor Name : TS. ZAHARIAH BINTI MANAP

Date : 10-01-2022

DEDICATION

To my beloved mother, SATIRANI D/O GENESAN,

father, RAVINDREN S/O A.KARUNAGARAN,

ABSTRACT

In the farming sector, fertilizing the crops is very important from the early stage to ensure good quality products during the harvest stage. However, this process takes a significant amount of time and could impact other activities of farmers, which may decrease productivity. Traditionally, farmers utilize the splash tank with bare hands to splash the fertilizer. This technique may cause primary infections because fertilizers contain a chemical substance called Alkali (NH3). It may lead to dangerous diseases such as respiratory issues through inward breath and skin cancer in the long run. Therefore, a safer method is needed to overcome the problem. This project develops a fertilizer spraying robot that can execute the task on the farmers' behalf. The robot will navigate on a farm and execute the tasks based on commands sent wirelessly using Bluetooth signals from a distance. The development of the robot is divided into two phases: hardware and software development. Hardware development involves building a moving robot with a fertilizer spraying system, and software development focuses on the mobile application. According to the testing the fertilizer spraying robot is able to connect with the mobile appilication via Bluetooth which can be control around 100 m of surrounding. Then the fertilizer spraying robot able to move forward, backward and able to turn left and right according to the signal given by the mobile application. This robot able to turn on the water pump to spray out the fertilzer and turn off the water pump to stop the spraying mechanism depend on the signal given by the farmer by using the mobile application. The implementation of the robot in the real application will be useful to farmers by reducing their work burden and minimizing the risk of human body injury due to direct contact with the chemical contents of fertilizer.

ABSTRAK

Dalam sektor pertanian, pembajaan tanaman adalah sangat penting dari peringkat awal untuk memastikan produk berkualiti baik semasa peringkat penuaian.Proses ini mengambil masa yang banyak dan boleh memberi kesan kepada aktiviti-aktiviti lain petani yang boleh mengurangkan produktiviti.Secara tradisinya, petani menggunakan tangki percikan dengan tangan yang terbongkar untuk membelasah baja.Teknik ini boleh menyebabkan jangkitan utama kerana baja mengandungi bahan kimia yang dipanggil sebagai Alkali (NH3).Dalam jangka masa panjang, ia boleh membawa kepada penyakit berbahaya seperti isu pernafasan melalui nafas masuk dan kanser kulit.Oleh itu, kaedah yang lebih selamat diperlukan untuk mengatasi masalah ini. Dalam projek ini, kami akan membangunkan robot penyemburan baja yang boleh melaksanakan tugas bagi pihak petani.Robot itu akan menavigasi di ladang dan melaksanakan tugas berdasarkan perintah yang dihantar secara wayarles menggunakan isyarat Bluetooth dari jauh.Pembangunan robot dibahagikan kepada dua fasa iaitu pembangunan perkakasan dan perisian.Pembangunan perkakasan melibatkan membina robot bergerak dengan sistem penyemburan baja, dan pembangunan perisian memberi tumpuan kepada aplikasi mudah alih.Kami akan menguji prestasi prototaip robot dalam aplikasi sebenar. Menurut ujian, robot penyembur baja mampu menyambung dengan aplikasi mudah alih melalui Bluetooth yang boleh dikawal sekitar 100 m. Kemudian robot penyembur baja mampu bergerak ke hadapan, ke belakang dan mampu membelok ke kiri dan kanan mengikut isyarat yang diberikan oleh aplikasi mudah alih yang akan dikendalikan oleh petani. Robot ini boleh menghidupkan pam air untuk menyembur keluar baja dan mematikan pam air untuk menghentikan mekanisma penyemburan bergantung kepada isyarat yang diberikan oleh petani dengan menggunakan aplikasi mudah alih. Pelaksanaan

robot dalam aplikasi sebenar akan berguna kepada petani dengan mengurangkan beban kerja mereka dan meminimumkan risiko kecederaan tubuh manusia akibat sentuhan langsung kepada kandungan kimia baja.

ACKNOWLEDGEMENTS

This project consumed huge amount of work, research and dedication. Still, implementation would not have been possible if we did not have a support of many individuals and organizations. Therefore we would like to extend our sincere gratitude to all of them.

First and foremost, I would like to express my gratitude to my supervisor, TS. ZAHARIAH BINTI MANAP for her precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) for the financial support which enables me to accomplish the project. Not forgetting my fellow colleague, HARRISH and THIAGU for the willingness of sharing their thoughts and ideas regarding the project.

Finally , my highest appreciation goes to my parents, and family members for their love and prayer during the period of my study. An honourable mention also goes to my parents for all the motivation and understanding.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

NH3- Alkali

LIST OF ABBREVIATIONS

IoT - Internet of Things
GPS - Global Positioning System
Wi-Fi - Wireless Fidelity
RFID - Radio Frequency Identification
IR - Infrared
LORA - Long Range Radio
LORAWAN - Low Power Wide Area Network
NB-IoT - NarrowBand-Internet of Things
QPSK - Quadrature Phase Shift Keying
BPSK,- Binary Phase Shift Keying
SCM - System Control Module
CSS - Chirp Spread Spectrum
UAV - Unmanned Aerial Vehicle
RF - Radio-Frequency
ISM BAND - Industrial, Scientific and Medical Band
SPP - Serial Port Profile
SIG - Special Interest Group
DC – Direct Current
LiPo - Lithium Polymer
USB - Universal Serial Bus
LTE - Long-Term Evolution

CHAPTER 1

INTRODUCTION

In this chapter, the overview of the project is briefly discussed. This chapter also emphasizes the problem statement, objectives of the project, scope, and the organization of the whole report.

1.1 Background

Robots are most frequently encountered as villains in movies that will destroy human populations. But in real life, robots are a wonderful and helpful creation that a human ever made to make people's lives easier. Nowadays, robots are more advanced in technologies and performance. There are robot technologies involved in many sectors such as in the medical field, military, etc. However, this report is about applying robot technology in the farming sector. This project aims to develop a fertilizer spraying robot that is wirelessly controlled through a mobile application. The project consists of two main stages, which are hardware and software development. Hardware development involves building a moving robot with a fertilizer spraying system, and software development focuses on the mobile application. The robot is expected to follow the command sent from the mobile phone accurately. The implementation of the robot in the real application will be useful to farmers by reducing their work burden and minimizing the risk of human body injury due to direct contact with the chemical contents of fertilizer. The fertilizer spraying robot is based on the principle of automatically helping farmers spray the fertilizers in their lawns or farms. The

main feature of this project is that it can control the movement of fertilizer spraying robots by the farmers. This is made possible by controlling the motion of the robot using smartphone applications. The applications work with the help of a Bluetooth module, a trans-receiver that communicates through radiofrequency. In this project, Arduino UNO is used as the main microcontroller as it is very reliable, low cost, and can be easily interfaced with multiple peripherals.

1.2 Problem Statement

The duty of controlling and overseeing the plant development from early-stage to develop harvest stage includes observing and recognizable proof of plant illnesses, controlled water system, and controlled fertilizers. These activities especially fertilizing the crops, take a great amount of time and can be very stressful and could impact other activities of a farmer. In the meantime, farmers utilize the splash tank with an uncovered hand to splash the fertilizer, which causes the primary infections because the fertilizers contain a chemical substance NH3. This situation leads to dangerous diseases such as respiratory issues through inward breath and skin cancer. Due to those negative impacts, a fertilizer spraying robot is introduced. Therefore, in this project, we will develop a robot that can shower the fertilizer to the crops by itself, which will be controlled by the farmers using their smartphones. The farmers can utilize this robot to move quickly and splash the fertilizer with offer assistance of dc motors. By using the fertilizer spraying robot, the farmer can prevent themselves from direct contact with the chemicals in the fertilizers, which protect the farmers from getting diseases due to the chemical fertilizers.

1.3 Project Objective

The aim of this project is to develop a fertilizer spraying robot that minimizes human intervention in the plant fertilizing process. There are three objectives as listed below;

a) To develop a fertilizer spraying robot based on Arduino Uno and Bluetooth module.

b) To integrate the Bluetooth module embedded in the developed fertilizer spraying robot with a mobile application.

c) To test the performance of the developed fertilizer spraying robot.

1.4 Scope of Project

The scope of the project explains the limitation of the fertilizer spraying robot. This fertilizer spraying robot is specifically made in a small-scale farming field. This project can commonly use in-home farming. The scope of fertilizer spraying robot for home farming:

1. The robot is compact and small in size, which is easy to carry around.
2. The fertiliser spraying robot's movement can be controlled within 100 m by using a Bluetooth Module.
3. The capacity of the fertilizer spraying robot is invented to carry 500 ml of liquid fertilizer in its container.
4. This robot is semi-automatic, where the user can control the robot's movement wirelessly by using their smartphones.
5. The robot can sustain itself till the battery usage is high.
6. This robot is expected to work in any weather, such as rainy or under the hot sun.

7. The mobile application can control the movement of the robot and control the fertiliser's purging.

1.5 Significance of Project

The fertilizer spraying robot is mainly made for farmers. This is because farmers are using fertilizer in a huge range. The fertilizer robot helps the farmers to spray fertilizer by using a spray tank that has the capacity to fill 500ml of fertilizer. This robot is also suitable to household wives who are planting at their homes. They can control this robot by just sitting at one place so that they can do one work just by sitting at one place. They can easily use this robot because it just like control a remote control car, but this one is controlled by handphones. The uniqueness of this fertilizer spraying robot is that it can avoid body contact to harmful chemicals. Moreover, users can save their time and this fertilizer spraying robot help them to make their life easier. This fertilizer spraying robot gives a helpful hand toward the user in any kind of weather. The users can use the fertilizer spraying robot by staying in their houses or cottages. This fertilizer spraying robot can be used in home farming, small-scale farming and crop fields.

1.6 Summary

This entire chapter was briefing about the basis of this project. Most of these project objectives and problem statements had been presented to ensure the path of this project outcome. The project-based on creating a fertilizer spraying robot. The production of this fertilizer spraying robot is to prevent the problems faced by the farmers. The fertilizers cause some health issues to the farmers. With this production, the health problems faced by the farmers caused by the chemical fertilizers will be less.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In the farming sector, fertilizing the crops is very important from the early stage to ensure good quality products during the harvest stage. Fertilizer is a compound of several nutrients that a crop or plant needed to grow healthier. There are two sorts of fertilizers, primarily classified as natural and inorganic fertilizers. The organic fertilizers (animal wastes and plant residues) must be broken down into inorganic forms in the soil before plants can take up the nutrients required for growth and reproduction. They are relatively inefficient because they contain low concentrations of nutrients and hence, large volumes of material need to be transported and spread over farming fields. According to the authors in [1], inorganic fertilizers have a high level concentration of supplements that are quickly accessible for plant take-up. Therefore, relatively small quantities of inorganic fertilizers are required to use over the whole farming field with the low-cost consumption. Other than, inorganic fertilizers can be defined to apply the fitting proportion of supplements to meet plant development prerequisites. Nevertheless, those inorganic fertilizers may cause health issues to the farmers who utilized them such as skin cancer. This is because the inorganic fertilizers contain a chemical substance which called as NH3. Therefore, a safer method is needed to overcome the problem. To overcome this issues, numerous sorts of research have been carried out in upgrading and moving forward the way of applying fertilizer to the crops by utilizing the innovations. This chapter surveys articles and works from past investigate on fertilizer sprayers.

2.2 Overview of Fertilizer Sprayer

A detailed overview on fertilizer spraying robot can be found in [10]. The author depicted the distinctive advances, methods and calculations utilized to invent a fertilizer spraying robot. The foremost common and broadly used technologies as specified within the articles are GPS, ZigBee, Wi-Fi, Bluetooth, RFID, Infrared, Arduino, Raspberry Pi and sensors such as Coast Sensor, Ultrasonic and IR Sensor. In [7] the author made a comparison of innovations utilized in Fertilizer Spraying Robot between commonly utilized innovation conjointly from other articles. Table 2.1 summarizes the comparison between technologies used in fertilizer sprayer, which done by the authors in [2]–[5], [8], [9] also sort a comparison between the technologies specifically based on their frequency band, standard range or accuracy, scalability, and cost.

Table 2.1 : Comparison between technologies used in Fertilizer Sprayer.

	Specification			
Technologies	Frequency Band	Standard Range	Strength	Weekness
Infrared	875nm +-	56 cm – 2.5 m	Cheap	Have the sunlight interference
Ultrasonic	520 kHz	10 mm – 20 mm	Good accuracy	Expensive , have interference
Wi-Fi	2.3 GHz, 6 MHz	1.5m	Cheap and good accuracy	Exposed to access point
Bluetooth	2.5 GHz	35 cm-meters	Cheap and good accuracy	Signal mapping is needed.
RFID	920–925 MHz	30 cm	Cheap and passive side	Low accuracy
ZigBee	916MHz to 2.4GHz	100 cm – 500 cm	Can reuse the infrastructure	Low accuracy and need special equipment

For future development, the authors in [10] mentioned about new technology that is being developed in fertilizer sprayer namely the Internet of Thing (IoT) technology. Common IoT technologies which use for long range connectivity in the several articles are LoRa, NB-IoT and SigFox. In [10] the author compares the significance of those long-range connectivity technologies based on their modulation, interface immunity, localization, standardization, maximum data rate, coverage, range, bandwidth, frequency and cost. Meantime, according to the author in [11], [12] mentioned that in the future, the fertilizer spraying robot will merge and control with smartphones and also with a wireless remote control. Table 2.2 compare the specification of the Long Range (LoRa) connectivity technologies such as NB-IoT, SigFox and LoRa which commonly used in fertilizer spraying robots.

Table 2.2 : Comparison between Long Range Connectivity technologies used in Fertilizer Sprayer.

	Long Range Connectivity Technologies		
Specifications	NB-IoT	SigFox	LoRa
Modulation	QPSK	BPSK	CSS
Interface Immunity	Low	High	High
Standardization	3GPP	SigFox Company	LoRa-Alliance
Maximum Data Rate	200 kb/s	100 kb/s	50 kb/s
Coverage	164 dB	160 dB	157 dB
Range	1 km to 10 km	10 km to 40 km	5 km to 20 km
Bandwidth	200 kHertz	100 kHertz	250 kHerts and125 kHertz
Frequency	Licensed LTE Frequency	ISM Band 433,9 MHertz	ISM Band 433,9 MHerts
Cost	High	Low	Low