DEVELOPMENT OF A LIQUID FERTILIZER SPRAY WITH ANGLE CONTROLLED NOZZLE

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DEVELOPMENT OF A LIQUID FERTILIZER SPRAY WITH ANGLE CONTROLLED NOZZLE

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A report is submitted
in fulfillment of the requirement for the degree of
Bachelor of Mechanical Engineering

اونيۏرسيتي تيکنيکل مليسيا ملاک

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2021

DECLARATION

I declare that this project report entitled “Development of a Liquid Fertilizer Spray with Angle Controlled Nozzle” is the result of my own work except as cited in the references

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APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

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DEDICATION

To my beloved mother and father and also loved ones

ABSTRACT

Nowadays, agriculture play vital role as it become the main source of food where it can also be the main economy income for developing country. Since the last couple of years, the interest in durian grows exponentially among the local and global community. This encourages the local farmer to expand their durian orchard to meet the high demands from the consumer. This will increase the workload of the farmer. The agriculture drone is introduced to the farmer as a modern agriculture tools to replace the old method. The agriculture drone can be used for many operations such as monitor crop health, apply fertilizer and pesticide, water the crops, crop mapping and surveying, and many more. This project compares the available drone in the market to compare their unique parameter. The design of the drone also proposed based on the date gathered through the online survey question to generate the customer requirements and feedback rating from the consumer. The design of the drone is then realized using the computer aided design software, SolidWorks. Since the fabrication process cannot be done due to current pandemic condition, the drone will be undergoing simulation test using ANSYS software to the determine the static structural of the frame, flow simulation of the propeller, and the flow simulation of the nozzle. All the result from the simulation was displayed in the figure form.

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ABSTRAK

Pada masa kini, pertanian memainkan peranan penting kerana menjadi sumber makanan utama di mana ia juga boleh dijadikan sebagai sumber pendapatan ekonomi utama bagi negara membangun Sejak beberapa tahun kebelakangan ini, minat terhadap durian berkembang pesat di kalangan masyarakat tempatan dan global. Ini mendorong petani tempatan memperluaskan kebun durian mereka untuk memenuhi permintaan tinggi dari pengguna. Ini akan meningkatkan beban kerja petani. Drone pertanian diperkenalkan kepada petani sebagai alat pertanian moden untuk menggantikan kaedah lama. Drone pertanian dapat digunakan untuk kebanyakan operasi seperti memantau kesihatan tanaman, menerapkan baja dan racun perosak, menyiram tanaman, pemetaan tanaman dan tinjauan, dan banyak lagi. Projek ini membandingkan dron yang ada di pasaran untuk membandingkan parameter unik mereka. Reka bentuk drone juga dicadangkan berdasarkan tarikh yang dikumpulkan melalui soalan tinjauan dalam talian untuk menghasilkan keperluan pelanggan dan penilaian maklum balas daripada pengguna. Reka bentuk drone kemudian direalisasikan menggunakan perisian reka bentuk berbantukan komputer, SolidWorks. Oleh kerana proses fabrikasi tidak dapat dilakukan kerana keadaan pandemik saat ini, drone akan menjalani ujian simulasi menggunakan perisian ANSYS untuk menentukan struktur statik badan drone, simulasi aliran bilah, dan simulasi aliran nozel. Semua hasil dari simulasi ditunjukkan dalam bentuk gambar.

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LIST OF ABBEREVATIONS

UAV	Unmanned Aerial Vehicle
WHO	World Health Organization
FAO	Food and Agriculture Organization
NDVI	Normalize Difference Vegetation Index
MKP	Mono-potassium phosphate
MAP	Mono-ammonium phosphate
NIR	Near Infrared
GPS	Global Positioning System
ESC	Electronic Speed Controller
Lipo	Lithium polymer
USB	Universal Serial Bus
HDMI	High-Definition Multimedia Interface
fps	Frame per second
RGB	Red, Green, and Blue
CPU	Central Processing Unit
SD	Secure Digital
ISO	International Standard Operation
QFD	Quality Function Deployment
CAD	Computer-Aided Design
DC	Direct Current

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LIST OF SYMBOLS

rpm	Rotation per minute
mph	Miles per hour
in	Inch
GPA	Gallon per area
Nm	Newton meter
rad s^{-1}	Radian per second
°C	Degree Celsius
m s^{-1}	Meter per second
N	Newton
m s^{-2}	Meter per second square

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CHAPTER 1

INTRODUCTION

1.1 Background

Agriculture is the science of cultivating the soil, harvesting crops and raising livestock, and the science or art of the production of plants and animals (Black et al, 1990). Agriculture plays a vital role in nowadays society as we depend on it as our main source of food and raw materials. The old-fashion way of using human power as well as the animal cannot satisfy the demand needed by society. Many types of research have been made to improve the quality and the production of the crops including the invention of new technology, the machine, and new techniques to solve this problem. One of the technologies that are invented to be used in nowadays agriculture is drone technology. A drone is an unmanned aerial vehicle (UAV) that can be controlled remotely.

The uses of a drone in agriculture are becoming more popular among large corporation that requires a lot of manpower to manage. It is ideal to use the drone to do a task that is difficult and time-consuming if we do use the old fashion way. The drone can be used to do soil health scans, monitor crop health, assist in planning irrigation schedules, apply fertilizers, estimate yield data, and provide valuable data for weather analysis (Sylvester, 2018). The sensor can be attached to the drone to collect data. This will provide valuable and real-time information to the farmer so that further actions can be taken. Location in the field that needs weeding could also be identified by using the drone. The drone also can be used to apply fertilizer to the crop by attaching the tank and the nozzle to

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it. This will exponentially increase the efficiency of the farmer and escalate the production of the crops while maintaining its quality.

In Malaysia, the demand for durian fruits is very high. During the season. The price of the fruits can reach up to RM35 for 1kg of Malaysia's Musang King durian. The durian orchard has many trees that would reach up to 20 meters until 40 meters when matured. The farmer needs to provide proper management to the durian tree such as watering, applying fertilizer, pest and disease controlled, and others. The durian tree requires a different type of fertilizer according to the age of the tree. The fertilization phase of the durian is divided into two states which are the vegetative state and fruit development state. The vegetative state requires about 5 years where the fertilizer used are focusing on the growth of the durian tree while the fruit development state is focussing on the crop growth. During the fruit development state, the foliar fertilization technic can be applied using drone technology. Foliar fertilization is an application where diluted fertilizer is applied directly through the leaves of the tree as a complementary treatment.

The agriculture drone for the durian orchard is mainly used to apply fertilizer and pesticide to the trees. Many criteria of the drone need to be considered to maximize the results such as flight height and velocity, spray volume and pressure, type of nozzle, size of spray tank, the size of droplets, durations of flight, and others. Besides applying fertilizer and pesticide, a sensor can also be attached to it to collect the data regarding the condition of the tree, soil, and crops. With the correct selection of features on the drone, the local farmer can now implement the uses of the drone as a new and advanced method.

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1.2 Problem Statement

In Malaysia, the local farmer mostly uses manpowered tools and tractor to manage their estate. Then, the new agriculture innovation which is the use of drone as a new alternative for agriculture introduced. The criteria of the available drone in the market need to be analyse and compared to choose the most suitable product that can be used in durian's orchard.

The agriculture drone needs to have the functions that can be applied in everyday work of the local farmer at the durian orchard. The drone needs to have suitable components and parts to be used for spraying fertilizer and pesticide, crop mapping and surveying, and crop monitoring.

The use of the agriculture drone is suggested to increase the productivity of the farmers to handle the orchard. Since the use of agriculture drone in durian orchard is considered to be a new method, more study needs to be done to determine the best way to utilise the drone to increase the efficiency of using this new approach.

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1.3 Objective

The objective of the project are as follows:

1. To study the architecture design and functions of agriculture drone that are available in the market.
2. To customize the drone with suitable components and parts that are suitable for spraying fertilizer and pesticide crop mapping and surveying, and crop monitoring.
3. To investigate the spraying mechanism and pattern that can be applied to the durian's tree to increase the efficiency of the drone.

1.4 Scope of Project

The scopes of the project are:

1. The specification of the agriculture drone in the market are compared to determine the capability and compatibility to complete the tasks.
2. The component and parts of the drone are designed using the computer-aid design software.
3. The research about spraying mechanism and pattern are compiled to provide guideline that are suitable for durian orchard management.

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CHAPTER 2

LITERATURE REVIEW

2.1 Agriculture of Durian in Malaysia

In Malaysia, the durian cultivation used to be on a small scale where the size of the orchard was only half or one hectare each. The farmer initially does not regard the durian as a reliable source of income compared to the other commercial crop such as palm oil and rubber. Since the last couple of years, the interest in durian grows exponentially among the local and global community as the durian has been highlighted to be one of the selected foods to be grown in the Malaysian National Agro-Food Policy.

The production of the durian is greatly influenced by the seasons in Asia country. The process of flowering of the tree takes up to four weeks of dry season while the process of fruit ripening happens in wet weather. Generally, the peak time for the durian season is in June and July. Table 2.1 shows the durian season of the country that is the producer of durian fruits.

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Table 2.1: The month of durian seasons in each producer country

Production area	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Thailand												
Malaysia												
Indonesia												
Vietnam												
Philippines												
Laos												
Brunei												
Burma												
Singapore												
Kampuchea												

2.2 Drone in Agriculture

Nowadays, the focus of development in precision agriculture rise exponentially as the developing country are heavily dependent on agriculture field as source of income and foods. Due to the disease came from pests and insects, the agriculture fields face major loses as the productivity of the crop decrease. In order to overcome this problem, the pesticides and fertilizer are manually sprayed by the farmer toward the crops. This activity when done manually may lead to adverse effects from the poisonous concoction. The World Health Organization (WHO) has estimated that one million cases of ill effected from the direct interaction of fertilizer and pesticide. Rao Mogli and Deepak (2018) pointed out that the agricultural field could benefit from a more precise and safe delivery of pesticide and fertilizer with the use of drone. Hence, the use of drones in this respect would alleviate the harmful repercussion of the agriculture activity.

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In general, the agriculture drone is equipped with sensors, cameras, sprayer and nozzle that are used for crop mapping and monitoring, and pesticide spraying. Yamaha has developed Yamaha RMAX, the first agriculture drone to control pest and monitor the farm.

Figure 2.1: Yamaha RMAX that are used for pest control and crop monitoring.

(Rao Mogli and Deepak, 2018)

To implement the uses of drone in agriculture, a technical analysis is done to analyze the capability of the drone in agriculture operation such as soil and field analysis, pesticide spraying, crop monitoring and crop height estimation. The drone also depends on the hardware requirement on the critical aspects such as the drone weight, flight height and velocity, flight time, maximum payload, and configurations.

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2.3 Agriculture Drone in Malaysia

In Malaysia, the uses of drone fall under the Malaysia Aircraft category which mean it need to obey the operational standards as the manned aircraft. Ab Rahman et al.(2019) mention that the legal exercise of drone in Malaysia has stated that the drone cannot cause or create any harm in the air or the ground. Operator needs to receive authorization from the Department of Survey and Mapping Malaysia and Department of Civil Aviation before flying the drone as the drone that having a multi sensors are viewed as potential threat to national security.