



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DEVELOPMENT OF A GUIDE DRONE USING RF ENERGY  
HARVESTING**

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

by

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## **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 Degree of Electronics Engineering Technology (Telecommunications) with Honours. The member of the supervisory is as follow:

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## ABSTRAK

Drone ataupun lebih dikenali sebagai quadcopters adalah merupakan salah satu kenderaan yang paling awal mempunyai keupayaan untuk berlepas secara menegak ke udara dan mendarat dengan berjaya. Drone secara asasnya adalah sebuah helicopter yang menggunakan empat rotor untuk berlepas secara menegak dan kekal di udara semasa penerbangan. Objektif untuk projek ini adalah membangunkan drone yang dikuasai oleh penuaian tenaga RF. Perkembangan dan pelaksanaan drone yang dikuasai oleh tenaga RF dibentangkan untuk Projek Tahun Ijazah Sarjana Muda. Projek ini memperkenalkan teknologi terkini di dunia yang merupakan penuaian tenaga RF. Pengambilan tenaga RF adalah sumber tenaga alternatif untuk menguatkan operasi drone, dengan menukar tenaga RF ke kuasa DC. Tenaga RF diperolehi dari persekitaran sekitar yang dihantar oleh pemancar radio dan media telekomunikasi yang tidak terhad di seluruh dunia seperti internet wayarles, telefon bimbit, stesen pangkalan, stesen penyiaran, WiFi dan sebagainya. Tenaga RF adalah alternatif tenaga yang boleh diperbaharui dan bertahan selagi isyarat Frekuensi Radio hadir di sekitarnya. 32bit Acro Naze32 Pengawal Penerbangan digunakan dalam projek ini kerana ia lebih mudah untuk di program dengan perisian BetaFlight dan dapat beroperasi dengan bekalan minimum 3.7v. Projek ini memberi manfaat kepada keperluan komuniti sebagai memperbaiki dan meningkatkan drone. Oleh itu, dengan melaksanakan projek ini, ia dapat menyelamatkan kos mengekalkan drone dan meningkatkan keupayaan penerbangan quadcopter untuk penerbangan lebih lama.

## **ABSTRACT**

Drone also known as quadcopters or quadrotor were one of the earliest vehicles to have the ability to take-off vertically to the sky and successfully landing. Drone is basically a multirotor helicopter that uses four rotors to take-off and stay in flight. The objective in this project is to develop a drone powered by the RF energy harvesting. The development and implementation of a drone powered by RF energy is presented for the Bachelor Degree Final Year Project. This project is introducing the latest update technology in the world which is RF energy harvesting. RF energy harvesting is an alternative energy sources to power up the operations of the drone, by converting the RF energy to DC power. RF energy is obtain from ambient surrounding which transmitted by unlimited amount of radio transmitter and telecommunications medium around the globe such as wireless internet, mobile phone, base station, broadcasting station, WiFi and so on. RF energy is an alternative of renewable energy which can last for as long as Radio Frequency signal is presence in the surrounding. 32bit Acro Naze32Brushed Flight Controller is used in this project as it is easier to program with the BetaFlight software and able to operate with minimal supply of 3.7v. This project gives benefit to community needs as improve and increase the quadcopter flight length and reduce the cost of renewing the batteries of drone. Thus, by implementing this project, it can save the cost of maintain a drone and improve the ability of flight for the quadcopter for a much longer flight.

## **DEDICATION**

I dedicate this research to Allah the Almighty, and the Merciful for for giving me wisdom and strength to accomplish this project. I also dedicate this to my parents, Abd Ghami bin Mohammad and Rosina binti Mohd Amin who endlessly provide me with financial support as well as moral support with any rest. I also dedicate this project to supervisor Sir Win Adiyansyah Indra who makes this study possible and also to my friends for giving us moral support. To my beloved parents and family thank you for the support I love you all.



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## LIST OF SYMBOLS

<b>V</b>	-	Voltage
<b>I</b>	-	Current
<b>R</b>	-	Resistor
<b>cm</b>	-	Centimetre
<b>dB</b>	-	Decibel
<b>P<sub>r</sub></b>	-	Power Receiver
<b>P<sub>t</sub></b>	-	Power Transmitter
<b>P</b>	-	Power
<b>h<sub>r</sub></b>	-	Height Antenna Receiver
<b>h<sub>t</sub></b>	-	Height Antenna Transmitter
<b>L</b>	-	Length
<b>d</b>	-	Distance
<b>V</b>	-	Velocity

## **LIST OF ABBREVIATIONS**

**FC** Flight Controller

**RF** Radio Frequency

# CHAPTER 1

## INTRODUCTION

### 1.1 Overview

This chapter will provide a quick explanation of the drone which is power by Harvesting Radio. In addition, the background, problem statement, objective, scope, project significance and summary will also be cover in this chapter.

### 1.2 Background

Drone also known as quadcopters or quadrotor were one of the earliest vehicles to have the ability to take-off vertically to the sky and successfully landing. Drone is basically a multirotor helicopter that uses four rotors to take-off and stay in flight. The first drone known to be invented and develop was in the year 1920 and given the name Omnichen 2. The Onmichen 2 was developed by a French engineer Etienne Omnichen. The Onmichen 2 manages to set a world record in 1924 as it flew a distance of 360m. In the same year, it also was able to fly over a distance of 1km circle in 7 minutes and 40 seconds. The earlier helicopter design that was developed was deemed to be too wasteful an inefficient because to contour balance the rotating force or also known as the torque which was created by the single main rotor, a tail rotor was used. Hence to find an alternative to the earlier helicopter that is less wasteful and efficient, serve as one of the main motivations of development of early quadcopters.

A normal early design of the drones would have the main single engine placed or installed centrally to the frame of the drone which was located in the fuselage of the copter, all four rotors of an early drone was drive by using multiple belts or shafts. Belts and shafts however weight quite a lot and very importantly subject to repeating breakage. Another main problem of an early drone is that to run all four of the rotor at the same speed and producing enough lift to hover the copter at the same time was incredibly difficult. Due to the reason that, the four rotors of a drone are all slightly different in weight and demission from each other, especially, when at a time there are no computer and good electric motor to running a stable drone flight.

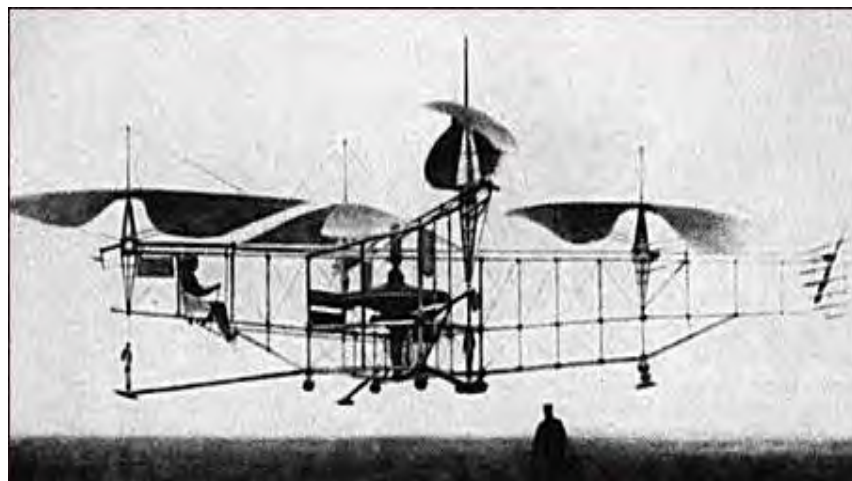


Figure 1: Oehmichen No 2 Quadcopter

The last few years saw the innovation of electric motors, microelectronic and micromechanical devices. In a modern quadcopter consist of four electrical motor mounted and each motor was mounted a propeller either directly above or under it. The flight computer serves to monitor the movement of the copter at a very constant pace and stable the copter flight. By increasing or decreasing the rpm or rotation per minute

of each individual motor, the drone will be able to change its pitch, yaw and roll movement. To move either forward or backward the pitch was change, change the yaw allow the head of the quadcopter to rotate or swivel and the roll change will fly the drone sideways. This fixed pitch design is much simpler than the complex swashplate mechanics that are required for single rotor helicopters. Most modern drone used this design because of all the design, it was the most successful. By scaling up the size of the drone it is possible to carry people using the drone. As technology in drone advances dramatically and the emerging and stabilised companies such as Walkera, Heli-Max, DJ Innovations, Blade and Parrot have launched multiple mini quadcopters design with that use state-of-the-art technology in drone design and computer for flight control, delivery and aerial photography.

Some of the most impressive features of the drones are that drones incorporate the features of pitched and co-axial helicopters. drones are a comfortable at blend of both pitched ones and co-axial one making it more agile, wind resistant and stable in flight with the used of tow layer motor. The technology of three-axis gyro give enhances to the drones stability. This made the drone ideal vehicles for aerial photography as drone could able to carried cameras and are a lot more stable and agile. Others features include the control of the quadcopter with a remote-controlled transmitter. The receive on board the drone process the signal from the remote controlled transmitter

The flight controller then signals the Electronic Speed Controllers (ESCs), which in turn either increase or decrease the voltage, send the drone's motors. When

comparing the aerodynamics between the drone and a plane for flight, the drone show a more stabilize movement. This was because two out of four motor moves in a clockwise rotation while the other two moves in a counter-clockwise rotation and in turn it negates any force or torque on the fuselage of the drone. Conversely, a typical helicopter's has a single rotor that rotates in clockwise, forcing the fuselage to move in the counter-clockwise rotation. The resulting torque puts pressure on it and makes it vulnerable. Therefore the simple design of a modern quadcopter won over many other pilots. They do not come with long shafts, unlike helicopters. These are difficult to align.

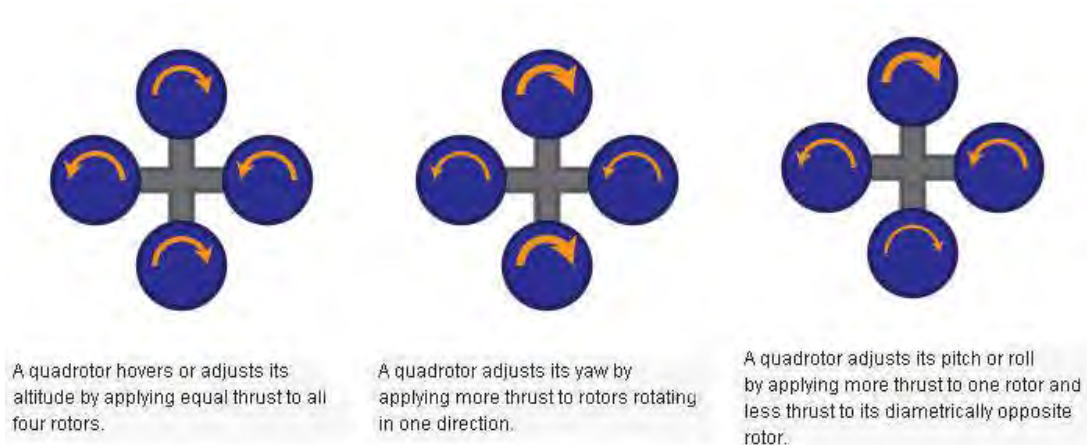


Figure 2: Flight control of the drone

In this Morden age, renewable energy is one of the main talking points anywhere in the world this is because Renewable energy will not run out while other sources of energy are finite and will someday be depleted. Put simply, renewable energies are those generated from sources that do not have a finite end, or those that can be recycled, typically from natural sources - like solar power, wind power and water power. As currently there are currently an increasing amount of Radio Frequency Energy or RF Energy that are being broadcasted from multiple radio transmission, of