UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND ANALYSIS OF DRONE CONTROL COMMUNICATION SYSTEM

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

by

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This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electronic Engineering Technology (Telecommunication) with Honours.

……

(Project Supervisor)

ABSTRAK

Projek ini adalah berkenaan dengan analisis kawalan komunikasi dron. Dron juga dikenali sebagai quadcopter atau UAV. Ia adalah sebualah kenderaan beroda kerana ia terbang dengan kipas/bilah pada setiap sisi. Struktur dan reka bentuk tidak terhad kepada satu reka bentuk sahaja tetapi terdapat dalam pelbagai jenis reka bentuk yang boleh di dapati. Rekaan dron berdasarkan penggunaan dron yang meluas bergantung kepada jenis penggunaannya. Setiap komponen yang digunakan untuk menbina dron juga bergantung kepada penggunaannya. Dron boleh dikawal secara manual dengan menggunakan remote control atau secara automatik dengan menggunakan perisian yang ditetapkan pada dron. Projek ini akan menganalisa sistem kawalan berdasarkan beberapa parameter. Dengan menganalisis parameter yang terlibat, sistem kawalan akan lebih mudah difahami.

ABSTRACT

This project is about drone control communication system analysis. Drone also known as quadcopter or UAV. It is a rotorcraft because it fly based from the propeller from each side. The structures and design not fix for one design but there were so many types of design can be found. The widespread use of drone make the design is refer to the work need to be done by the drone. Each components also depends to the application of the drone. Drone can be controlled manually by remote control or automatically by software install to the drone. This project will analyse the control system based on some parameters. By analysing all the parameters, the control system can be understand clearly

DEDICATION

My dearest parents, Yusoff bin Yaacob and Rokiah binti Abdullah,

My siblings and friends, who always pray for my success.

To my supervisor,

Mr. Chairulsyah bin Abdul Wasli,

Thank you for your kindness and always guiding me.

ACKNOWLEDGEMENT

In the name of Allah S.W.T The Most Merciful, with deepest gratitude of the Al-Mighty that give me ability to complete this final year project report.I would like to express my special thanks to my supervisor, Mr. Chairulsyah bin Abdul Wasli for all the guidance and assistance throughout my final year project. My appreciation also goes to my family and friends for always been there for me. Thank you for all my beloved person for always pray for me and for all the advice.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

BLDC	-	Brushless Direct Current
DOF	-	Degree Of Freedom
DRONE	-	Dynamic Remotely Operated Navigation Equipment
GPS	-	Global Positioning System
IMU	-	Inertia Measurement Unit
IC	-	Integrated Circuit
PWM	-	Pulse Width Modulation
R[redacted]	-	Radio Control
Rx	-	Receiver
RPM	-	Rotation Per Minute
Tx	-	Transmitter

CHAPTER 1
INTRODUCTION

1.0 Background

Over the last few years, there were growth for the remote control airborne vehicles manufacturing and sales. These unmanned aerial vehicles also known as many names such as drone, quad copter and others. Drone is an abbreviation from dynamic remotely operated equipment. This device is the mixture of electronics, mechanicals and the main part is the aviation principle. The most basic way on how it works is two propellers will spin in a clockwise direction and other two is rotating in an anti-clockwise which allows the drone fly in designated direction.

1.1 Problem Statement

Currently, the knowledge about drone control still rare. The information about it is out there but it seems does not explain more about the communication control between the drone. In addition, technology of drone remote control seems difficult. This involve with the device that control the either altitude or the speed of the drone. Besides, the application of drone is limited and prohibited due to the security and safety issue that can involve a lot of laws that need to be concerned.

1.2 Objective

The main objective of this research are:

1. To study the concept of drone communication.
2. To design an effective and friendly user drone control system.
3. To build an animation and simulation of drone control system that can be used for public.

1.3 Scope of Works

The scope works of this project, it will focus on the study of literature about drone control system. This works can be done by referring to any books, article and journal related to the drone communication. In addition this project also involve in finding all parameter and also the related equation. Besides, the project also will focus on designing a suitable animation to make it easier to understand how the drone communication works. The software used for the animation is Adobe Flash Cs5.5. This project also study on how to build GUI, MATLAB and create the simulation part used to describe how the measurement or calculation for the drone communication system. Other than that, this project also involves with finding the experiment result from references and all the data will be analyse. Last part of this project is, writing the thesis report.

1.4 Expected Results

1. An attractive animation that show drone control system.
2. An interactive GUI of drone system.
3. Analysis of all data finding from this project

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter provides and gathered the literature review and also summarized information of the related studies about drone. This also include the process, tools, application and also any relevant information about the drone. The main foundation for this project are from the information gathered from books, journals, and also internet.

2.1 History of Drone

Basically most people aware that before the commercialization of drone to public, a drone used in military. However, not many know that the founder of the main idea of this kind of remote controlled vehicles was created by the great inventor, Nicola Tesla and in fact, he was the one the first person patent for remote controlled vehicle. He describe his creation as the teleautomation and has become the roots of the aviation principle until this days [Nesta, 2008].

Drone might sounds new for this generation however the reality are, unmanned aerial vehicles have been used for a very long time ago. In 1860s a balloons loaded with explosives was launched by Union and Confederate during the Civil War and it was upgrade to Firebee drones in 1960s which was launched during Vietnam War. Since then, it was refer as the new paradigm of warfare because the increasing use of the drone in military. After that, there was more evolution towards the drones either for the application, size, speed and many more [New York Time, 1998].

As the technology become more progressive, new ideas comes and the uses of drone developing briskly. The rapidly popular unmanned aerial vehicles these days are quadcopters. The size of the quadcopter which is small have becomes one of the attraction to the public. It can be used in many ways which proven by the technology from used for the quadcopter.

2.2 Types of Drone

There are lots types of drone that have been introduced. Since the advance technology evolve rapidly, it is not surprisingly that there are always new models of drones produced. Drones have many types and each names refer to its configurations. The first type of drone is bicopter which have two rotors and tricopter have three rotors which controlled by servo. The shape of a bicopter and tricopter is shown in the Figure 2.1.

Figure 2.1 Tricopter and Bicopter

Another types of drones are hexacopters and octocopters. Since it have more rotors, both drones provide stability and yaw configuration. Usually the propeller set in ‘X’ or ‘+’ configuration. Hexacoptres is a drone that have six rotors make it more stable when it lands. It still can fly even one of the rotors having failure. Octocopters have eight rotors which have more stability and faster than hexacopter. However, the size is bigger than others. Mostly the frame of hexacopter and octocopter is shown in the Figure 2.2.

Figure 2.2 Hexacopter and Octocopter

The most well-known drone these days are quadcopter. It is propelled by four rotors which two of them propelled in clockwise and another two is anti-clockwise. Since it is smaller and stable than other type of drone, it become one of the popular drone because it can easy to hover and can fly in any direction. This type of drone are symmetrical than other. It use the simplest operation principle for the control which are pitch, roll, motion and yaw. The most basic quadcopter shown in the Figure 2.3

Figure 2.3 Quadcopter

.

The differences of these types of drones is shown in the Table 2.1

Table 2.1 Drone Comparisons

Types	Descriptions
• Bicopter	▪ Has two motors ▪ Cheaper ▪ Least stable ▪ Less lifting power
• Tricopter	▪ Has 3 motors ▪ Cheap ▪ Less stable ▪ Low lifting power
• Quadcopter	▪ Has 4 motors ▪ Reasonable price ▪ Stable ▪ More lifting power
• Hexacopter	▪ Has 6 motors ▪ Expensive ▪ Stable ▪ More lifting power
• Octocopter	▪ Has 8 motors ▪ Expensive ▪ Stable ▪ More lifting power

2.3 Main part used in Drone

The main part of a drone consist of the components which involve with how the drone communicate with the controller

2.3.1 Transmitter

The communication transmitter is responsible for generating a carrier and then for modulating, filtering and amplifying the modulated signal for delivery to an antenna [Jeffrey S.Beasly, 2014]. The modulating signal may be analog and or digital but regardless of the modulation type or form of intelligence used, the mixing that occurs in the transmitter modulator produces an output composed of frequencies in addition to those applied. The type of control communication used by a drone is radio control (RC). Usually it have four channels to control the movement of the drone which are pitch, elevation, and yaw and also roll. Usually, the low frequency used by the analog RC remote control is determined by a crystal but for digital, it often can be operated at the range of 2.4GHz. The transmitter has its own IC which control the signal that need to be sent and also known as Tx module. The Tx module will sent the desired signal to Rx module which wired inside the quadcopter. Each pins have its own functions and the data of PWM for the pins will be decoded parallel with the receiver module. The circuit for the transmitter is in the Figure 2.4 and the PWM Generator circuit is the Figure 2.5.

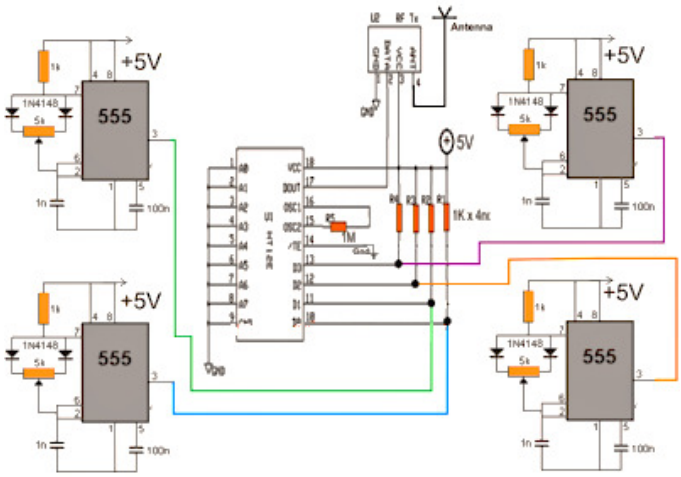

Figure 2.4 Quadcopter Transmitter Circuit

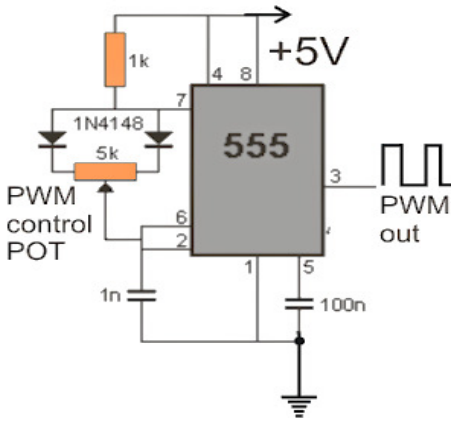

Figure 2.5 PWM Generator Circuit

2.3.2 Receiver

The communication receiver extracts intelligence from the radio frequency signal for continuous usage. The signal might be analog, voice, video and many more. The receiver must be able to select ad extract the preferred signal at the antenna [Jonathan D. Haymer, 2003].The Rx module will receive the signal and it will control the rotor which are BLDC motor. The receiver circuit is shown in Figure 2.6

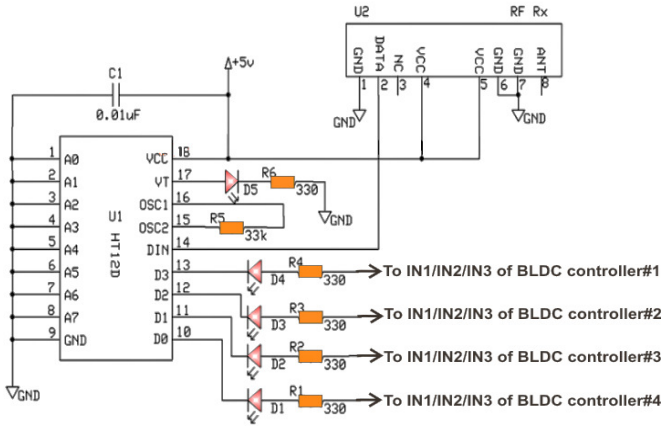

Figure 2.6 Quadcopter Receiver Circuit.

2.3.3 BLDC Motor

The BLDC motor controller configured and attached to the Rx circuit. Usually the circuit used is in the Figure 2.6. The rotating electric machine is some sort of induction motor that have permanent magnets mounted on the surface. If volt is applied, it will spin at 1000 RPM. So the drone will spin at 1200 RPM if 12 volts applied to the motor. Figure 2.7 shows the structure of a BLCD.

Figure 2.7 BLDC