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PROTOTYPING A MINIATURE AIRBORNE ROBOT

This report submitted in accordance with the requirement of the UniversitiTeknikalMalaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotics and Automation) with Honours.

by

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DECLARATION

I hereby, declared this report entitled "Prototyping a Miniature Airborne Robot" is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotics and Automation) (Hons.). The member of the supervisory committee is as follow:

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(Official Stamp of Supervisor)

ABSTRACT

Unmanned aerial vehicles (UAVs) could be used for military surveillance or spying. Generally it is small and lightweight. A challenge of implementing a UAV is using the control circuit. Overall, the robot is controlled using an electronic circuit via the supplied power supply. Power supply used for this robot is 6 volts. An electronic circuit was designed to control the motor speed robot while it is flying. A type of motors used in this project is the RC motor. The robot is divided into two parts, the robot body and robotcircuit. Structural analysis is required to obtain a stable design. This project is the concept of diversifying the flight control robot using only the electronic circuit control. It also created without using any instruction or assistance of computer software programming. In the process of developing this project there are six experiments were performed. Experiment experiments were recorded and used as a study to produce this robot. The overall design constraints must be considered such as material selection, design and electronic control structure and mode of operation of the robot. At the conclusion of this study, the robot is able to fly and flying robot controlled by a circuit that has been designed.

ABSTRAK

Kenderaan pesawat tanpa pemandu (UAV) boleh digunakan untuk pengawasan biasa atau tentera mengintip. secara umumnya ia adalah kecil dan ringan. Cabaran melaksanakan sebuah UAV adalah pengawalan menggunakan litar. Secara keseluruhannya, robot ini dikawal menggunakan litar elektronik melalui bekalan kuasa yang telah dibekalkan. bekalan kuasa yang digunakan pada robot ini adalah 6 volt. Satu litar elektronik telah direka untuk mengawal kelajuan motor robot semasa ia terbang. Jenis motor yang digunakan didalam projek ini adalah RC motor. Robot ini terbahagi kepada dua bahagian iaitu badan robot dan litar robot. Analisis diperlukan untuk memperoleh reka bentuk yang stabil. Projek ini adalah konsep mempelbagaikan robot kawalan penerbangan hanya menggunakan litar kawalan elektronik. Ia juga dibina tanpa menggunakan apa-apa arahan atau bantuan pengaturcaraan perisian komputer. Dalam proses membangunkan projek ini terdapat enam eksperimen telah dilakukan. Eksperimen-eksperimen ini telah dicatatkan dan dijadikan sebagai kajian untuk menghasilkan robot ini. Segala kekangan reka bentuk keseluruhan harus dipertimbangkan seperti pemilihan bahan, reka bentuk struktur dan kawalan elektronik serta cara operasi robot. Pada kesimpulan kajian ini, robot mampu terbang dan penerbangan robot dikawal menggunakan litar yang telah direka.

DEDICATION

To my beloved father and mother

Khairul Azuar Bin Mat Latif and Noreha Binti Yusoff

In appreciation of supported and understanding.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

UAV	Unmanned Aerial Vehicle
CPU	Central Processing Unit
ROM	Read-only Memory
RAM	Random-access Memory
FMA	Flying Machine Arena
GPS	Global Positioning System
BLDC	Brushless DC Motor
MEMS	Microelectromechanical Systems
RUAV	Rotor Unmanned Aerial Vehicle
PCB	Printed Circuit Robot
PIC	Peripheral Interface Controller
ISIS	Intelligent Input System Schematic
ARES	Advanced Routing Hardware & Software Editing
VSM	Virtual System Modelling
DC Motor	Direct Current Motor

CHAPTER 1

INTRODUCTION

1.1 Introduction of Project

The unmanned aerial vehicle (UAV) or a drone plays an essential role in military defense technology. The popularity of UAV in the past few years has surged. It is much easier to design robotic field assistants than it is constructing a tele robotic UAV as they is now becoming more intelligent and are able to execute increasingly complicated tasks. Without aircraft is a type of aircraft that do not require a pilot to operate either remotely or flown independently according to a pre-programmed flight plan. Now, most UAVs can carry out surveillance missions and dangerous attacks. The aim of this project is to developing an unmanned aerial vehicle (UAV) using electronic circuits when power are supplied. In this project, it focuses how to develop a small flying robot. This project is about 'Prototyping a Miniature Airborne Robot'. The flying robot is controlled by a remote control. Remote controls in this flying robot are used to control the speed of the flying robot. The speed of flying robot are depends on the variable resistor. Variable resistor is used to change or adjust the speed flying robot. The controller are designed by the specification that suitable and required. In this project also are not using a programming software. It consists of two parts such as robot chassis, remote controller. The variable resistor for this controller will be connected to RC motor to adjust the speed of flying robot. After the power supply is already to supplied, a RC motor function to drive the variable resistor to rotate.

1.2 Problem Statement

Microcontroller is a small cheap computer and built to control the electronic control. It is also designed to facilitate the tasks to be performed either manually or automatically. Normally fly in robot construction microchip because it contains all the memory and interfaces (input and output) sufficient for simple applications. It consists of basic parts that are essential to operate as a CPU, ROM, RAM, ports input or output and timer or counter. Problem statement for this project is due to be sensitive and microchip that can be easily detected by an unidentified individual as enemies and invaders.

1.3 Objective of Project

The overall design of a UAV that uses rotary blades to become airborne requires radio frequencies as control signals which chassis made of light-weight materials. The objective of this project is to build a laboratory prototype miniature robot that flies using a circuit robot controlling.

1.4 Scope of Projects

The scope of this project is the robot will be relatively small in size and in payload capability. It will have a remote control system to control a movement of robot. The flight will have a guided fixation. Besides that, the scopes of this project are:

1. Design of the robot chassis, electronics controls,
2. Development the assembly and testing procedures, and
3. Assessment the robot’s efficiency on airborne.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview of Project

Flying robots are widely used because there is a variety of functions and advantages such as in the military, defense and entertainment. In military and defense, flying robots used to make surveillance of enemy attack. Flying robots are also being used for mere entertainment. Flying robot can be divided into four types of fixed wing flying scheme, rotary wing, lighter than water and flapping wing.

2.2 Categories of Flying Robot

2.2.1 Rotor Flying Robots

The Flying Machine Arena (FMA) is state of the art experimental platform for exploration in aerial robotics and control. It depends on small quadrocopters and objective to investigate the physical and dynamical limits of both the cars and the overall control architecture. Three conferences in FMA have been brought in to generate a robot fly the airspace and motion catch volume, quadrocopter cars and control and communication (Lupashin, Schöllig, & D'Andrea, 2011).

A project lead by Gurdan, et al., (2007) developed a small, robust and extremely maneuverable independent flying robot that may be used both indoors under any weather conditions. The robot uses extremely high frequencies (updates rates around 50 to 100Hz) to enables extreme acrobatics maneuvers and to changing environmental conditions such as powerful, and chopping winds. According to Gurdan, the challenge to achieving this type of control is both on the hardware and the software front. There are the four rotor hardware, common design and components. The common design is contain a classical four rotor design with two center rotating pairs of propellers arranged in a square and in contact to the diagonals.

2.2.2 Flapping Wings Robot

Flapping wings cars can fill the niche left by traditional fixed and rotary wing car for little, maneuver and stealthy UAV's in military, civilian and exploration applications (Raghul, Mohammeed Ansari, & Manikandan, 2012). Ornithopter autonomy has not yet been achieved for the reason that the kinematics, aerodynamics and the stability, orientation and navigation of birds are much more difficult than that of a fixed wing aircraft. According to Raghul et al., this challenging problem has sparked a wave of exploration in ever changing modeling, flapping aerodynamics, structural routine and control technique.

They elaborate that a simple principles of the ornithopter blade element in the course of one revolution. The blade is forced to flay up and down once per revolution of the rotor, resulting in the undulating path. Unlike airplanes and helicopters, the driving airfoils of the ornithopter have a flapping or oscillating motion, in preference to rotary. A tested ornithopter should have wings skilled of generating both thrust, the force that propels the craft forward, and lift, the force, perpendicular to the direction of flight that maintains the craft airborne. These forces must be powerful enough to counter the effects of drag and the weight of the craft. A practical flapping wing must be able to flex or rotate. bendy wings can attain efficiency while keeping the driving mechanism basic, where to accomplish the desired flexibility and minimum weight must have experimented with wings that need carbon fiber, plywood, fabric and ribs with a stiff, powerful trailing.

2.2.3 Flying in a Structured Environment

Developing a research autonomous plane for flying in a laboratory space is challenges that force one to understand the specific aerodynamic, power and construction constraints (Nicoud & Zufferey, 2002). They analyzed the wing, propeller and motor characteristics and propose a methodology to optimize the motor, gear propeller system. They suggested that the flying scheme can be classified into four categories such as lighter than air, flapping wings, rotary wings, and fixed wings. Airships or blimps are easiest way to make a robot fly. Powered with three or more DC motors, the vehicles are quiet and not dangerous. Provided with ingeniously arranged protections, they can bump into obstacles without damage.

Nicoud and Zufferey elaborate that a flapping wings hummingbird is the dream for many researchers. Flapping wings represent the only hope to reduce the size below 10cm wing span and quite interesting projects are currently in progress. Helicopters are most likely too dangerous and noisy. Although the R/C tends to be heavy and expensive, the lighter indoor R/C helicopter weighs only 50g and even much smaller ones are considered by scientist. But they may be too fragile, too sensitive to payload and have very limited running time.

They explained the essential elements for the modeling and design of an indoor fixed wings flying robot, with a very low flight speed and adequate maneuverability for operation in a 10mx10m room. First some principles of basic aerodynamics are summarized and the correspondence laws are applied to get some clues on what happens with small dimensions and low speed. Then the wing, propeller, and motor design are tackled. Finally, some thoughts about the weight distribution and the navigation control are given. Because of other heavy components batteries and motors the weight of the wing should be less than 5g.

In addition, they suggested that a good method for the construction of such as a wing is to employ carbon rods for the frame and a thin plastic film for the cover. Actually, the laminar flow is good for drag but bubbles and then vortices will form easily with the lift suction. The theoretical shape for a propeller of a given pitch is easy to understand. The pitch depends on the propeller's rotation speed and the plane's air speed. However, the air is pushed by the propeller at a speed that is difficult to know. For motor selection, brushless motors are the lightest and the most efficient, but they need bulky command electronics. Using coreless DC motors is almost inevitable. The problem with indoor flying is the weight of the batteries, reaching easily one third of the overall weight of plane. Considerable care must be taken to reduce the weight everywhere.

On the other hand, Fang, Wang, and Sun (2010) described about a small quadrotor flying robot for the use of indoor autonomous navigation and exploration has described. Three levels hardware architecture is developed and a fusion of different sensors is implemented, which enables automatic hovering, control from remote controller, localization and navigation in indoor environment. The use of UAV is the only effective way to reach target to get information or to deploy instrumentation. In the last ten years, UAVs have improved their autonomy dramatically with the development of GPS position technology, inertial navigation technology, communication and control technology, and image processing technology.

Today, UAVs can consider as intelligent robotic systems integrating perception, learning, real-time control, reasoning, decision making and planning capabilities for operating in complex environments. They suggested that quadrotor has some advantages such as high payload or volume ratio, good hovering ability, low noise and easy maneuverability. By using four rotors that can rotate with individually controllable speeds make unnecessary the alteration of the rotor blades incidence angle, hence the mechanical structure of the helicopter becomes quite simple. The concept of the quadrator flying robot is illustrated in figure 1. The actuator system has two pairs of counter rotating, fixed-pitch blades located at the four corners of the vehicle. Figure 2 shows the approach and the movement of the quadrotor. Quadrotor can be controlled by properly changing the revolution of the rotors.