Spying Drone

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Abstract— this paper is presentation of the design methodology and realization of the Quadcopter, a normal model aircraft based on four propeller design. The Quadcopter can be controlled by radio transmission or operate under guidance of limited autonomous protocol. Flight stability of the Quadcopter is achieved using five degree of freedom (DoF) inertial measurement unit (IMU). Sensor data is integrated and processed using a proportional integral derivative controller (PID Controller), a feedback loop maintain by an on-board Atmel microcontroller.

Keyword: Quadcopter, IMU, PID controller.

I. INTRODUCTION

Research and development of unmanned aerial vehicle (UAV) and micro aerial vehicle (MAV) are getting high encouragement nowadays, since the application of UAV and MAV can apply to variety of area such as rescue mission, military, film making, agriculture and others. In U.S. Coast Guard maritime search and rescue mission, UAV that attached with infrared cameras assist the mission to search the target.

Quadcopter or quad rotor aircraft is one of the UAV that are major focuses of active researches in recent years. Compare to terrestrial mobile robot that often possible to limit the model to kinematics, Quadcopter required dynamics in order to account for gravity effect and aerodynamic forces. Quadcopter operated by thrust that produce by four motors that attached to it body. It has four input force and six output states (x, y, z, θ, ψ, ω) and it is an under-actuated system, since this enable Quadcopter to carry more load.

Quadcopter has advantages over the conventional helicopter where the mechanical design is simpler. Besides that, Quadcopter changes direction by manipulating the individual propeller's speed and does not require cyclic and collective pitch control.

Quadrotor helicopters are an emerging rotorcraft concept for unmanned aerial vehicle (UAV) platforms. The vehicle consists of four rotors in total, with two pairs of counter-rotating, fixed-pitch blades located at the four corners of the aircraft. Due to its specific capabilities, use of autonomous Quadrotor vehicles has been envisaged for a variety of applications both as individual vehicles and in multiple vehicle teams, including surveillance, search and rescue and mobile sensor networks. The particular interest of the research community in the Quadrotor design can be linked to two main advantages over comparable vertical take-off and landing (VTOL) UAVs, such as helicopters. First, Quadrotor do not require complex mechanical control linkages for rotor actuation, relying instead on fixed pitch rotors and using variation in motor speed for vehicle control. This simplifies both the design and maintenance of the vehicle. Second, the use of four rotors ensures that individual rotors are smaller in diameter than the equivalent main rotor on a helicopter, relative to the airframe size. The individual rotors, therefore, store less kinetic energy during flight; mitigating the risk posed by the rotors should they entrain any objects. Furthermore, by enclosing the rotors within a frame, the rotors can be protected from breaking during collisions, permitting flights indoors and in obstacle-dense environments, with low risk of damaging the vehicle, its operators, or its surroundings. These added safety benefits greatly accelerate the design and test flight process by allowing testing to take place indoors, by inexperienced pilots, with a short turnaround time for recovery from incidents.

II. OBJECTIVES

1. To design quadcopter that can be controlled wirelessly.
2. To design graphical user interface to communicate and control quadcopter.
3. To equip quadcopter with sonar sensor to display underwater structure and track moving objects.
4. To test the performance of quadcopter.

III. LITERATURE REVIEW

1. Nuryono S Widodo, Anton Yudhana and Sunardi (2014), "Low cost open source based UAV for aeriel photography", this paper described what it needs to build a low cost UAV for aerial photography applications. The experimental results indicate that the UAV built in this research has the capability to be used as a basic platform for autonomous aerial photography system. The Ardupilot Mega (APM) used in this paper along with the appropriate hardware and software configuration offers a possibility to build a low cost UAV for aerial photography applications. A GPS based autopilot combined with open source camera software on a Canon pocket camera can be configured to perform an autonomous aerial photography with the cost under $1000. Further development on the image processing portion promises a fully autonomous aerial photography system with an image stitching capabilities, resulting in an automatic panoramic view reconstruction of ground location from the captured ground imagery. [1]

2. Shaik Guneshwor Singh (2015), "Self navigating Quadcopter", the objective of this work is to give an autonomous quadcopter with a stabilized and efficient performance using PID controller. The three parameters P, I

and D are the key for stabilization of the quadcopter. Sonar technique is used for implementing an enhanced system of obstacle and collision avoidance. The work of quadcopter carries certain risk and so needs a lot of care while working on it and so certain limitations had to be faced while carrying out the work like air turbulence during take-off and landing, inconsistencies in quadcopter material, rigidity of the quadcopter structure and unsteady wobbly nature of rigid propellers. Sustainable materials of hardware were used so that more work and application can be expanded in future like addition of vision to the quadcopter for localization and navigation. With the vision support surveillance applications in the field of traffic, agriculture, animal observation and various research studies can be extended. Further works on it with neural network techniques can help in achieving an artificially intelligent quadcopter. Working on the failsafe to be an inbuilt will help in detecting crashes automatically as well as implementation of a reliable Dead Reckoning technique. The usage and application of a quadcopter are dynamic and so it can be extended and expanded to many varying degrees of changes and development. [2]

3. Kalpesh N Shah, Bala J Dutt and Hardik Modh (2014), "Quadrotor- An unmanned aeriel vehicle", the core intension of our project is to study the complete designing process of Quadrotor from the engineering perspective and to fabricate a working model of UAV-Quadrotor with improvement in its weight carrying capacity. Our main goal is to fabricate a Quadrotor which can be used for multipurpose application in market, military, commercial and industrial applications like Traffic monitoring and management, Search and rescue operation, Temperature and altitude estimation, Crowd management, Locating forest fire or frost conditions in farmlands, Weather forecasting, post natural disaster, Object identification and Reconnaissance. With the help of our project guides, we have the resources and technical knowledge to successfully complete this project. We chose the UAV Quadrotor for project because of its flexibility, high learning opportunity and potential of future research. This project can go further in variety of research work to integrate various technologies with UAVs to get various useful outputs. This project will be definitely useful to implement new function of high weight lifting in the account of UAVs. [3]

IV. PROBLEM STATEMENT

1. Main problem of quadcopter is balancing and stability.
2. To develop light and strong floating arrangement for the quadcopter.
3. Material and sensor arrangement for quadcopter (not available in INDIA).

V. THEORY

Designs of Quadcopter are divided into two stages that is part design in first stage and full interface at second stage. Flow chart of Quadcopter design is described in Figure below:

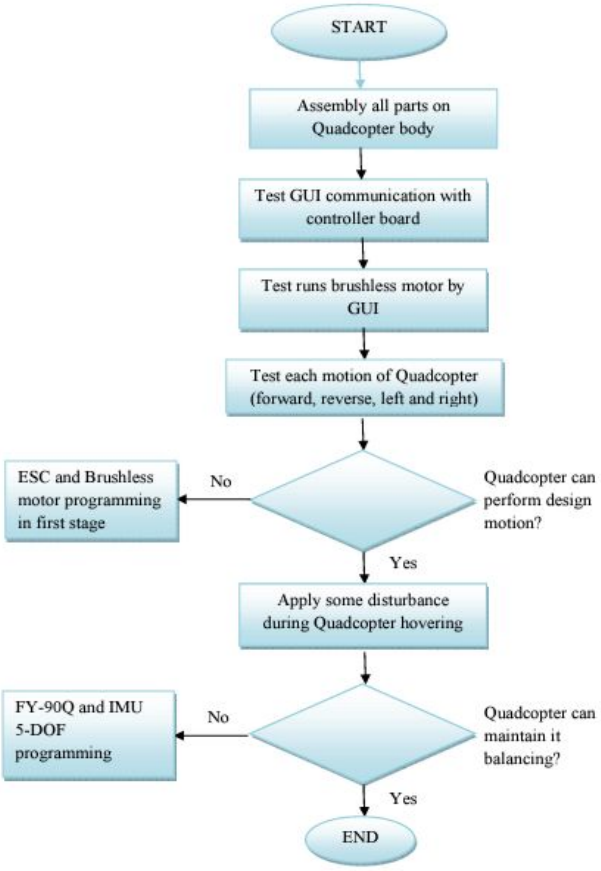

Figure:1 Flowchart for design of quadcopter

Quadcopter can described as a small vehicle with four propellers attached to rotor located at the cross frame. This aim for fixed pitch rotors are used to control the vehicle motion. The speeds of these four rotors are independent. By independent, pitch, roll and yaw attitude of the vehicle can be control easily. Pitch, roll and yaw attitude off Quadcopter are shown in Figure

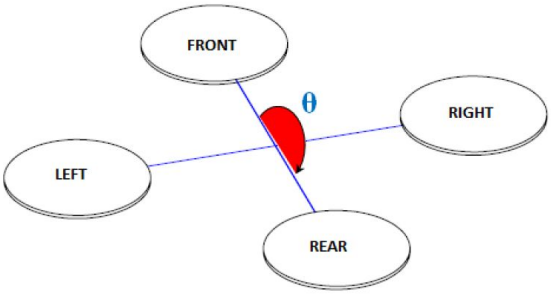

Figure 2 Pitch direction of quadcopter

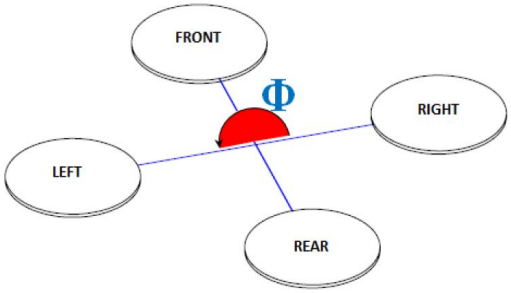

Figure 2 Roll direction of quadcopter

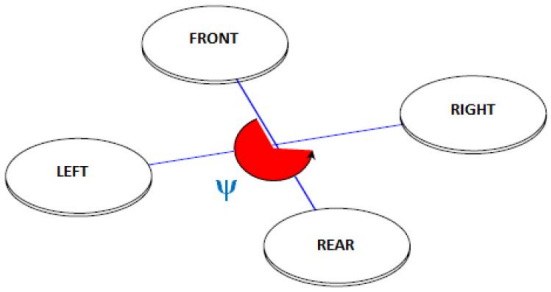

Figure 4 Yaw direction of Quadcopter

Quadcopter have four inputs force and basically the thrust that produced by the propeller that connect to the rotor. The motion of Quadcopter can control through fix the thrust that produced. These thrust can control by the speed of each rotor.

1. Propeller

Propellers are rated using two values;

- Diameter in inches
- Pitch in inches.

A 10x4.5 propeller for example has a 10" diameter, and "travels forward" 4.5 inches with each revolution.
Propellers can be clockwise or counter clockwise.
Thrust produced by each propeller can be calculated by following equation,

$$T=4.392399\times10-8.R.(D\hat{}3.5/\sqrt{P}).(4.23333\times10-4.R.P-V)$$

The amount of power a motor must put out to turn a propeller is given by the following equation:

$$W=k\times R^3\times D^4\times P$$

VI. PROBABLE OUTCOME

1. The aim of this project was to build and program a quadcopter that can be used to collect GPS information of underwater structure and underwater moving objects.
2. Quadcopter must be capable of flying and landing in stable manner.
3. Quadcopter must be capable of determining its current location using GPS data.

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