QUADCOPTER FOR AGRICULTURAL USE

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Abstract

The project goal was to design a semi-autonomous Quad copter for the purpose of agricultural use. The Quad copter was designed to be small enough so that costs would be minimized. It is used for agricultural spraying, viewing and surveillance .The aerial Quad copter used for agricultural surveillance is an unmanned vehicle used for proper and accurate surveying of the crops and leaves reducing the human effort. The agricultural farm is surveyed by an infrared camera which will show the color image displaying the difference between infected or diseased crop and matured crop. The innovative foldable frame design developed will allow the Quad copter to be transported safely and with ease in a cylindrical shaped cushioned box packing. A tank is placed above the quad copter. By the use of tube the solution is supplied to sprayer. This paper introduce a quad copter which is used for pesticide spraying in agriculture field is handle by android application. Here the quad copter can be control through android phone for fertilizer spraying. This system reduces the problem related to the agricultural field and also improve the agricultural productivity

1. Introduction

A Quad copter is a multi-copter that is propelled and lifted by four propellers (rotors). Opposed to fixed-wing aircraft (most common example is an airplane), a Quad copter's lift is generated by revolving narrow-chord airfoils, symmetrically placed, are adjusted as a group. Control of motion is attained by altering the pitch and/or rotation rate of one or more propellers.

The Quad copter can have other applications instead of just a fun recreational model. One use is for the military, instead of sending someone into a dangerous area, the Quad copter equipped with a camera would fly in and gather valuable reconnaissance information.

A unique framework is offer by automated
agriculture for robotic developments. Precision agriculture can be automated for primary and secondary agricultural tasks. The primary goal is to improve the agriculture production. The coupling
between field workers and robots should be done in such a manner that humans should feel comfortable in the presence of robots. HRI system is introduced To face issues such as regulations, safety and comfort. Flexible automation is focused in this work.

This paper introduce a quad copter which
is used for pesticide spraying in agriculture field is handle by android application. Here the quad copter can be control through android phone for fertilizer spraying. This system reduces the problem related to the agricultural field and also improve the agricultural productivity.

Each rotor produces both a thrust and torque about its Centre of rotation, as well as a drag force opposite to the vehicle's direction of flight. Quad copter achieves lift, yaw, roll and

pitch simply via a manipulation of the thrusts of four motors relative to each other. This way, fixed rotor blades can be made to man oeuvre the quad rotor vehicle in

all dimensions. Applications of quad copter are in, agricultural surveying, weather forecasting, traffic forecasting, scenic photography, weapon for war crisis, post natural disaster analysis, civil surveying, for chemical leaks and amusements.

2. Mechanical design

2.1 Design Methodology

• Design Of Quad Copter Arm (Static load consideration) :-

Material used Aluminum 6061-T6

• Density = 2712 kg/m3

• Modulus of Elasticity = 68947.57 MPa

• Poisson's Ratio = 0.33

• Yield stress = 275.79 MPa

• Ultimate Stress = 310.264 MPa

• Considering Theory of Failure:[1]

• Factor of safety (FOS) = Yield point stress/Design stress

• Let FOS = 10Thus Design Stress = Yield point stress/FOS

• Design Stress = 275.79/10 = 27.579 MPa

2.2 Innovative Design Concept

The innovative quad copter design in which the any two arms of the quad copter arms

can be folded either sides removing the propeller and the camera attachment. Hence

this can transported with ease in a cushioned packed box and can again be assembled at the place of use. The entire design is made in Siemens Solid Edge software. It allows us to have a full 3D view of the system with motor mountings and circuit mountings. The physical properties of the material can also be known with the accurate volume and weight analysis.

3. List of Quad-copter components:

1- Frame.

2- Microcontroller (Adriano Uno).

3- Motors (A2217-9 Brushless Out runner Motor).

4- Electronic Speed Controller (ESC).

5- Lithium Polymer Battery.

6- Propeller.

7- Inertial Measurement Unit (IMU Digital Combo Board).

8- RF receiver.

3.1 Frame

The first consideration is the material to be used. It must be lightweight, sturdy, and affordable. The forces which act on the quad-copter primarily will be gravity and air pressure.

We chose plastic which is less weight from the other material.

* We designed a prototype frame with a 12cm X 12cm square plastic central plate with four rods 27cm.

3.2 propeller

Dimension: 10X4.7 inch

2 blades Directly attached to motor

2 each rotating CW and CCW (a "pusher" and a "puller").Propeller balance reduces vibrations

3.3 Power Supply

Lithium polymer batteries are used in quad-copter for their low weights and high capacities. LiPo batteries are available as 3.7V per cell. By series and parallel combination, desired power output can be achieved. These batteries are rated on their
C-rating. C-rating specifies how fast a battery can discharge. A 2000mAh battery with 12C rating would be able to discharge 12 times its capacity i.e. 24000mAh for 1/12th of an hour.

Initially these batteries provide burst current and C-ratings are also specified as per burst currents.

3.6 Microcontroller

Arduino is a single-board microcontroller with a simple open source hardware board designed around an 8-bit Atmel AVR microcontroller. The software consists of a

standard programming language compiler and a boot loader that executes on the microcontroller. Some shields communicate with the Arduino board directly over various pins, but many shields are individually addressable via an I²C serial bus, allowing many shields to be stacked and used in parallel. Arduino programs are written in C or C++ with RS232 as serial communication. There is an inertial measurement unit, or IMU, interfaced with controller. IMU is an electronic device that measures and reports on a craft's velocity, orientation, and gravitational forces, using a combination of accelerometers and gyroscopes, sometimes alsomagnetometers. IMUs are typically used to maneuver quad copter.

4 Design specification

Flight

Semi-autonomous

Wireless control

Adjustable Speed

Electrical Requirements

Power Limitations

3.3 Volt circuit

3 Minute Run time

Lightweight

Compact Frame

Aesthetically Pleasing

Controls

434 MHz Wireless

Dual Joysticks

Intuitive Behavior

Ease of Use

Control range up to 50 yards

Throttle

Controls Vertical Height

↑: All faster

↓: All slower

Pitch

↑: Front slower

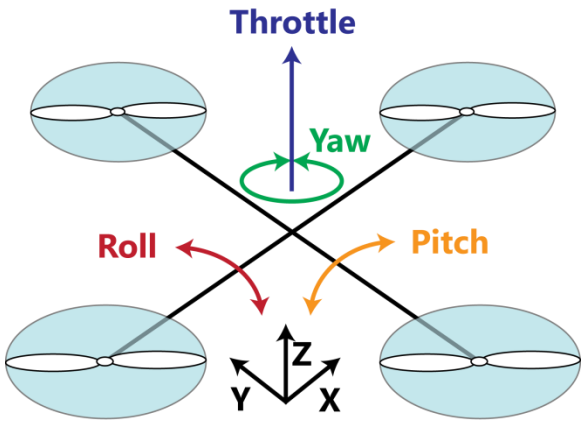
↓: Rear slower

Roll

←: Left slower

→: Right slower

5 control



6. Principal of QC operation

The quad copter is simple design with four rotor propellers with controller (Figure 3). The flight controller is the main part of this vehicle. This auto pilot controls all the operation commanded by us. The four rotors to create differential thrust and the quad copter hover and move accordance

with the speed of those rotors. There are two types of configuration in

Quad copter construction. First one is Plus (+) configuration and another one is Cross (X) configuration. In this project we used X (Cross) configuration. Both the models are same, but the control of these models slightly different. The cross configuration is easier than plus configuration model. Total mass to lift is 4kg means, the total thrust produced by rotors should be 8 kg. GPS guidance system is used here to navigate the UAV. Pre-loaded trajectory gives the real time coordinates to ardupilot controller.

Based on this GPS coordinates, the

Microcontroller navigates the UAV

7 Limitation

The QC is unable to perform at long distance range due to limited amount of power supply from Lithium polymer battery. Increment of power source will increase the range.

8.Future Scope

From the future perspective, agriculture drone can assist farmers to reduce excessive use of water and will contribute to reducing the chemical load on the environment by spraying on the plant that require attention. Therefore, it future this can be called as the green-tech tool. Drones are not only confined to the agriculture sector but can successfully be used across several industries such as Military and for delivering pizza.

Government of developed countries are focusing on setting out the favourable strategy for enhancing the use of such drones by increasing the funding and commercialising agriculture technologies.

9.conclusion

However precision agriculture is about to know a further progress and UAVs will play a crucial role. Important savings (20% - 90%) in

terms of water, chemical treatments and labor are expected. Flight regulation an issue but UAVs, for most agriculture applications, have low weight and fly at low altitudes over uninhabited and private areas.

This project being flexible,
allows changing the functions it performs and also allows integration of any
technology that would prove to be useful. This project will clearly demonstrated the
goals of proving that small scale UAVs are useful across a broad range of applications.

REFERENCES

1. V. Paul. Gasping for Airspace. 2013. SPECTRUM.IEEE.ORG.

2. M. A. Rahman. "Enabling drone communications with WiMAX Technology," Information, Intelligence, Systems and Applications, IISA 2014, The 5th International Conference on, 2014. pp.323,328.

3. C. Bing. "The Design and Operation of City Agricultural Sightseeing System with the Internet of Things Technology," Measuring Technology and Mechatronics Automation (ICMTMA), Sixth International Conference on, 2014. pp.681,683.

4. L. Bencini, F. Chiti, G. Collodi, D. Di Palma, R. Fantacci, A. Manes, G. Manes. "Agricultural Monitoring Based on Wireless Sensor Network Technology: Real Long Life Deployments for Physiology and Pathogens Control," Sensor Technologies and Applications. SENSORCOMM '09. Third International Conference on, 2009. pp.372,377.

5. Balakrishnan, N, Mayilsamy, K & Nedunchezhian, N 2015, ‘An investigation of the performance, combustion and emission characteristics of CI engine fueled with used vegetable oil methyl ester

and producer gas', International Journal of Green Energy, vol.12, pp. 506-514. P-ISSN: 1543-5075, E-ISSN: 1543-5083 (Electronic).

6. Karthikeyan, R**,** Solaimuthu, C & **Balakrishnan, N** 2014, 'A study of performance and emissions of diesel engine fuelled with neat diesel and heat hydnocarpus pentandra biodiesel' IOSR Journal of Mechanical and Civil Engineering, vol. 10, issue.2, pp. 53-57, E-ISSN: 2278-1684, P-ISSN: 2320-334X.

7.Balakrishnan, N & Mayilsamy, K 2014, 'Effect of compression ratio on CI engine performance with biodiesel and producer gas in mixed fuel mode', Journal of Renewable and Sustainable Energy, vol.6, pp. 0231031-02310313. ISSN: 1941-7012.

8. Balakrishnan, N & Mayilsamy, K 2013, 'A study of cotton coated with intumescents flame retardant: Kinetics and effect of blends of used vegetable oil methyl ester', Journal of Renewable and Sustainable Energy, vol.5, pp. 0531211-0531218. ISSN: 1941-7012.

9.Balakrishnan, **N,** Mayilsamy, K & Nedunchezhian, N 2015, 'Experimental investigation of evaporation rate and emission studies of diesel engine fueled with blends of used vegetable oil biodiesel and producer gas' Thermal Science, vol. 19, No. 6, pp. 1967-1975, ISSN: 0354-9836.ssss