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DESIGN AND DEVELOPMENT OF QUAD COPTER FOR 500ML AGRICULTURE SPRAY

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ABSTRACT

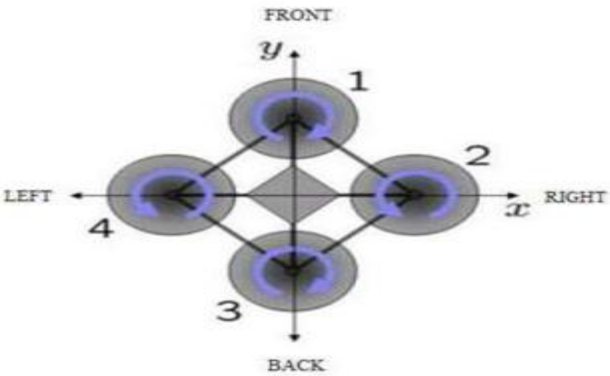
The use of pesticides in agriculture is essential to maintain the quality of large-scale production. It is very important to improve the efficiency and productivity of agriculture by replacing laborer's with intelligent machines like robots using latest technologies. The application of pesticides and fertilizers in agricultural areas is of prime importance for crop yields. In this, we describe an architecture based on unmanned aerial vehicles (UA Vs) i.e. drones or quad-copter which can be used for agricultural applications where drones or quadcopters are responsible for spraying chemicals on crops. Drones are used to spray pesticides to prevent the spread of plant diseases. The process of applying the chemicals is controlled by means of wireless sensor network (WSN) deployed on the cropfield.

Keyword:-unarmed vehicle, drone, agriculture, fertilizers,WSN

I. INTRODUCTION

There has been a rise in use of Unmanned Aerial Vehicle (UA V) in recent years even in the developing countries like India. They are being used in surveillance applications like traffic monitoring, border surveillance, environmental monitoring, target tracking and may other application.

A Quadcopter is also known as Quadrotor or Quadrotor Helicopter is a type of UA V which can be controlled by remote controllers or computers. As the name suggests Quadcopter is a UA V with four motors which are mounted on frame. The frame is in a shape of „X" or p lus sign (+). Each motor has a propeller fixed On it which rotates clockwise and anticlockwise to produce balance torque as shown in fig. When this balance torque advances to safe thrust level it lifts itself. The propellers used in Quadcopter are symmetrically pitched hence generating more torque and less turbulence due to which motors don't have to work as hard. The Weight needs to be low enough so the Quad copter's upward thrust creates a force great enough for flight to occur. Control of vehicle motion is achieved by altering the pitch and/or rotation rate of one or more rotor discs, thereby changing its torque load and thrust/lift characteristics. The motors speed of rotation and direction of rotation change according to the user's desire to move the device in a particular direction. The rotation of motors change as per the transmitted signal sent from thetransmitter



II. LITERATURE REVIEW

(a.patel, 2013) The main purpose of this paper is to study about robust design of a Quad copter which can be used in the market for agricultural surveillance use. The Quad copter for this UA V design since it has interesting design elements with stability and potential for marketable gains.

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(H lim, 2012)This paper presents trajectory tracking control works concerning quadrotor aerial robot with rig id cross structure. The quadrotor consists of four propellers which are two paired clockwise rotate and anticlockwise rotate. A nonlinear dynamic model of the quadrotor is provided, and a controller based on the improved dynamic inverse is synthesized for the purpose of stabilization ion and trajectorytracking.

(Neha S. Morey1)This paper elaborates an architecture based on Unmanned Aerial Vehicle (UA V) which is used for fertilizer or pesticide spraying in agriculture process. This will save the water and chemical requirement up to 20-90% . It is not fatal for hu man working in the farms. The precision agriculture can be done using this UAV for fertilizersspraying.

(A.A. Bhujbal)The main aim of this paper is to design Agriculture Drone for Spraying Pesticides. In this paper, they describe an architecture based on unmanned aerial vehicles (UA Vs).The use of pesticides in agriculture is essential to maintain the quality of large-scale production.

Table 1 motor rpm calculation [6]

motor	Rpm/volt	Max rpm
BE2217-800KV BLDC	800	2220
A2212/13-1000KV	1000	2275
ROBOKART1200KV BLDC MOTOR	1200	3330
1600KV A2212 BLDC QUAD COPTER	1600	4440
ROBO KART 1800KV BLDC	1800	4975

Sample calculation for max.rpm of motor :-
=((rpm/volt)*0.5*battery volt)/2
=(800*0.5*11.1)2
=2220 rpm

The next step is to determine the max.rpm of the propeller. Max rpm for a propeller is found by Equations and solving for rpm.

$$=\left(\frac{2}{\pi}\right)^{\frac{1}{2\omega}}\left(\frac{a^{3/2}m^{3/2}}{\alpha D\sqrt{\rho}}\right)^{\frac{1}{\omega}}$$

(FLITRY) from this paper we study about the spraying pesticide technique balancing of quadcopter and quadcopter design.

(p.v.reddy,) this paper is elaborates an basic design and consideration of for frame design .

III. CALCULATION

Weight of frame F330 (i.e.) : 700g
Weight of one Esc : 28g
Weight of battery 2200mah : 360g
Weight of one motor 1200kv : 57.6g
Weight of flight control board : 50g
Weight of tank : 500g
Miscellaneous weight : 100g

So the total weight of Quad copter comes out to be
=>700+112+360+240+50+500+100 = 2100g
But fo r a quad copter to take flight the required thrust is twice the total flying weight. So, required thrust becomes
=> 2100/4 = 525g

The total load of quad copter is 2100g which is divided in 4 motor so the required thrust produced for single motor is2100/4=525g

g=gravity(9.
81 m/s2)
m= mass
(kg)
α=power coefficient of air-craft
world.com ρ=density of air (1.225 kg/m3)
ω= power factor from air-craft world.com Table 2 propeller calculation

Ideal trust	Propell er(dia?*pit ch?)	Diameter m	pc	pf	Max rpm
525g	6*4	0.1524	0.015	3.2	11118
Air density	7*5	0.1778	0.042	3.2	7880
1.2*e4kg /m3	8*4	0.2032	0.06	3.2	6590
	8*6	0.2032	0.106	3.2	5516
Gravity=	8*8	0.2032	0.148	3.2	4970
	9*4.5	0.2286	0.09	3.2	5595
9.81 m/s2	9*9	0.2286	0.129	3.2	5000
	10*5	0.254	0.352	3.2	2800
	10*7	0.254	0.448	3.2	4178
	10*10	0.254	0.144	3.2	4675
	11*5.5	0.2794	0.223	3.2	4078
	11*7	0.2794	0.68	3.2	3212
	11*8	0.2794	0.222	3.2	3963

IV. SYSTEM DISCRIPTION

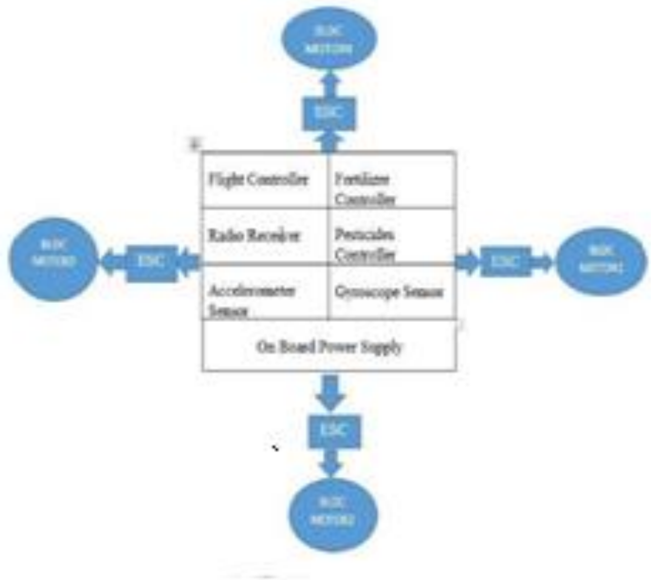

Fig 1 Block Diagram

(A) Frame

The frame of the Quadcopter provides the physical structure for the entire aircraft. It joins the motors to the rest of the aircraft and houses all of the other components. The frame must be large enough to allow all four propellers to spin without collision, but must not be too large and therefore too heavy for the motors. For our Quadcopter. We deign our frame.

FIG 3 BLDC MOTOR

(C) Battery

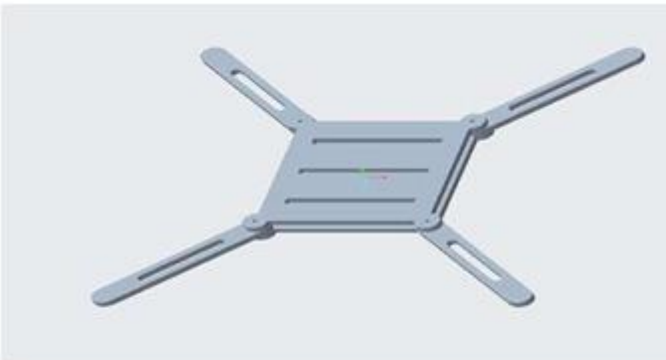

FIG 4 LiPo Battery

(B)Motor

FIG 2 Frame

The battery provides electrical power to the motors and all electronic components of the aircraft. Lithium Polymer (LiPo) batteries are used almost exclusively, because they have high specific energy. Hobby LiPo batteries have a capacity rating and discharge rating. The capacity rating, in milliamp-hours (mAh) indicates how much current the battery may output for one hour. Discharge rating, indicated by the letter —C||, show how fast the battery may be safely discharged. To determine max allowed current, multiply the C value with the capacity. For this project, we selected Turing 2200mAh40Cbatteries The motors spin the propellers to provide the Quadcopter with lifting thrust. Quadcopters almost exclusively use brushless DC motors, as they provide thrust -to-weight ratios superior to brushed DC motors. However, they require more complex speed controllers. Hobby motors are typically given two ratings: Kv ratings and current ratings. The Kv rating indicates how fast the motor will spin (RPM) for 1V of applied voltage. The current rating indicates the max current that the motor may safely draw. For our project, we selected 1000Kv, 15A max.

(D) Propeller

FIG 4 Propeller

Propeller co me in many sizes and materials. They are measured by their diameter and their p itch, in the format (diameter) x (pitch). Pitch is a measurement of how far a propeller will —travel|| in one revolution. Prop selection is important to yield appropriate thrust while not overheating the motors. For our project, we selected 10x4.5 carbon fiber props which yield 1000g m of max thrust while drawing 10.2A.With four motors, the max thrust for the quad is approximately800g m. Our quad has an all-up- weight of 2.0 kg, resulting in an overall thrust -to-weight ratio of 2 this allows the quad to hover just below half- throttle.

(E) SpeedControllers

Every motor needs an individual electronic speed controller (ESC for short). These speed controllers accept commands in the form of PWM signals and output the appropriate motor speed accordingly. Every ESC has a current rating, which indicated the maximum current that it may provide the motor without overheating. Appropriate ESCs must be chosen to ensure that they can provide enough current for the motors

(F)

(G) RadioReceiver

The radio receiver (Rx) receives radio signals from an RC transmitter and converts them into control signals for each control channel (throttle, yaw, roll & p itch). Modern

(G) Flight Controller

The flight controller is the —brain|| of the Quadcopter, and performs the necessary operations to keep the Quadcopter stable and controllable. It accepts user control commands from the Rx, combines them with readings from the attitude sensor(s), and calculates the necessary motor output.

H)Pump

The main function of the pump is to spray the pesticide for the. It lifts the pesticide from the tank and sprays it. For our paper we used the 3V mini aquaticpump

FIG 5 PUMP

V. SUMMARY

Agricultural drone have the potential to improve the yield crops. Agricultural drone can help the farmers to transform the agriculture industry. The agricultural sector can benefit significantly from implementation of unmanned aerial vehicles with the potential to imp rove the soil and plant knowledge, efficiency of input, and economical and environmental sustainability. However, their effective implementation depends upon some mandatory critical aspects that must be considered, including the configuration, mass, payload, flight range and costs. Cost effectiveness can be proven in cases where UA V can be applied to cover large land areas; never the less, improvements remain crucial with regard to battery duration, and consequently, payload and flightautonomy.

VI. REFERANCES

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