



# Design and Fabrication of Agro Servicing Gyrocopter

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## Abstract:

The gyrocopter is a unmanned aerial vehicle, which is used for many purposes. It having more stability and high thrust ratio compared to helicopters and higher efficiency compared to other flyers. In the agriculture field, spraying the fertilizers on the plants located in forest area is very difficult and also some fertilizers are very harmful to humans who worked in this fertilizer spraying work. So, we planned to attach the fertilizer sprayer system in the gyrocopter for solve this problem. From this design we can able to resolve the above-mentioned problem. We can easily spray the fertilizers on plants even rough places.

**Keywords:** agriculture application, autogyro, gyrocopter, fertilizer spraying methods.

## I. INTRODUCTION

An **Unmanned Aerial Vehicle (UAV)** is the aerial vehicle it is powered by without human. The UAV contains, a ground-based controller and a system of communications. The UAVs can fly all the direction and dimensions automatically. It fly under remote control by a human operator or autonomously by onboard computers. Compared to manned aircraft, UAVs are commonly used to missions which is difficult and hazardous to humans.it is mostly used for drone racing, sports purposes. So much of terms are used in the UAV.

**These are given below:** The term **drone**, mostly used by public was controlled by remote and flown target aircraft used for practice of a battleship's guns to firing and the term was used in the 1920's Fairey queen and 1930's. The International Civil Aviation Organization (ICAO) adopted this term drone and also used in a European Union's SESAR Joint undertaking roadmap for 2020. This term prominence the importance of parts other than an aircraft. It's included parts such as ground control stations, data links and other support equipment. Many similar terms are in use. A UAV is defined as a "an aerial vehicle it doesn't having any human pilot and it produce the lift by using auto rotation wing". Therefore, missiles are didn't comes under the UAVs.

## II. METHODOLOGY

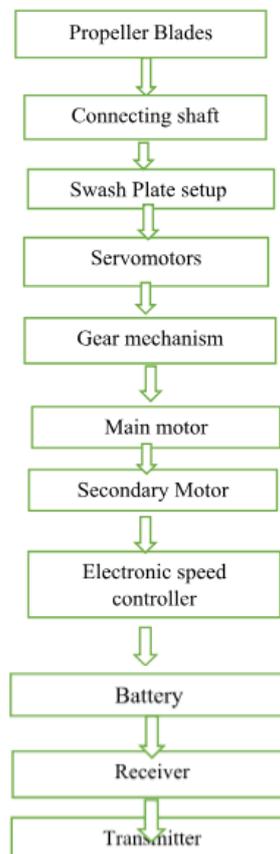


Figure.1. Methodology of MWT

### III. MATERIAL SELECTION

#### 3.1 Motor



Figure.2. Emax-HL2215-450Motor

Motor is an electrical device which converts electrical energy into mechanical energy. Mostly an DC motor operates by interaction between magnetic field and winding currents by producing force in terms of rotation.

##### 3.1.1 Specifications

Table.1. Specifications of motor

Sl.No	Requirements	Range
	Lipo cells	3s-4s
	KV	3850 Tr/v/min
	Weight	67g
	Shaft Diameter	3.2 mm
	Max current	40 amps
	RPM/v	3200/8600/3800

#### 3.2 Servo



Figure.3. EMax-ES08AII Servo

Servo is a one type of rotary actuator it controls the angular or linear position, velocity and acceleration.

##### 3.2.1 Specifications

Table.2. Specifications of servo

Sl.No	Requirements	Range/ Command
	Operating voltage	4.8v-6.0v
	STD direction	Positive
	Stall torque(4.8v)	1.5 kgs.cm
	Operating speed(4.8v)	0.12sec/60 deg at no load
	Stall torque(6.0v)	1.8 kgf.cm
	Operating speed(6.0v)	0.10sec/60 deg at no load
	Size	23×11.5×24 mm
	Weight	2.5g
	Plug available	Futaba, JR
	Other	Analog, plastics

#### 3.3 Electronic Speed Controller



Figure.4. BLC-40 ESC

It is an electronic device that control and regulate the speed of motor. It also provides reversing of the motor& dynamic braking. Electronic speed controls used in electrically powered radio-controlled motors.

##### 3.3.1 Specifications

Table.3. Specifications of ESC

Sl.No	Requirements	Range
	Voltage range	7.4-14.8v(2s-4s-Lipo)
	Resistance	0.0048Ω
	Continuous load(5mins)	40A
	BEC voltage	5v
	BEC current	2A
	Weight	27g
	Dimensions	52×24 ×7.9

#### 3.4 Transmitter



Figure.5. Fly Sky Transmitter

It is equipment used to generate and transmits electromagnetic waves carrying messages or signals.

##### 3.4.1 Specifications

Table.4. Specifications of Transmitter

Sl.No	Parameters	Range
1.	Number of channels	6
2.	RF range	2.40-2.48 GHZ
3.	Bandwidth	500KHZ
4.	Band	142
5.	QF power	>20dbm
6.	AFHDS2A & AFHDS	2.4GHZ
7.	Code type	GFSK
8.	Sensitivity	1024
9.	Low voltage warning	less than 2.4 volts
10.	ANT length	26 mm ×2
11.	Weight	463 gm
12.	Power	6v (5.4AA × 4)
13.	Size	174×190×40 mm (L×W×H)
14.	Model memories	20

### 3.5 Receiver



Figure.6.Receiver

Electronic device that receives signals from transmitter and convert them into the all devices.

#### 3.5.1 Specifications

Table.5. Specifications of receiver

Sl.No	Parameters	Range
1.	Channel	6
2.	Frequency range	2.4055-20475GHZ
3.	Bandwidth number	140
4.	Transmitting power	20 dbm
5.	RF receiver sensitivity	105 dbm
6.	Encoding	GFSK
7.	Antenna length	2×26 mm
8.	Input power	4.0 -8.4 VDC
9.	Dimension	47×26.2×15 mm
10.	Weight	14.9 gm

### 3.6 Propeller



Figure.7. Propeller

Propeller is a mechanical device for propelling an aircraft. It consists of revolving shaft with two or more broad, angled blades attached to it. Propeller blades are made by many materials. For our project we use the wood. A propeller is like a fan it transmits power by converting rotational motion into thrust. There is difference in pressure is produced between the forward and rear surfaces of the air foil shaped blade and a flow is accelerated behind the blade.

### 3.7 Swash plate



Figure.8. Swash plate

Swash plate is a device that translates input signals of helicopter flight controls into motion of the main rotor blades. The main purpose of the swash plate is control the angle of the

main rotor blades. By changing the angle of rotor blades we can control the flight forward, backward and roll actions. The main rotor blades are spinning, and swash plate is used to transmit commands from the non-rotating frame to rotating rotor hub and main blades of the frame. The swash plate is controlled by servomotors.

## IV.EXPRIMENTAL SETUP

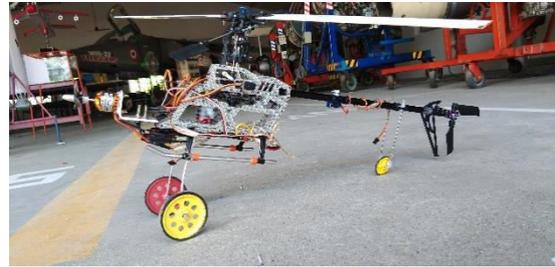


Figure.9. experimental setup

- In gyrocopter the essential parts to construction are Motors, Swash plate, Servomotors, Battery, Propellers, Electronic speed controller, etc.,
- The outer frame of Hiller hover Helicopter setup was taken.
- In that frame first motor is fitted on the bottom Centre of the frame.
- After that swash plate is to be fitted on the top of the frame.
- Two main propellers are fitted in the top of the swash plate.
- Below the swash plate three servomotors are fitted.
- They are totally 3 servos are fitted on the frame.
- After servo, Gyro is fitted on the frame.
- Next to the gyro, two separate ESCs are connected to the motors.
- Then the ESCs are connected to the battery.
- Battery is fixed bottom of the frame.
- All the connection wires are connected to receiver board.
- Then finally transmitter is to be fitted.
- Outer case is made up of plastic body.
- The secondary motor is fitted in the front side of the gyrocopter.
- Additional setup is used to fit the secondary rotor in the gyrocopter.
- The rudder was fitted rear side of the gyrocopter. A separate servomotor for rudder is placed in the near to the rudder.

## V. DESIGN AND PRINCIPLE

### 5.1 3D view of gyrocopter model

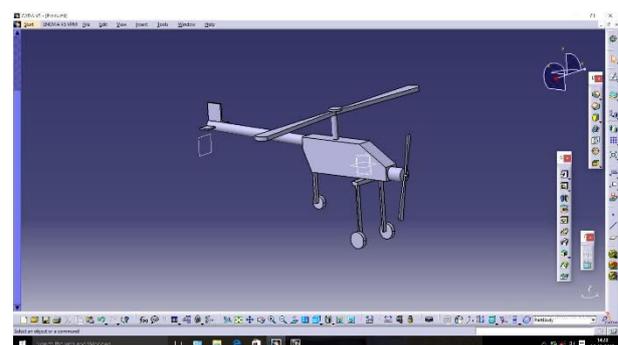


Figure.10. gyrocopter model

## 5.2 Working Principles

- It works under the principle of Newton's law of motion.
- An autogyro, also known as a gyrocopter or gyroplane is a type of rotorcraft that uses an unpowered rotor in the free autorotation to produce the lift. Forward thrust is provided typically, independently by an engine-powered propeller.
- Every rotor ought to be controlled separately by a speed controller, motors are the primary force behind how autogyro fly.
- The autorotation of primary motor is generated by the air flow from the thruster engine.

## VI. WORKING

- First, the transmitter switches are to be in neutral position.
- Next switch on the transmitter & binding the transmitter based on model actions.
- The power supply is given by motor through battery.
- By using the controls on the transmitter, the motion of the gyrocopter is positioned.
- Forward, left, right, backward motion is controlled by transmitter control.
- Initially give the small amount of thrust power provided two motors because the stability of the gyrocopter.
- Afterward increase the thrust power the two motors propeller blades rotates at minimum level of speed.
- That much speed gives the minimum lift, the lift is increased based on propeller blade rotation.
- The front motor provides the forward thrust and it rotates the primary blades. It provides the lift to the autogyro.
- Actually, gyrocopter will fly at X-Y-Z axis that directions are controlled by transmitter.
- If we give full thrust power the gyrocopter can fly maximum speed at respective direction.
- At the time of landing the motor power is reduced gradually without any variation in the stability.

## VII. RESULT AND DISCUSSIONS

Thus, design and fabrication of the gyrocopter will produce the lift and it spray the fertilizer in manner way. The front attached motor produces more thrust and primary motor increase the flight performance.

## VIII. CONCLUSION

In this project we designed the gyrocopter for agro-servicing purpose. All the flight parameters of autogyro are calculated. The gyrocopter is designed based on our requirements. We also list out the material specification of gyrocopter. Based on that material specification the materials are selected for fabrication process. The main objective of this project is increasing the performance of the gyrocopter and use the gyrocopter in agriculture area. After design and calculation, the model is fabricated. After the fabrication process the fertilizer tank is fixed in the gyrocopter for the purpose of spray the fertilizer on the plants in agricultural fields. The flight performance of gyrocopter is calculated. The model is designed in CATIA software. Gyrocopter is the combination of helicopter and airplane. Based on this principle the model is designed and fabricated. The two high rpm motors give higher thrust and lift. The outer structure is produced higher strength and stability. All the aerodynamic properties of gyrocopter are measured. In the testing process a small vibration is occurred in the inner structure of the gyrocopter because of main rotor

rotation. In future work this problem will be solved. The flight properties of gyrocopter like range, endurance, lift, drag are calculated. The flight duration of gyrocopter model is low. Because the batteries used in the model having less power. In later research this problem is resolved. The fertilizer system works well in both liquid and solid fertilizers. The sprayers are correctly spray the fertilizers on the plants and it covers the projected zone. All the operations of the gyrocopter is works well.

## IX REFERENCE

- [1]. Vassilios M.Spathopoulos, Stewart S.Houston, Douglas G. Thomson flight dynamics issues relating to autogyro airworthiness and flight safety, University of Glasgow.
- [2]. Dr Douglas Thomson, Dr Stewart Houston, advances in the understanding of autogyro flight dynamics, University of Glasgow, UK.
- [3]. Zhihao CAI, Ningjun LIU, Jiang ZHAO & Yingxun WANG Control and dynamics analysis for miniature autogyro and compound autogyro, Beijing 100191, china.
- [4]. Anand Saxena, A technical essay on the gyroplane, University of Maryland, College park.
- [5]. Dr Douglas Thomson, Dr Stewart Houston, experimental and theoretical studies of autogyro flight dynamics, University of Glasgow.
- [6]. Weber, A.Jenal, C.Kneer, J.Bongartz, Gyrocopter based remote sensing platform, Germany.
- [7]. A. Miraliakbari, M.Hahn, J.Engels, Development of a low cost sensor system for use on gyrocopters, Germany.
- [8]. Darius Vainilavicius, Vygantas Augustis, Marius Malcius, Analysis of autogyro rotor balancing and vibration, Lithuania.
- [9]. MA Tielin, HAO Shuai, XUE Pu, LI Gen, GAN Wenbiao, A Fast method of aerodynamic computation for compound gyroplane, China.
- [10]. Lutz BANNEHR, Tobias KIRSCHKE, Lothar KOPPERS and Christoph ULRICH, Possible applications of a gyrocopter in the field of environmental research, Germany.