

# Study of Solar Powered Unmanned Aerial Vehicle

<sup>1</sup>Shivani Sawant, <sup>2</sup>Ashish Kapde, <sup>3</sup>Harshada Gadakh, <sup>4</sup>Rohan Sontakke

<sup>1,2,3,4</sup>Student, , D. Y. Patil College of Engineering, Akurdi , Pune 411033 Corresponding Author: Prof. Ms. Utkarsha Kharade

Submitted: 15-05-2022

Revised: 20-05-2022

Accepted: 25-05-2022

**ABSTRACT**— In this paper, the detailed idea or design plan of solar powered UAV is given. The solar powered unmanned airborne vehicle is worked on electric based impetus frameworks with assistance of renewable source of vitality. Sun energy is unlimited sustainable source. this is often utilized for persistently supply of energy to the battery and make vehicle more productive. Substitution of ordinary fuel or electric vitality by solar vitality its profoundly recipient. For aerial vehicle weight is the major element for the steady and smooth drive of vehicle. The main components of UAV structure fabric, impetus framework, sun-oriented cell board, batteries, motor, and payloads etc.

In present work, the detailed Study of Various Components which required to Solar Powered Aerial UAV is Done. According to Study and specifications the Mechanical Design of part like BLDC Motor, Battery, Propeller etc. is completed.

**Keywords**—Solar powered UAV, flexible Solar cell, Mechanical System design, Payload, Endurance, Renewable energy)

## I. INTRODUCTION

Unmanned Aerial Vehicle is a vehicle that doesn't convey a human operator. With the assistance of streamlined powers UAV gets vehicle lift and subsequently it can fly independently. In this day and age, there are loads of uses of Unmanned aerial vehicles for different purposes like military application, search and salvage activities. But, because of the low power supply their exhibition isn't great. For more power assuming that we increment the limit of battery, it will build the weight and size of battery which straight forwardly influence the flight time of UAV. Additionally, the emission brought about by such vehicles is influencing our current circumstance as well as the ozone layer. In this

way, there is an extraordinary interest to utilize limitless solar energy through sunlight-based cells. Our fundamental rule is to utilize solar power, this should be possible by Solar panels which cover the entire surface of the wings.

The fundamental rule of solar UAV is to have solar based cells on the region of the airplane, typically the wing. When exposed to insolation, the cells convert solar radiation into electrical energy. How much energy that is created relies upon elements like the day of the year, the hour of day, the tendency of the cells concerning the sun, and the degree of overcast cover. The electric power relay is finished by a circuit board containing a programmable computer chip. A Power Management and Distribution framework on the circuit board guarantees that the maximum force is acquired from the solar cells. The gained power is principally used to charge the battery. At the point when less or no solar power is accessible, the battery turns into an energy source. Creating higher productivity solar cells or batteries would work on the overall effectiveness and execution of the airplane. Hence, the presentation of high result low power utilization electrical parts and higher productivity propellers would accomplish better power protection and the board. Besides, acquiring vigorous lightweight materials for structure and appropriate airfoil choice would improve payload limit, flight execution, and perseverance of the airplane. These are continually being considered in the innovation universe of today. Numerous advancements have moved past hypothetical and mathematical analysis into real creation and use of small- scale gadgets. These efforts in innovative progression, as should be visible today with the plan of more modest yet more effective frameworks, keeps on directing the example in which solar airplane are created and worked. A basic report and analysis of this innovative pattern would demonstrate a valuable device in

anticipating the future of solar powered airplane. The idea of solar controlled plane is to utilize sunlight-based energy, which can possibly wipe out fuel or electric power utilization. By replacing ordinary fuel and electric power with sunlight-based energy, the solar controlled plane is feasible to be an answer for accomplish long endurance. This project is aimed at the Study, design, and analysis of solar powered UAV. Primary objective of this work is to increase the efficiency, minimize the cost, reduce the weight and improves self-controlling of the Solar UAV.

## II. OBJECTIVES

- To design solar powered aerial vehicle by considering design specifications and requirements of UAV vehicle using 3D Modelling software.
- Analysis of battery performance for better efficiency as well as for light weight of UAV.
- To optimize the weight of the aircraft wing by replacing the existing material with Composites.

## III. LITERATURE REVIEW

Parvathy Rajendran et al. [1] gives the insights concerning little UAVs detail, design and frameworks portrayal. A short-range perseverance UAV framework influences the information checking, life practicality and result execution of a mission because of UAVs being reliant upon the batteries. The heaviness of the battery and low temperature climate is the primary driver for the poor UAV execution. By further developing the UAV framework with batteries, the perseverance passable is between 45 minutes to 4 hours. Hence, the battery is presently not alluring to be broadly utilized for UAV. Supplanting the batteries by sun-based cells in the UAV System. This UAV has just about 24 hoursflight ability. The extent of this UAV will be restricted to airplane weighing under 7 kg comprehensive of the payload, since it requires no airport regulation consent except if working in limited airspace.

Zhong Lei and Hiroshi Kawamura [2]. In this paper, a vehicle was planned with thought of preparing sunlight-based cells on a superficial level to create adequate electric power for flight. The V-moulded tail has less wetted surface region and lightweight and assumed a part of winglet on the lifting body, and along these lines diminished drag. A sun based controlled automated ethereal vehicle ought to be equipped for flying productively and inserting adequate payload. The power accessible which is produced by the sun-oriented cells, ought to be bigger than the power required. The

enormous range and high viewpoint proportion might diminish the lift- actuated drag, work on streamlined execution, and increment surface region for the sunlight-based cells. In this review, a bunch of single glasslike silicon cells with 23% transformation proficiency were extraordinarily overlaid with exceptionally straightforward movies to adjust the planned sun-oriented plane.

Jaw-Kuen Shiaua & Der-Ming Maa [3]. This paper summarizes plan, usage, and test of a solar-powered UAV. In this paper fundamental accomplishments are Streamlined execution plan and sun-based control administration framework plan. For streamlined execution plan mass of flying machine, wing reference range and cruise speed considered. A sun-oriented control administration framework is planned to get electric vitality from the sun- based framework. The framework incorporates sun-oriented cell boards, greatest control point tracker, and control transformation. In this paper arrangement strategy are Slope based optimization and calculation Stochastic look calculations i.e., Hereditary calculation. cruise speed for the least vitality operation depends on the wing zone, add up to weight of the airplane and discuss thickness (height).

Joan B. Rodriguez, Carlos Gil Moralesb, Efrén M. Benavidesa [4]. A To begin with Approach to Sun based Flying with the Utilize of compact Plan by Joan B. Rodriguez, Carlos Gil Moralesb, Efrén M. Benavides In this term paper the point of that's to display a preparatory detailing of the plan issue with quantitative exchange capacities to which Suh's standards are at that point connected and another point of this article is to diagram a sun based plane plan issue in terms of Proverbial Plan, in arrange to serve as an illustration when educating Suh'sstandards in their quantitative detailing to understudies and professionals. This paper is comprising of Detailing of the plan issue, compact Plan Investigation. In most of the existing sun-based airplanes, sun-based cells are apportioned on the best of the wing. From the viewpoint of Aphoristic Plan, this setup makes a reliance between control, perseverance and wing stack.

This paper is displayed by Karthik Reddy B.S.[5], Aneesh Poondla. In this paper by considering the essential challenges for sun oriented fuelled air ship which are a geological range of operation, vitality collection and capacity, payload, and plan parameters, a plane was planned and manufactured by joining the sun-based cells onto the wing. In this paper by dissecting diverse discuss foils, they select a appropriate aerofoil which is WE3.55, with this aerofoil wing span and

chord had chosen. Here for 3S battery 12.4 V was required, each sun powered cells gives out 0.57 V which suggests 22 sun powered cells are required to meet focused on voltage. Two more cells are included for security, so add up to 24 cells are utilized. The diversion for the central wings was tried tentatively. A program Ansys has been utilized to discover out avoidance and push utilizing limited component strategy.

#### IV. COMPONENT SPECIFICATION PROPELLER

A Gadget that changes rotating movement into direct pushed. Pushed nothing how strongly a motor thrust forward or upward. i.e., Propeller gives lift for the airplane. The standard pushed weight proportion is 1:1 Propeller pitch is the remove secured in one revolution. Expansive measure propeller produces more pushed and more torque. Propeller speed depends on voltage provided from the motor. In this extend, we utilize the plastic propeller since it is cheaper and lighter in weight. Too, the time of smashing harm is exceptionally less. In this UAV 405 mm propeller length is prefer with around 3.2mm shaft diameter.

#### BLDC

BLDC stands for Brushless DC Motor. Brushless engines are fundamentally utilized for movement control, situating or incitation frameworks. This engine impels the propeller. A BLDC engine comprises of two primary parts, a stator and a rotor. Stator encompasses a coil course of action and the rotor could be a changeless magnet. It has 14 magnets and 12 windings. On the off chance that we apply current through a coil it'll produce a attractive field and the attractive field lines depend on the current heading. that that we actuate each coil will pull one in the rotor's lasting magnet. on after the off chance another the rotor will keep pivoting since of the drive interaction between changeless and the electromagnet. For controlling the engine, we utilize an ESC controller and the ESC controller is controlled by a microcontroller by sending the PWM flag. This flag changes the yield recurrence of the ESC controller and speed of the engine. in this extend, we utilize the BLDC engine since it is more dependable, less loud, less weight, tall speed, tall torque and long life. Lower KV engines are competent of pivoting expansive propellers and utilize less current.

#### ELECTRONIC SPEED CONTROLLERS

Electronic speed controllers (ESCs) are gadgets that permit Sun oriented UAV flight

controllers to control and alter the speed of the electric engines. ESC gets the current from battery and changed over it DC to AC and supply to the BLDC engine. A flag from the flight controller causes the ESC to raise or lower the voltage to the engine as required, hence changing the speed of the propeller. An ESC the brushless engine development or speed by actuating the fitting MOSFETs to form the turning attractive field so that the engine pivots. The higher the recurrence or the speedier the ESC goes through the 6 interims.

#### SERVO MOTOR

servo engine could be a basic electric engine, controlled with the assistance of servomechanism. The gadget is controlled by a criticism flag generated by comparing yield flag and reference input flag. A servomotor could be a direct actuator or rotational actuator that permits for exact control of straight or precise position, speeding up, and speed. It comprises of a engine coupled to a sensor for position criticism. In this venture we utilize three servo engines for controlling the UAV. One is for controlled the wings of UAV. Moment and third is at tail of the UAV. They control the heading and adjust of the Ethereal Vehicle.

#### FLEXIBLE SOLAR PANEL

Solar panels are those devices which absorbs the sun's rays and convert them into electricity or heat. This electricity supplies renewable energy to your purpose. These solar cells are installed on the surface of the wings of UAV. They capture alternative energy reaching the UAV surface during daylight. Such generated power is supplied to the motor to propel the UAV and to recharge the battery on board. The battery supplies power when darkly or under clouds.

In this project we are going to use 6V-100 mA Flexible solar panels. Whose operating voltage is 10.2 V and working current is 2.9 Amp.

#### PAYLOAD

Payload it means it's an equipment of UAV that carries load to perform its duty. For ex- Camera, Sensors, etc. Payload may vary consistent with our UAV purpose. it's usually counted outside of the weight of the UAV itself and includes anything additional to the UAV.

Payload is split into two types.

1. Active Method: - This method involves preliminary irradiation of studied objects.

For ex- radar.

2. Passive Method: - This method involves detects certain signals from the world surface.

For ex- Camera, Sensors, Gamma spectrogram.  
**RECEIVER**

Receiver is a device that receive electric signals or waves comes from the transmitter. In receiver, at the same time there is only one radio frequency that can operate. But with the help of AFHDS (Automatic frequency Hopping Digital System) we can operate two or more radio frequency at the same time. Receiver Doesn't just receive the signal from the transmitter but it also interprets the signals and converts them into the alternating current. This information is then sent to the flight control board which puts the information into action.

In this project we are going to use FLY SKY FS-iA6B receiver. This receiver has easy binding, compact dimensions and dual antennas. Dual antennas give the excellent reception and interference rejection capability. Also, the receiver has end-on connectors to enable neat installation in tight spaces. Due to all this advantages, we are going to use this FLY SKY FS-1A6B receiver.

#### **TRANSMITTER**

Transmitter is a device that's used in telecommunication to supply the radio waves so as to transmit or send data with the assistance of antenna. A transmitter incorporates a unique ID so when binding; the receiver remembers this ID and accepts data from that transmitter only. This avoids memorizing other transmitter signals and dramatically decreases inference and increases safety. transmitter is employed to manage speed; direction operate solar UVA from ground. during this project, we required 6 channels and a pair of 4 GHz frequency so that's why we use Fly sky fs-i6 transmitter. This transmitter has digital trims, backlit LCD screen or & Easy to use Programming & Navigation Buttons.

#### **BATTERY**

It is a combination of one or more electrochemical cells that are capable of converting stored energy into electricity. It's a chargeable battery. Solar power may also be stored in electrochemical batteries. When solar power is pumped into electric battery, a chemical process among the battery components stores the energy. The reaction is reversed when the battery is discharged, allowing current to exit the battery.

### **V. WORKING**

In order to understand how UAV, fly and work, first we understand something basic about the development of a typical UAV. A UAV is formed from different light composite materials so as to

extend maneuverability while flying and reduce weight. UAV may be equipped with a range of additional equipment, including cameras, GPS guided missiles, Global Positioning Systems (GPS), navigation systems, sensors, and so on. The essential components that each UAV must have, could be a waterproof motor frame, flight and motor controllers, motors, transmitter and receiver, propellers, and batteries or the other source of energy. UAV works on control feedback system. That is, after the input adjustment is applied, the change of the control amount is measured and feedback is adjusted to input until the control amount reaches the target value. The UAV moves vertically and uses the rotor to advance and stop.

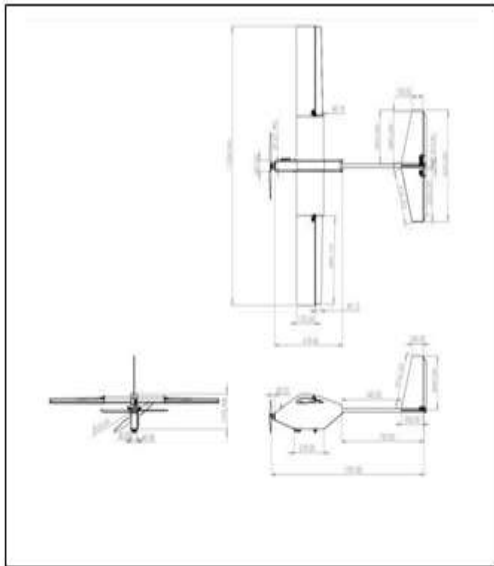
When the rotor pushes the air, the air also pushes the rotor back. this is often the essential principle that the drone can go up and down. Furthermore, the faster the rotor rotates, the greater the lift, and the other way around. during this project we are visiting use 11-inch twisted shape propeller having 2 blades. Basically, propeller is employed to comeup with the thrust which is crucial to lift the UAV. These propellers are mounted on the shaft of the BLDC motor.

The BLDC motor have 1000 kV power and operating current around 12 v. The electrical energy provided by battery must be convert into electricity for the BLDC motor to figure. For this conversion Electronic Speed Controller has been used. Also, the speed of BLDC motor is controlled by ESC. One connection of ESC is connected to receiver.

Receiver is intermediate between transmitter and ESC controller. It receives electric signals or waves comes from the transmitter. This information received by receiver. because it is Solar-powered UAV, solar cells installed onboard, captures solar power reaching the aircraft surface during daylight. Such generated power is then supplied to the motor to propel the aircraft and other electronics or to recharge the battery on board. The battery supplies power when darkly or under clouds.



## VI. LAYOUT



## VII. APPLICATIONS

### i. Future of Aviation field

This can so modern aviation is incredibly polluting accounting approximately 3% of human global warming footprint and aviation industry also try to reduce CO<sub>2</sub> emissions to help environment balance that case use of renewable energy like Solar Energy is the best option.

### ii. Future utility to solve traffic problems

We are able see that one primary reason of Traffic is due to huge & bulky transporting vehicles so by utilizing little lighter flying machine activity issue can be reduced.

### ii. Use for agriculture purpose

As We know that India is the Rural nation. So basely UAVS is utilized to: require high determination picture of and assembled information specifically into computer over program or field whereas flying cloud and from this information agriculturist can alter their cultivate gear i.e. Sum of inputs like seed, fertilizers, pesticides that would ought to connected in field.

### iv. For defense Purpose

The parts of UAVs can move broadly based on the inconvenience of the military operation that's to be conducted. Border Security Conduct observation missions and track unlawful exercises without gambling lives. Against Fear Distinguish dangers and distinguish risk-prone zones from a farther location.

## VIII. FUTURE WORK

In future our main Aim is to design and Analysis of UAV. The following steps need to complete:

1. Design and Assembly of all components using 3D modelling Software.
2. Material selection for UAV.
3. Analysis of all components using Ansys Software.

## REFERENCE

- [1]. Parvathy Rajendran and Howard Smith, "The Development of a Small Solar Powered Electric Unmanned Aerial Vehicle Systems", 2013, Universiti Sains Malaysia, Engineering Campus, 14300 Nibong Tebal, Pulau Pinang, Malaysia Cranfield University, Aircraft Design Centre, School of Engineering, MK4 0AL Cranfield, UK. [1]
- [2]. Zhong Lei and Hiroshi Kawamura, "Development of a Solar-Powered Unmanned Aerial Vehicle", January 2014, Tokyo University of Science, Suwa, Chino, Nagano, Japan 391-0292.
- [3]. Jaw-Kuen Shiaua & Der-Ming Ma, "Development of an experimental solar-powered unmannedaerial vehicle", Mar 2015, Department of Aerospace Engineering, Tamkang University, Tamsui, New Taipei City 25137 Taiwam. [3]
- [4]. Joan B. Rodriguez \* , Carlos Gil Moralesb , Efrén M. Benavidesa,b, "A First Approach to Solar Aviation with the Use of Axiomatic Design", 2015, Department of Propulsion and Fluid Mechanics, UPM, Plaza Cardenal Cisneros 3, 28040 Madrid, Spain. [4].
- [5]. Karthik Reddy B.S., Aneesh Poondla, "Performance analysis of solar powered Unmanned Aerial Vehicle", December 2016, Mechanical Engineering, VIT University, Vellore, Tamilnadu, India. [5]