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Unmanned Aerial Vehicle for Spray Painting Submitted in Partial Fulfillment of Requirement for the Award of Degree of BACHELOR OF ENGINEERING

Dnyanshree Institute of Engineering & Technology

Of

SHIVAJI UNIVERSITY, KOLHAPUR

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CERTIFICATE

This is to certify that the project report entitled, “Unmanned Aerial Vehicle for Spray Painting”

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It is a bonafide work carried out by these students under the guidance of Prof. Mr. Jamdade A.S. It has been accepted and approved for the partial fulfillment of the requirement of Shivaji University, Kolhapur, for the award of the degree of Bachelor Of Engineering (BE Electronic & Telecommunication). This work and project report has not been earlier submitted to any other Institute or University for the award of any degree or diploma.

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It is a matter of great satisfaction and pleasure for me, in presenting this project phase we report of BE (Electronic & telecommunication) course. First and foremost we would like to thank to our principal and all the staff of “**Dnyanshree Institute of Engineering & Technology, Satara.**” for making available such an excellent infrastructure and a friendly atmosphere conducive for acquiring in- depth theoretical and practical knowledge in the field of Electronics & telecommunication engineering.

We received help and guidelines from a number of people during the development and completion of this project phase. We report & Credit to a great measure goes to our head of the department **Prof.Mr.Jamdade A.S.** as well as our **Principal Dr.A.D. Jadhav Sir** for encouraging us to undertake such a challenging project phase we report as a part of our seventh semester of BE course work. We wish to express our appreciation and gratefulness for the most cooperative attitude of **Principal Dr. A.D. Jadhav Sir** for their valuable guidance, thoughtful suggestions and the constant moral support in completing our project work.

Thus, with sincerity of purpose and faith in the almighty, we present this Project report.

ABSTRACT

The hexacopter assisted painting spray pump is equipment which is used for painting the high altitude buildings utilizes the same principle as that of the hexa copter for lifting purpose. In which rotary motion high speed brushless DC motor, whose shaft is connected to propeller can be converted to the upward thrust which lift the equipment, spraying pump is working on the principle of rotary pump which is used for spaying colorful paints. Six high speed, six torque DC motors utilizes battery power for there working. Propeller blades are connected to DC motor shaft. Due to the rotation of blades the thrust is produced because of air suppression from upward to downward direction and because of this, pressure on the top of the propeller reduces and pressure underneath the propeller increases, hence equipment gets lifted .for spraying the colors we used submersible liquid spraying pump. The controlling of the hexa copter is the part of electronics. The radio frequencies are used for transmission of control signals from remote to the hexa copter.The hexa copter will paint the tall buildings just like how the remote will be operated. The main application of the hexa copter is to fly and paint the building where human approach is difficult.

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CHAPTER- 1

1.1 INTRODUCTION

Building and construction is one of the important industries around the world. In this fast moving life construction industry is also developing expeditiously. But the labors in the construction industry are not sufficient. Applications and activities of robotics and automation in the construction industry started in the early 90's aiming to upgrade equipment operations, improve safety, modify concept of workspace and furthermore, ensure quality environment for building occupier.

After the advances in the robotics and automation the construction industry has developed very fast. In contempt of the advances in the robotics and its wide spreading applications, painting is also considered to be the tough process & it also has to paint the whole building. To make this work easier, secure and also to reduce the number of labors the remote operated spray painting machine was introduced.

The painting chemicals can cause hazards to the human painters such as eye and respiratory system. Also the nature of painting procedure that requires recast the work and hand rising makes it tedious, time and effort consuming. These factors inspire the development of remote operated Unmanned Aerial Vehicle system for spray painting.

Drone means either miniature fixed wing airplanes or more commonly hexa copter and other multi bladed small helicopters. The drone is driven by an aerial vehicle which is operated to fly independently. The driving medium is a type of small representation unmanned aerial vehicle (UAV). Where the UAV provides the advantages of cheap costs, stealth and a diminished human risk factor.[5]

1.2 Problem Statement

It is impossible to achieve perfect work in the whole painting processes. There are some problems arising from men, machines, methods and materials. So, to improve the process is by reducing the problems as low as possible. The studies are about the method that use in the process and propose a new method that can overcome those problems. An experimental of automotive paint sprays will be conducted with some parameter focused on the flow visualization using experimental method. The time utilization for the painting is maximum to reduce this problem the atomized spray painting will be used. Painting high altitude building is cumbersome work. Now a days, unavailability of labors on high wedges increase difficulties in painting the building. The painting work affects the respiratory system of human being, to overcome this problem the Unmanned Aerial Vehicle is efficient for painting.[2]

1.3 Objectives

The aim of this project is to reduce the problems that occur at the construction industries in term of cost and quality in the painting the buildings. So the following objectives need to be done:

- 1) To reduce labor cost the Unmanned Aerial Vehicle system is operated by remote controller. Hence need less no. of labors.
- 2) Due to spray painting, the accuracy of the painting is increased and the quality of the painting is also improved.
- 3) This system will reduce the wastage of the paint while painting.[3]

1.4 Methodology

While the design and performance considerations in Unmanned Aerial Vehicle are similar to manned aviation, Unmanned Aerial Vehicle designers do not have to take an onboard pilot into account. This gives Unmanned Aerial Vehicle's the advantage of reduced drag & weight (due to the elimination of the cockpit) as well as the ability to sustain a greater amount of gravity forces, allowing more complex flight management. Improvement in navigation & sensor advanced telecommunications technologies permit control at high altitudes over considerable distances. Technologies have made Unmanned Aerial Vehicle platforms more reliable in terms

of flight control and hexacopter is an aircraft without a human pilot on board. It is controlled through the remote by an operator on the ground. It will serve as the platform for spraying of paint on buildings. The body of hexacopter is fully made of aluminium with a paint tank underneath with a capacity of 1 litre and a nozzle for spraying purposes.[2]

1.5 COMPONENT SPECIFICATION

Table 1: Hardware components

Sr.No.	Component	Parameter	Range
1	DYS D2836 750KV 880KV 1120KV 1500KV 2-4S Brushless Outrunner Motor	Supply Voltage	11.1V DC
		Operating Current	10.6A
		Operating Speed	1300rpm/volt
		Drivers	ELFA1040
		Power	190W
2	FSCT6B 6ch (Remote controller)	Frequency	2.4GHz
		Transmitted Power	0.8W
		Operating Range	1KM
3	ATmega328 (Arduino Uno M/C)	Operating Voltage	5V DC
		Input Voltage	7-12V
		Operating Frequency	16MHz
		BITS	32Bits
		SRAM	2KB
		EEPROM	1KB
		Flash Memory	32KB
4	ELFA1040(Electronic Speed Controller)	Operating Voltage	6-16.8V
		Output Power	10-25
		Maximum Current	40A
		Weight	62gm
		Size	26mm (L)* 23mm(W)* 11mm(H)
5	Li-polymer Battery	Output Voltage	11.1V
		Charge Current	1.0A
		Weight	46gm

Table 2: Physical structure

UAV System	Specifications
Actual Weight	3 KG
Length of Arm	32 cm
No.Of Arms	6

1.6 Block Diagram

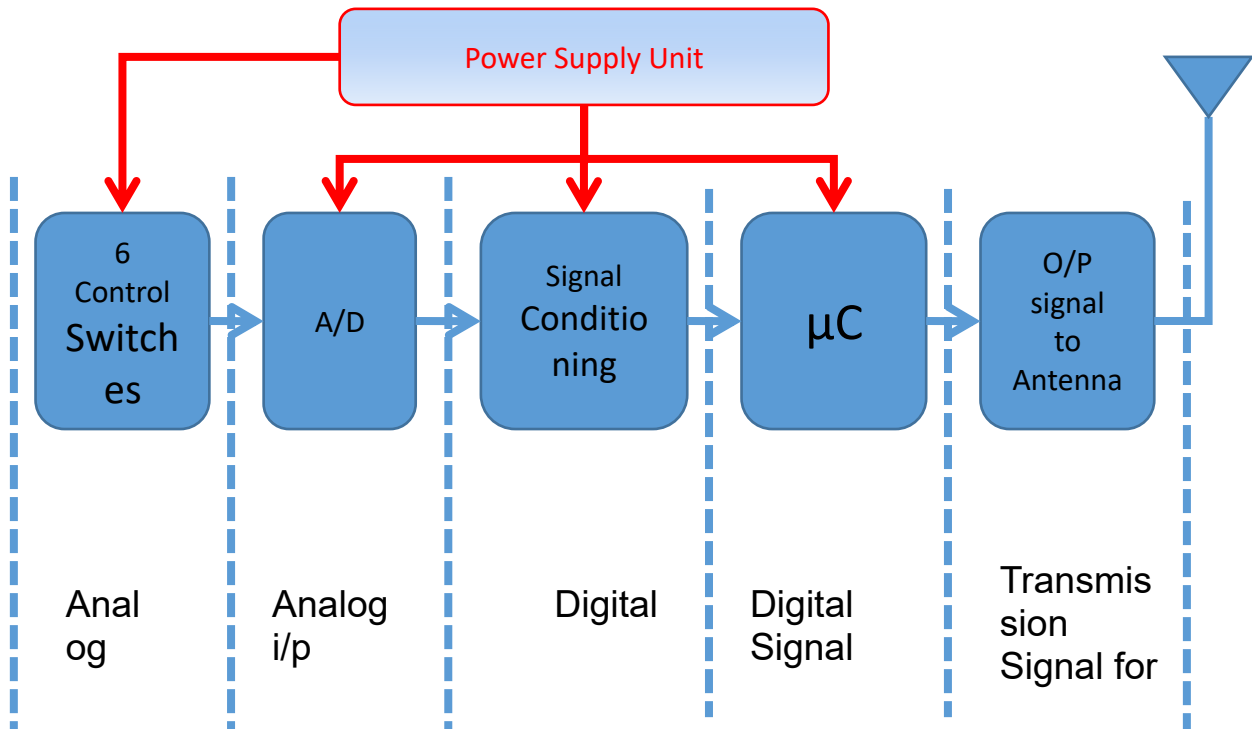


Fig.1 Block Diagram of REMOTE.

- **Control Switches:** There are Six control switches on remote namely for six channel.
- **A/D Converter:** Analog signal coming from switches is converted into digital signal. An ADC may also provide an isolated measurement such as an electronic device that converts an input analog voltage or current to a digital number proportional to the magnitude of the voltage or current.
- **Signal Conditioning:** Digital converted signal passes through buffer noise is removed. signal conditioning means manipulating an analog signal in such a way that it meets the requirements of the next stage for further processing.
- **Microcontroller:** This control the signal of remote. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems.
- **Output Block:** This block fed the signal to antenna.

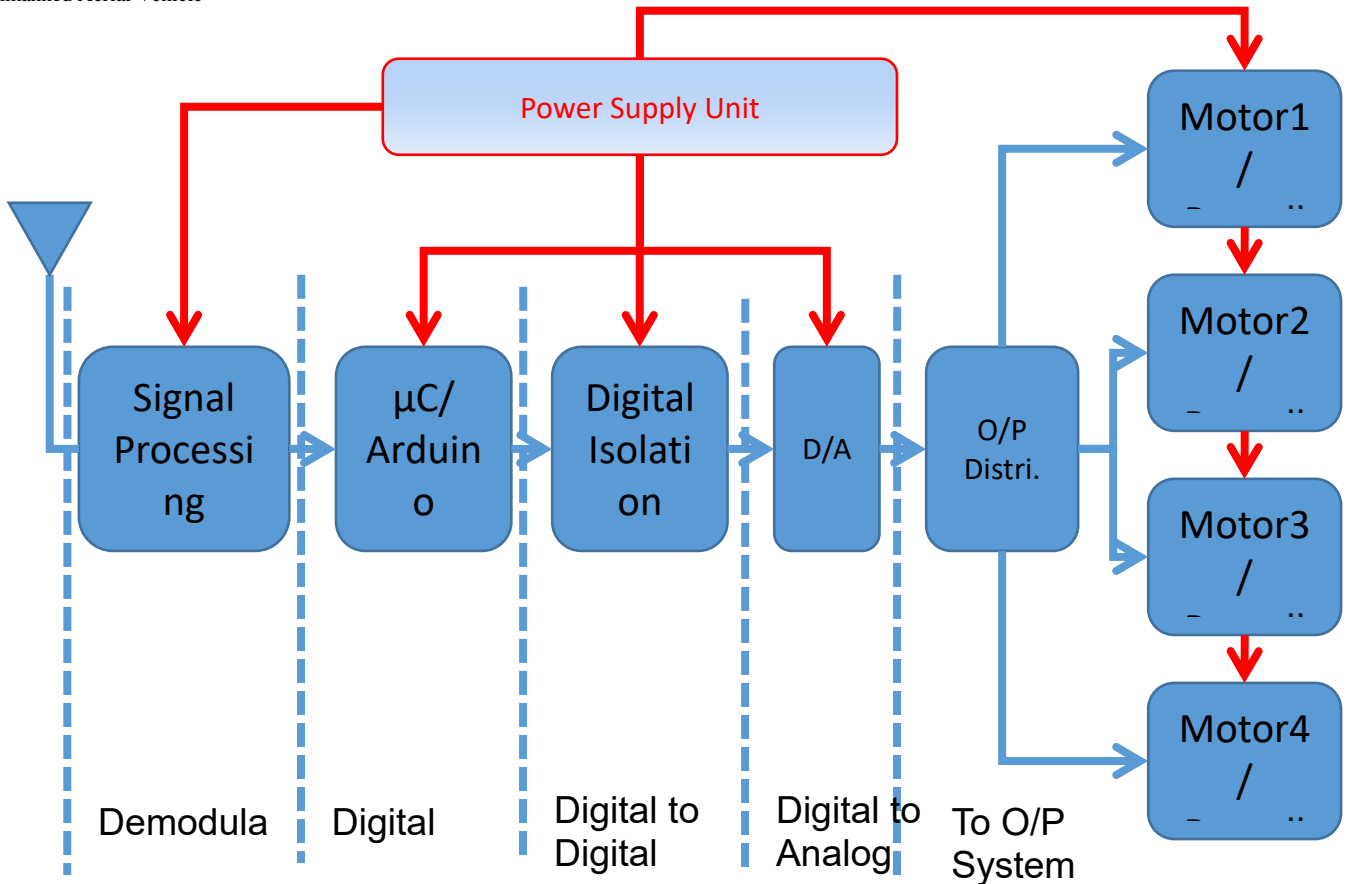


Fig.2 Block diagram ONBOARD SYSTEM.

- **Signal Processing:** Signal processing concerns the analysis, synthesis, and modification of signals (i.e Demodulation), which are broadly defined as functions conveying "information about the behavior or attributes of some phenomenon", such as sound, images, and biological measurements.
- **Microcontroller[Arduino]:**Arduino based controllers are used because it is more of Embedded Systems. Communication between microcontroller and all other sensors is established so that controller can process the sensor readings and sends control signals to actuators to achieve a stable flight.
- **Digital Isolation:**Digital isolators use signal - ended,CMOS or TTL logic, Switching technology.Digital isolation is used for protection of signal line.
- **D to A converter:** After the digital isolation we get digital signal and this signal is converted to the analog signal in this D to A converter.
- **Output Distribution:** In output distribution the analog signals are distributed in all the motors or propeller.

1.7 Platform Used

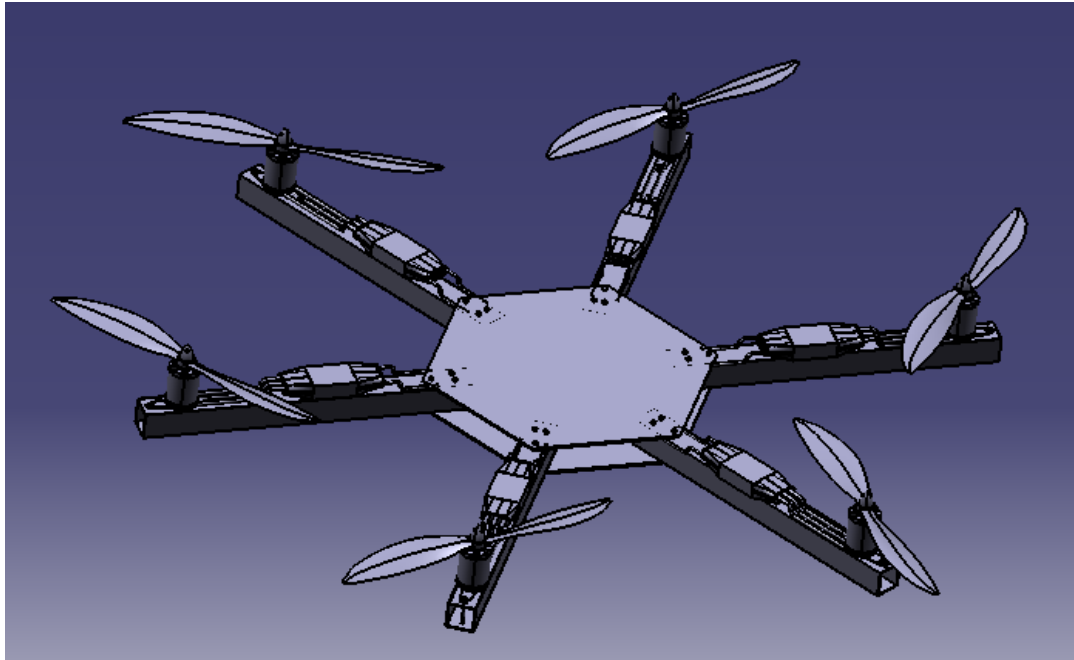
Table 3: Software

Sr.No.	Platform/Tools	Availability	
		In Campus	Out of Campus
1)	Arduino IDE (1.8.4)	-	Yes
2)	LT spice	-	Yes
3)	Proteus 8	Yes	-
4)	Catia (V5R19)	-	Yes
5)	Ansys-CFX(16.2)	-	Yes

1. Catia Software :

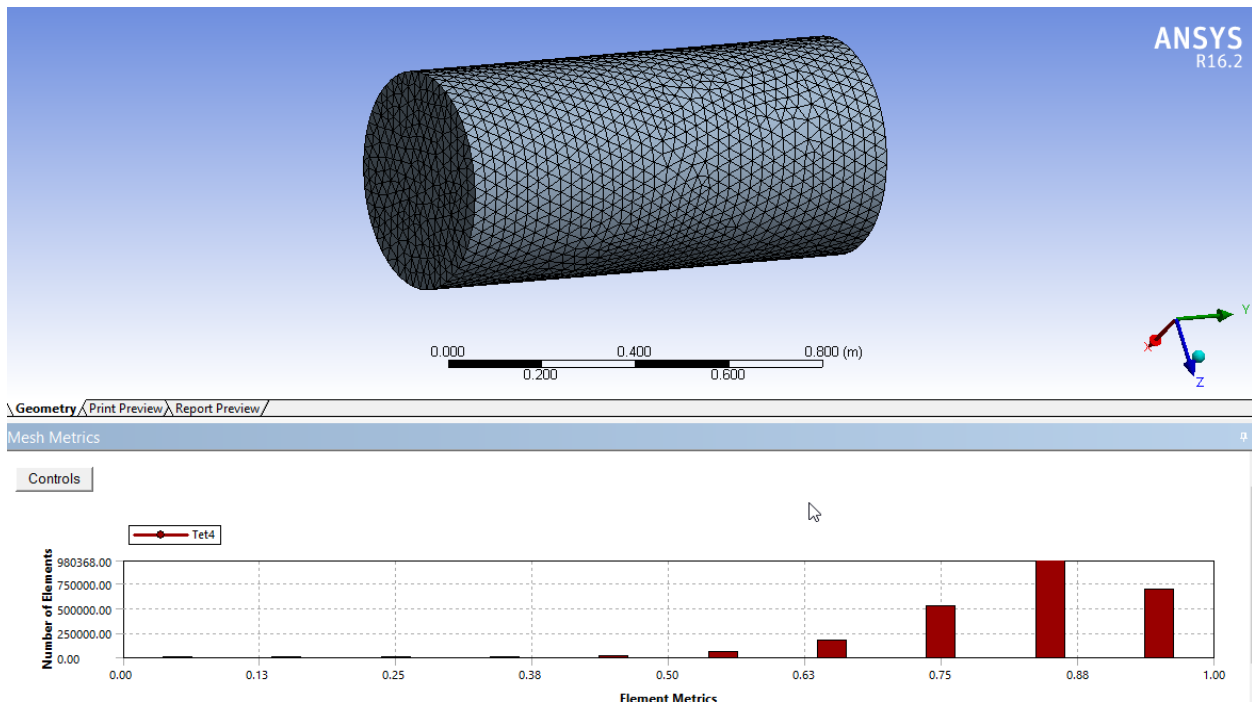
The Catia is a multi-platform software suite for computer-aided design (CAD).It is used for shape designing, styling, surfacing workflow and visualization to create, modify and validate complex innovative shapes of 3D models.

Actual 3D Model of UAV System:

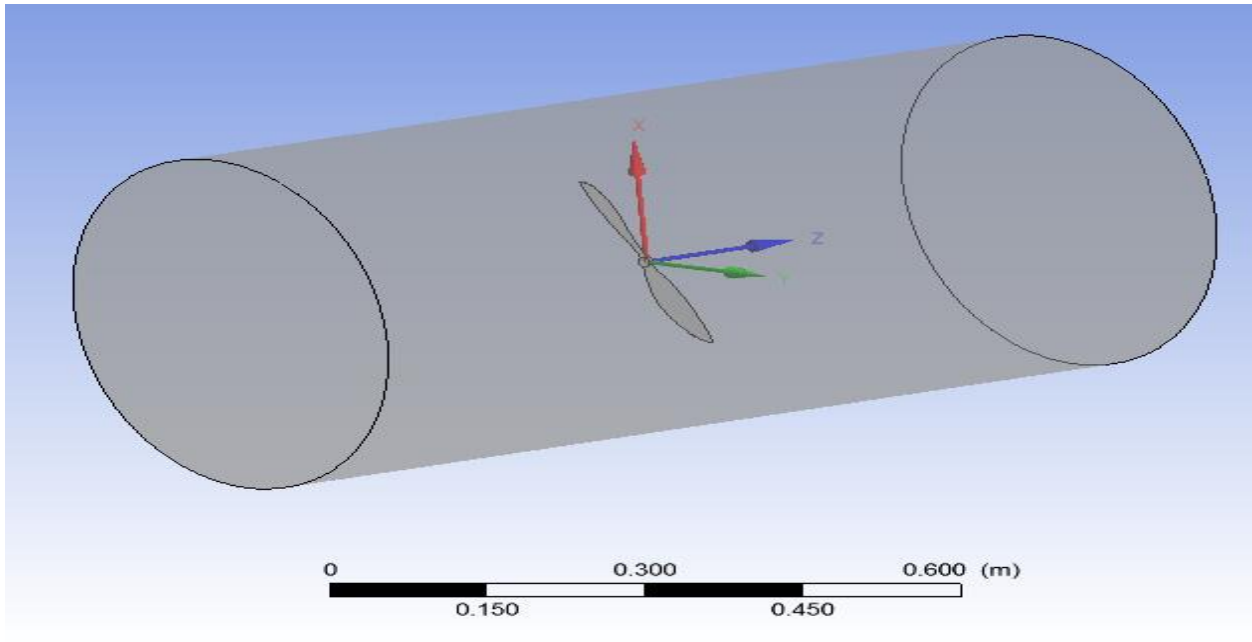


Ansys Software: Ansys is the software used for simulation of the motors. It is used for testing of the thrust generated by motor for the given power supply.

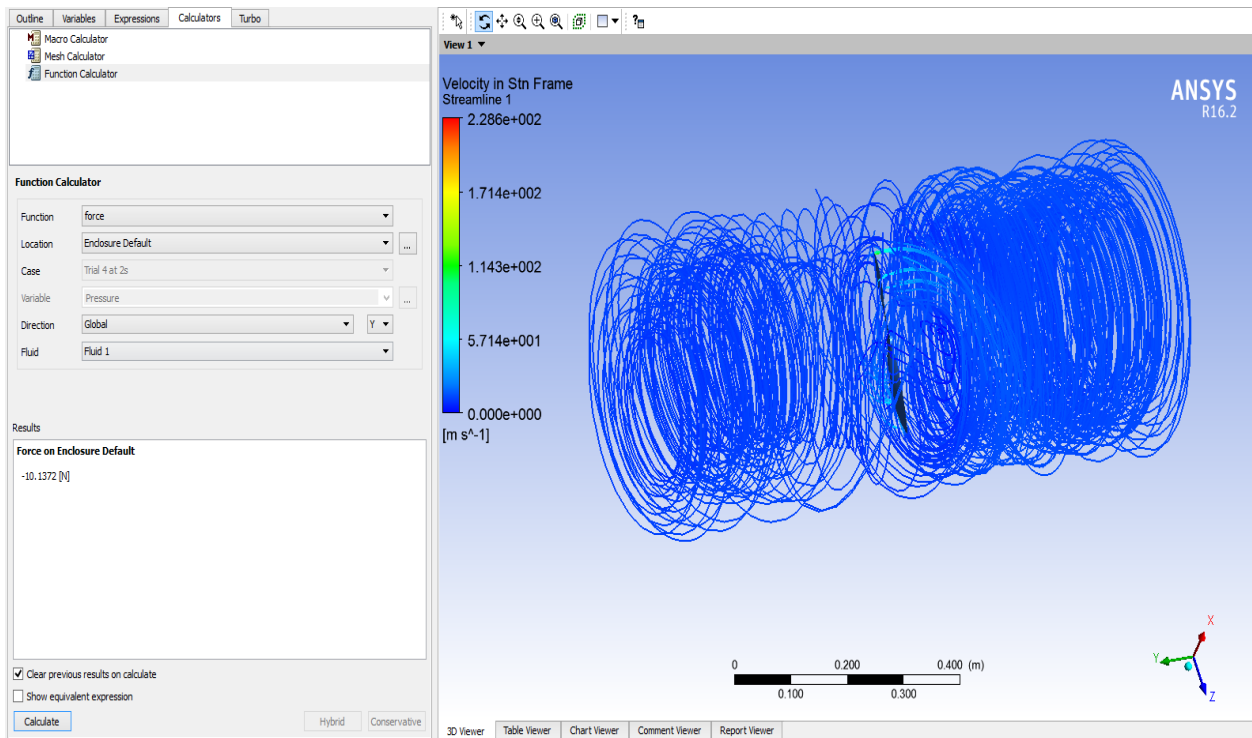
Ansys simulation of Brushless Motor:



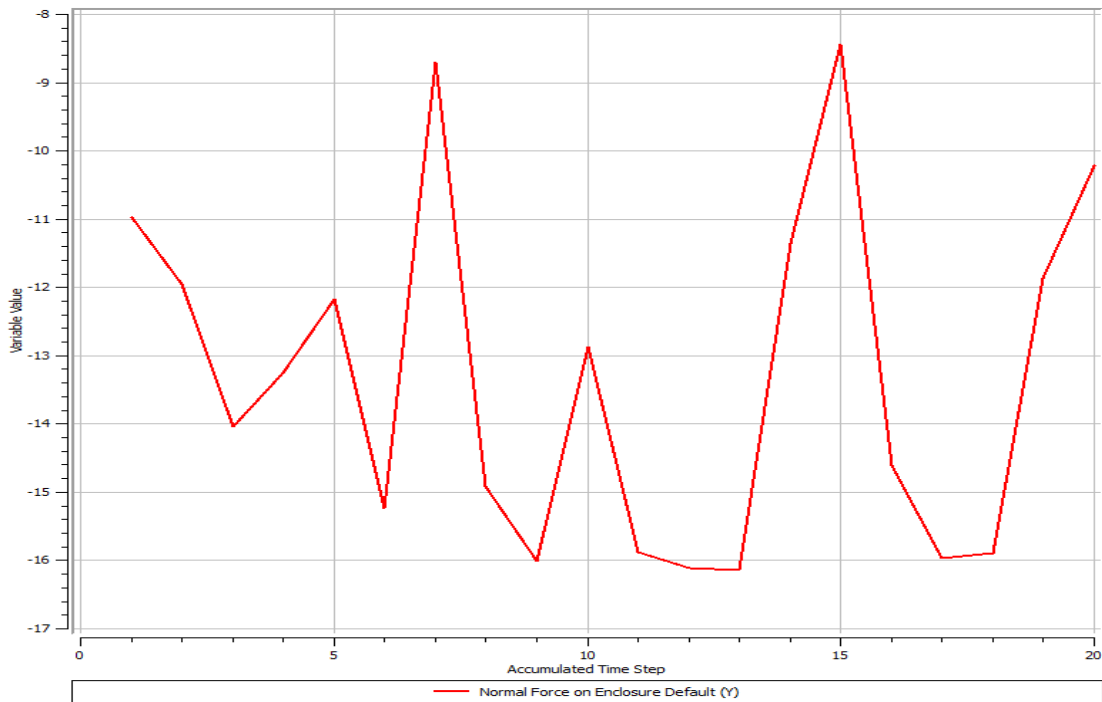
Actual Propellers Mechanism



Axial Thrust on Enclosure:



Variation of thrust w.r.t time:

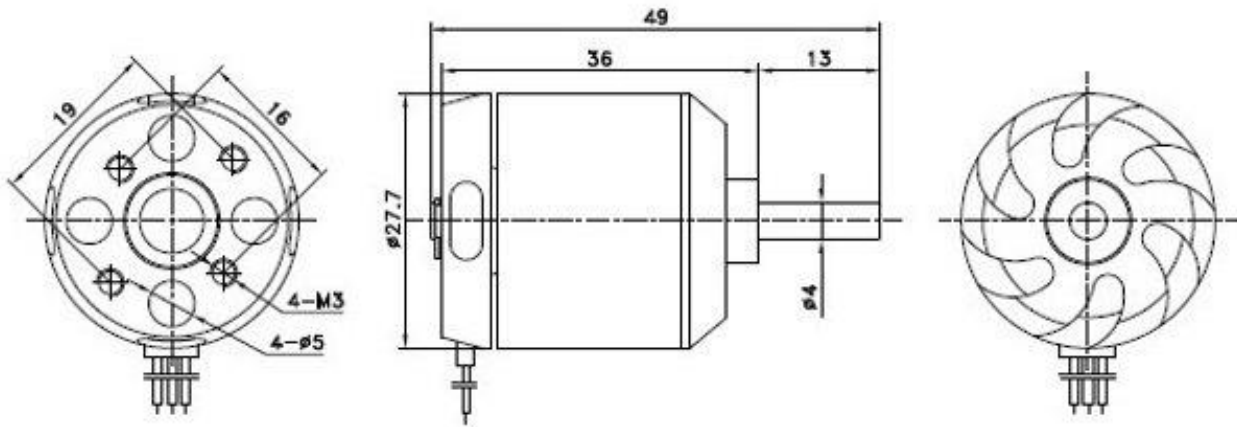


Electronic Part

Remote Controller:



Brushless Motor:



Courtesy banggood.com

CHAPTER -2

2.1 LIETRATURE REVIEW

In this couple of month we spend searching topics for project work we came across the Unmanned Arial Vehicle that is drone, as described in various journals and magazines as well as over the internet as follows.

- [1] **Title:** Design & Fabrication Of Remote Operated 3-Axis Spray Painting Machine
Author : Prof. Dinesh B. Shinde
Publication : IJARIE-ISSN(O)-2395-4396
Year : 2016
Description : In this paper, the design & fabrication of painting mechanism and nozzle conventional painting technology.

- [2] **Title :** A Wireless Data Acquisition System for Detecting the Flight Status of Unmanned Aerial Vehicles
Author : Cui Qin, Chaoxin Wang
Publication : Proceeding of the 11th World Congress on Intelligent Control and Automation Shenyang, China
Year : 2014
Description : This paper designs an Unmanned Aerial Vehicle (UAV) wireless data acquisition system, for detection the flight status. The system can continuously measure air pressure, acceleration, temperature and other signals of the Unmanned Aerial Vehicle surface in real time.

- [3] **Title :** Efficient Deployment of Multiple Unmanned Aerial Vehicles for Optimal Wireless Coverage
Author : Mohammad Mozaffari
Publication : IEEE based paper
Year : 2016
Description : In this paper, the downlink coverage probability for Unmanned Aerial Vehicles as a function of the altitude and the antenna gain is derived.

- [4] **Title :** Develop an unmanned aerial vehicle based automatic aerial spraying System
Author : Xinyu Xue
Publication : Journal paper of ELSEVIER
Year : 2016
Description : Electric centrifugal nozzles and an aerial irregular wave prevention paniting tank to improve the spray quality from an Unmanned Aerial Vehicle.

- [5] **Title :** Arab Academy for Science and Technology and Maritime Transport
Author : unknown
Publication : Report of UAV
Year : 2007
Description : The flite time calculations and the thrust calculations are given in this paper. The exact structure of the UAV system is compact and light in weight, which is reliable for the flying of the UAV.

- [6] **Title :** United states department of labor

Publication : www.osha.com

Year : 2016

Description: Percentage of accidents occurs at during works on scaffolds.

2.2 Motivation

In this technical world, nowadays skilled labors are scarce for painting tall buildings. Also cost involved in constructing scaffoldings is high. In order to ease the painting high altitude buildings and minimize the problems such as unavailability of painters, danger involved in climbing scaffolding we are designing and developing UAV for spray painting. An estimates 2.3 milion construction workers or 65% of construction industries work on scaffolds. In a recent BLS(burue of labor statistics) studies in 72.% labors injured in

Construction sites.[6]

CHAPTER -3

3.1 Result of the Calculation:

Axial thrust generated by single propeller in environmental condition [motor 1300kv and 12V battery] is =10.13N

Single propeller can carry approximately 1kg weight according to the simulation

3.2 Reference

- [1] “Arab Academy for Science and Technology and Maritime Transport”
- [2] “Manual of RC Timer ESC 30A Brushless Motor Speed Controller”
- [3] “ABHIKAHA: Aerial Collision Avoidance in Quadcopter using Cloud Robotics”
- [4] “Path Planning for Spray Painting Robot of Workpiece Surfaces”
- [5] “CHARACTERISTIC STUDIES ON TYPES OF PAINT SPRAY FOR AUTOMOTIVE PARTS IN SMALL AND MEDIUM INDUSTRY”
- [6] “Intelligent Wireless Fire Extinguishing Robot”
- [7] “Development of Unmanned Aerial Vehicle (UAV) Ornithopter with Wireless Radio Control”
- [8] “Wireless Communications with Unmanned Aerial Vehicles: Opportunities and Challenges”
- [9] “THE USE OF UNMANNED AERIAL VEHICLES AND WIRELESS SENSOR NETWORK IN AGRICULTURAL APPLICATIONS”
- [10] “Unmanned Aerial Vehicle with Underlaid Device-to-Device Communications: Performance and Tradeoffs”

1. Books:

- A. How to fly helicopter by larry collier
- B. Design of Machine elements by R.S.khurmi
- C. MAKE: DIY Drone and Quadcopter Projects.
- D. University Edinburgh, UK - UAV – A Concept study

2. Websites:

- A. www.researchgate.net
- B. ieeexplore.ieee.org