DESIGN AND DEVELOPMENT OF ORNITHOPTER

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ABSTRACT

- *An ornithopter is a type of aircraft that uses flapping wings to generate lift and propulsion. These designs are inspired by natural aviators such as birds and insects known for their ease of flight and maneuverability in the open sky. The concept of an ornithopter has been around for centuries, with Leonardo da Vinci being one of the first to sketch designs for a flying machine that used flapping wings. Today, ornithopters are often studied as a potential alternative to traditional aircraft, as they have the potential to be more efficient and maneuverable in certain situations.*

Keyword : *- natural aviators, manoeuvrability, surveillance ….*

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1. INTRODUCTION

Since time immemorial, flying in the sky has been a source of fascination to most humans. The sight of the birds flying freely and majestically in the air fills one with longing and joy. And thus were inspired the various attempts by mankind to achieve flight and take to the skies. Natural fliers occur with surprising diversity, inhabiting most kinds of habitats on earth, and display remarkable evolutionary features that allow them adapt expeditiously to their environment.

Birds have a weight range varying from around 1g (Bee-Humming bird) to around 10-12 kgs in certain large raptors. The size range in birds varies from around 5-6 cm to a humungous wingspan of 1.8-2 m found in Philippines eagle. Insects on the other hand have spans varying from a few hundred microns in the smallest insects to around 25 cms of an Atlas Moth. In these ranges due to the low-Reynolds number flows, the conventional aerodynamics is not accurate enough to predict the behaviour of the aircraft.

Fixed winged aircrafts normally employ wings only to generate the lift required to sustain in the air. The thrust required to overcome drag is normally supplied by a separate propulsion system. This necessitates the presence of an extra device which can be avoided if lift and thrust can be combined as in nature. In addition, fixed wing aircrafts have many other disadvantages as compared to Ornithopters which will be indicated later. Another prominent kind of aircraft is the rotary wing aircraft. These have disadvantages in terms of speed, efficiency and manoeuvrability. That said, the question might arise as to why Ornithopters have not attained a lot of popularity. The simple reason for this is the level of complication involved. Additionally the advantages of an Ornithopter are more relevant at small scales, where, unfortunately, incorporating the flapping wing features is mechanically more of a challenge.

2. LITERATURE REVIEW

Fixed winged aircrafts typically employ bodies only to induce the lift needed to sustain in the air. The thrust needed to overcome drag is typically supplied by a separate propulsion system. This necessitates the presence of an redundant device which can be avoided if lift and thrust can be combined as in nature. In addition, fixed sect aircrafts have numerous other disadvantages as compared to Ornithopters which will be indicated latterly. Another prominent kind of aircraft is the rotary sect aircraft. These have disadvantages in terms of speed, effectiveness and manoeuvrability. That said, the question might arise as to why Ornithopters haven't attained a lot of fashionability. The simple reason for this is the position of complication involved. also the advantages of an Ornithopter are more applicable at small scales, where, unfortunately, incorporating the flopping sect features is having a more mechanically challenge.

2.1 Aerodynamics

Review of introductory Aerodynamics is a branch of dynamics concerned with studying the stir of air, particularly when it interacts with a solid object. Aerodynamics is a subfield of fluid dynamics and gas dynamics, with important proposition participated between them. Aerodynamics is frequently used synonymously with gas dynamics, with the difference being that gas dynamics applies to all feasts.

2.2 Lift

Lift and the Measure of Lift is the aerodynamic force acting on any body moving through a fluid in a direction vertical to the direction of its stir. The product of lift can be explained on the base of Newton ‟ s third law

3. PROBLEM DEFINITION AND METHODOLOGY

The introductory methodology used in this model is a flopping sect medium. They hold the crucial features needed for flight of the prototype. Although it's seen to be insolvable to achieve the exact moment of sect conduct through mechanical gear of a model certain aspects can be mimicked to insurance working.

Also, indeed when the shape of bodies add on to their geste in air. For illustration, the shape of a swallow bodies are different from that of a pelican. quaffs are quick to cover short distance and sharp turns but pelicans can last longer, this is due to the wingspan. So selection of the sect shape is pivotal pertaining to the type of operation needed for the model. The selection of material also has a huge effect in working of the prototype. numerous factors should be added to induce the most precise type of accoutrements used.

Fig.-3.1

Fig-3.2

Fig-3.1 & 3.2: are the wing type used in the ornithopter

4. Flapping Wing aerodynamics

During flopping flight. the bodies also changes their angle of attack depending on the stroke. flopping flight is principally rowing in the air sect. particularly at the scale of interest is significantly different from fixed bodies substantially.

First at small scale Reynolds number of the model is veritably low compare to macro scale. flopping involves up and down movement of the bodies. Theodorsen assumed that the wake of the air antipode would take the form of a nonstop whirlpool distance of sinusoidally varying strength, stretching from the running edge to perpetuity in the downstream direction. The wake wasn't allowed to change shape in response to the haste convinced by the wake. This Theodorsen’s proposition will come in the times to come the standard tool to dissect air antipode flutter, helicopter aerodynamics and flopping flight problems.

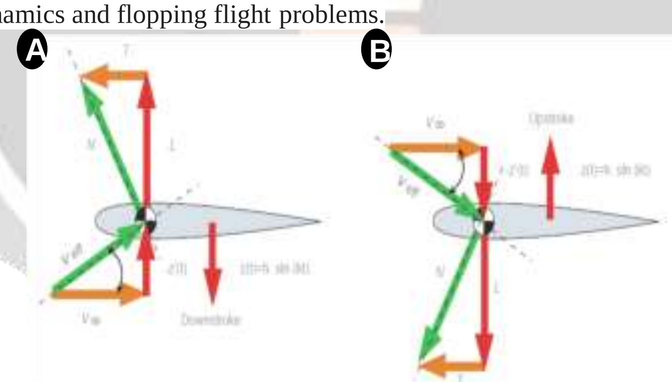

Fig 4.1: Thrust (T) and lift (L) components of the normal force vector (N) during heaving motion.

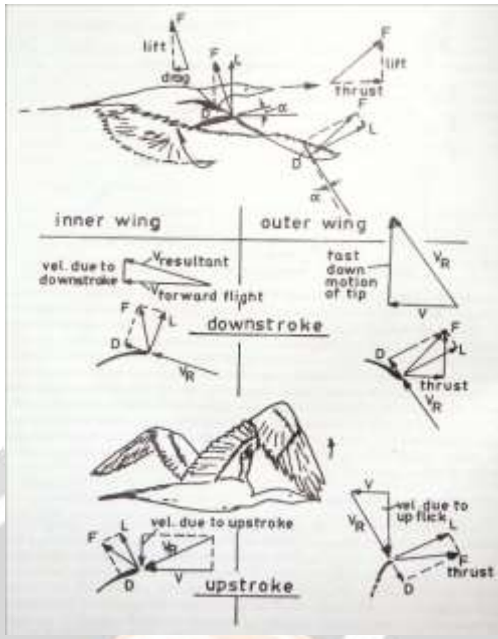

Fig-4.2: Wing flapping forces.

4.1 Dynamic Stall

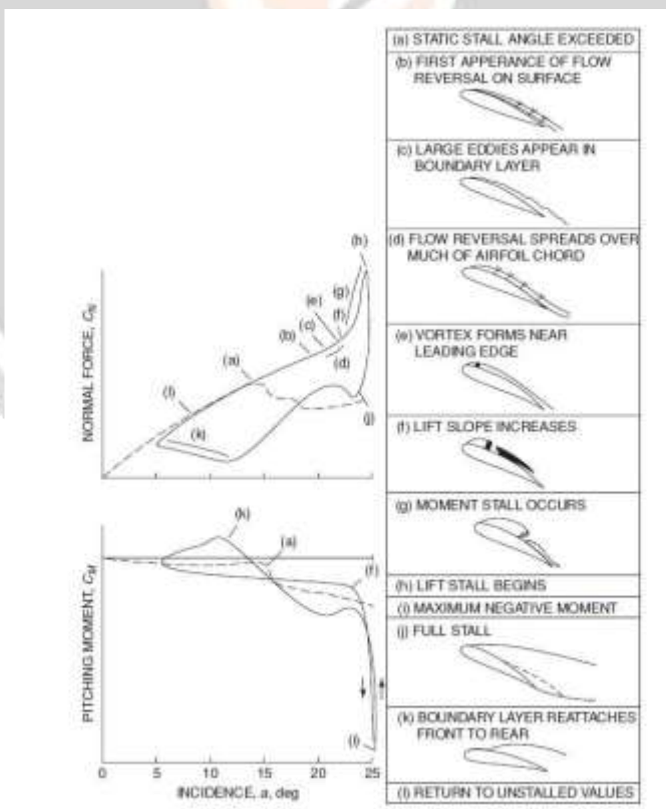

Fig 4.2 Dynamic Stall events7

One of the most important marvels taking place in any flopping aircraft is the dynamic cube. It's relatively distinct from the steady inflow cube that might do in a fixed- sect aircraft.

When an airflow is accelerated impulsively to constant haste, the set whirlpool needs time to develop to its final, steady- state strength.
Depending on the pace of acceleration, it may take up to six passion lengths of trip for the rotation and lift to reach 90 of the final values(Ellington, 1995). still, the fast acceleration of the airflow can affect in lift improvement that's due to the so- called Wagner effect, which describes the unsteady aerodynamics associated with an accelerating airflow. Specifically, an impulsively started airflow develops only a bit of its steady- state rotation incontinently; the steady- state value can be attained only after the airflow moves through several passion lengths. Dynamic cube, or delayed cube, is frequently used to describe the redundant lift associated with a sect traveling at high Ao As for a brief period, with a large LEV(Leading Edge Vortex), before it stalls.

5. COMPONENTS USED

5.1 Body used

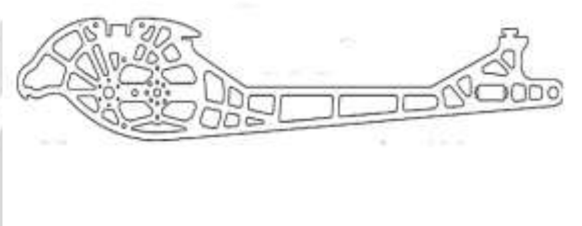

Fig-5.1: Mechanism body

The body is made from a carbon fibre frame where the electronic factors are attached. The places are cut out grounded on the dimension of each factors and destined locales. These Effective places are formerly cut help keep the electronic factors fixed in place. The carbon frame is used as it's featherlight and has high continuity in the presence of slightly strong wind.

5.2. Gear Mechanism

Fig-5.2: Gear mechanism

Outboard Wing Hinge fabrication methods will not allow a staggered crank, it might be preferrable to separate the two wing hinge lines so that the connecting rods pass together between the wing hinges. Since the angle between the connecting rods is small, the flapping is fairly symmetric. You will need a more complicated body structure to support the outboard wing hinges.

5.3 Wings

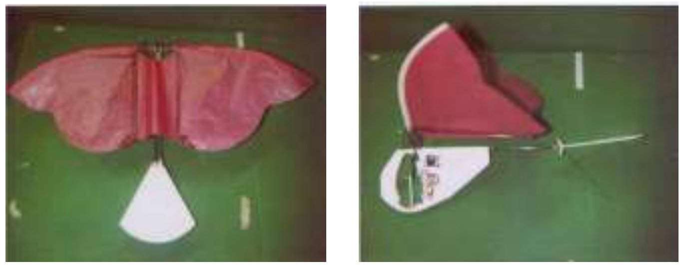

Fig-5.3 wings design

The material used for wink are carbon fiber rods and Teflon wastes. They've the continuity as well as featherlight features. The carbon fiber rods are placed in cross manner and are sutured not the fabric. The exoskeleton of the bodies are nearly shaped like the exoskeleton of club bodies. This pattern provides much further inflexibility in maintaining the pressure distribution throughout the sect. The Wingspan 27 elevation Length 20 elevation Gross Weight 55 grams for our model specification

5.4 Overall view

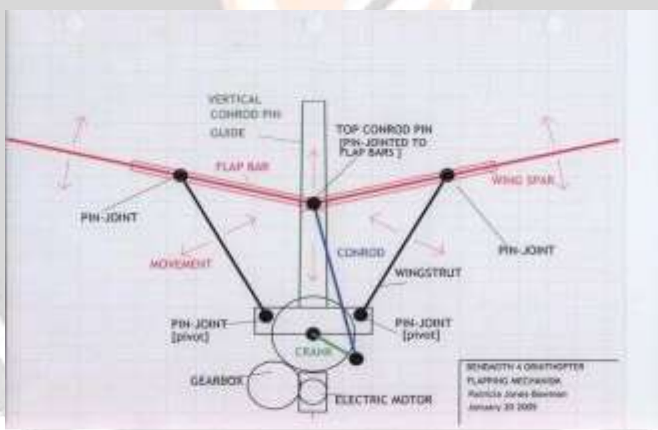

Fig-5.4: overall view of wings

The single conrod mechanism employed in the Behemoth models. The wing spars form the leading edge of the wings and hold the wings.

6. CALCULATIONS

The computations are grounded on the data acquired from the factors used,

Dc motor – 3700 kV or 4200 kV

Battery –7.4 V or11.1 V

1) The speed of the model can be determined by the data attained, Speed = 3700 ×7.4

= 444 Rps.

Speed = 4200 ×11.1

= 777 Rps.

2) Gear teeth rate of the gear medium is needed to find out the flopping rate for the motor,W.K.T n1 = 444 Rps. n2 = ?

Using the formula, (1)

Using the gear teeth of 72, 8, 9 and 84. 444/ n2 = 84/ 9 n2 = 47.57 Rps.

thus,

47.57 = n2/ n3 = 72/8 n3 = 5.285 Rps.

Hence, the number of flaps are set up to be5.285 flaps per second.

3) For the battery used in mAh, it depends n the model, If the average current drawn is 15 A for 10 twinkles, also

c = I ×t.(2)

15 × 10/ 60 = 2500 mAh.

4) For current rate ‘ C ’, If peak current drawn is 30 A from 3000 mAh

C = 30 A/ 3000 mAh

= 10C.

7. ELECTRONIC CIRCUIT

Electronic circuit done for these ornithopter is mainly on the transmitter and receiver as the prototype . mainly its has consist the arduino , servo motor , electronic speed controller , brushless motor are all connected to the receiver and for the power they all connected to the Li battery

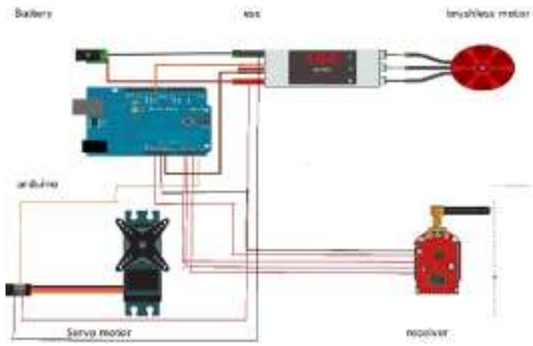

Fig-7.1: Circuit connections on the ornithopter.

Fig-7.2: the remote controller.

The operation of these prototype will work on the basics of simple RF signal .well transmitter will send the signal and The receiver will receive the signal and operates the the ornithopter will help in the flaps the wings according to the given speed

8. CONCLUSION

. Ornithopters, also known as flapping-wing aircraft, are a fascinating type of flying machine that mimic the flight of birds by flapping their wings. While there have been various attempts to build functional ornithopters throughout history, it remains a challenging feat due to the complex aerodynamics and mechanics involved.

Despite the difficulties, recent advancements in technology and materials have led to significant progress in ornithopter design and construction. Ornithopters have potential applications in fields such as surveillance, search and rescue, and environmental monitoring. Additionally, they have the potential to be more energy-efficient than traditional fixed-wing aircraft, making them an attractive option for certain applications.

However, there are still significant challenges that need to be addressed, including power supply, control, stability, and noise reduction. Overall, while ornithopters are an exciting area of research, there is still much work to be done before they can be used reliably and widely in practical applications

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Fig-8.1: Prototype.

The following conclusions are drawn from the work

1. Surveillance is carried out using the model, images are transferred back taken by the lens attachment to the system.

2. Use of RF signal helps in the wide range operations.

3. Sonar sensors range the distance between the model and forthcoming obstacles.

4. The model is able of generating low frequency of ultra-sonic swells to scarify down catcalls from fields and field runways. This generated frequency isn't dangerous to catcalls.

9. ACKNOWLEDGEMENT

I would also like to acknowledge the contributions of the engineers, designers, and researchers who have continued to refine and improve ornithopter technology over the years, making it more efficient, maneuverable, and versatile.

Lastly, I am grateful for the opportunity to learn about ornithopters and their history, and for the support and guidance of my mentors and colleagues who have helped me in my research on this fascinating topic.

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