Remote Control Flying Robo Bird (a.k.a Ornithopter)

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ABSTRACT

This project aims to design, build, and test a prototype ornithopter capable of sustained to flight using flapping wing . The ornithopter was designed based on avian biomechanics principles, with a focus on achieving efficient lift and thrust generation. The prototype was constructed using light weight materials such as carbon fiber and plastic materials , and those connected to the miniature electric motor. Flight tests were conducted to assess the aerodynamic performance of the ornithopter, including measurements of lift, thrust, and power consumption. Results indicate that the ornithopter achieved stable flight and demonstrated promising aerodynamic efficiency. Challenges encountered during the project, such as control system optimization and structural stability, are discussed along with potential avenues for future research. Keywords: Ornithopter, Flapping Wing , Aerodynamics, Prototype Design, Flight Testing.

Keyword :- *flapping wing* , *efficient lift and thrust* , *aerodynamic performance* , *system optimization etc…*

1 INTRODUCTION.

An ornithopter, a machine designed to achieve flight by flapping its wings like a bird.
In the brain of human innovation and ingenuity, few endeavors have captured the imagination quite like the ornithopter. Which is derived from the Greek words "ornithos" meaning bird, and "pteron" meaning wing.
At its core, an ornithopter is a flying machine designed to emulate the intricate wing movements just like a bird. thus achieving flight through the dynamic flapping of wings (it gat the thrust). The attraction of the ornithopter lies not only in its mimicry of nature but also in its embodiment of human ambition and perseverance. In that we gat added many more Mechanism like electric motor, gears, batterys and gat used some codeing to gat command.
It is the bast option for the drone in future. With the halp of it we gat easily gat spie on any one or any particular area.

1.1 Equipment :-

Motor : Speed 2200 RPM, Voltage 12 Volt , Power 1400 kv , Weight 100 gm.
Electronic speed controller : An electronic speed control (ESC) is an electronic circuit that controls and regulates the speed of an electric motor. It uses the direct current from the battery coupled with a switch system to achieve an alternating three-phase current that is sent to the motor.

Battery :Batteries are the heart of a drone's power supply, and their performance can significantly affect the overall flight time, speed, and stability of the drone. Lithium Polymer batteries is used due to the high energy density, light weight, and ability to provide low discharge rates.

Servo motor : Servo motors are used in drones to move control surfaces, such as flaps. A servo motor is a type of motor that can rotate with great precision.

Arduino nano : Arduino is a main controller in the system which controls all the functions. A set of instructions are given to arduino and it performs the function according to it.

Gear box : The gear box is used for the flapping of the wings which uses motor .

nRF24L01 : The nRF24L01 is a wireless transceiver module, meaning each module can both send as well as receive data. They operate in the frequency of 2.4GHz and it can cover a distance of 100 meters (328 feet) .

2. WORKING

The working principle of an ornithopter involves generating lift and thrust through the flapping motion of its wings, emulating the flight mechanics of birds and insects. Here is a detailed explanation of the working of an ornithopter:

1**. Wing Flapping Mechanism Flapping Motion:**

Downstroke: During the downstroke, the wings move downward and forward. This motion pushes air downward and backward, generating lift (which counteracts gravity) and thrust (which propels the ornithopter forward). The wing's angle of attack (the angle between the wing and the oncoming air) is optimized during this phase to maximize lift.

Upstroke: During the upstroke, the wings move upward and backward. To minimize drag during this phase, the wings often adjust their angle of attack or use flexible joints to reduce the resistance against the air. This allows the ornithopter to maintain forward momentum with less energy expenditure.

Power Source:

Electric Motors: Many ornithopters use electric motors connected to a gear system that translates rotational motion into the flapping motion of the wings.

Internal Combustion Engines: Some larger ornithopters might use internal combustion engines for greater power and longer flight duration.

Human Power: Smaller ornithopters can be powered by human muscle, especially in hobbyist or educational models.

Transmission System:

A system of gears, cams, and linkages converts the power from the motor or engine into the rhythmic flapping motion required for flight. This mechanism ensures that the wings move in a controlled and efficient manner, simulating the natural wing beats of birds or insects.

2. **Control Systems Stabilization:**

Tail and Control Surfaces: Similar to an aircraft, an ornithopter may have a tail and other control surfaces (such as rudders and ailerons) to help stabilize and steer the vehicle. Adjusting these surfaces changes the pitch, yaw, and roll of the ornithopter, allowing for controlled maneuvers.

Sensors: Advanced ornithopters are equipped with sensors like gyroscopes, accelerometers, and GPS to provide data for stabilizing and navigating the flight.

Autonomous Control:

Flight Controllers: Onboard flight controllers use data from the sensors to adjust the wing flapping rate, angle, and control surfaces in real-time, maintaining stability and following a predetermined flight path.

Artificial Intelligence: AI can be used to enhance the autonomous capabilities of ornithopters, allowing them to adapt to changing environments and complex tasks autonomously.

3. Takeoff and Landing

Takeoff:

The ornithopter generates lift by increasing the flapping frequency and angle of attack. Once enough lift is produced to overcome gravity, the ornithopter takes off. Takeoff can be from a stationary position or with a short run-up, depending on the design.

Landing:

To land, the ornithopter reduces its flapping rate gradually, decreasing altitude in a controlled manner. Control surfaces are used to maintain stability and guide the ornithopter to a smooth landing.

4. Flight Dynamics

Hovering:

Some ornithopters are capable of hovering by adjusting the flapping motion and control surfaces to generate enough lift to stay stationary in the air.

Forward Flight:

In forward flight, the combination of downstroke-generated thrust and the lift keeps the ornithopter moving forward and airborne. The balance between lift and thrust is crucial for efficient and stable flight.

Maneuvering:

Maneuvering is achieved by altering the flapping pattern asymmetrically, changing the control surfaces' positions, or shifting the center of mass. This allows the ornithopter to turn, climb, or dive.

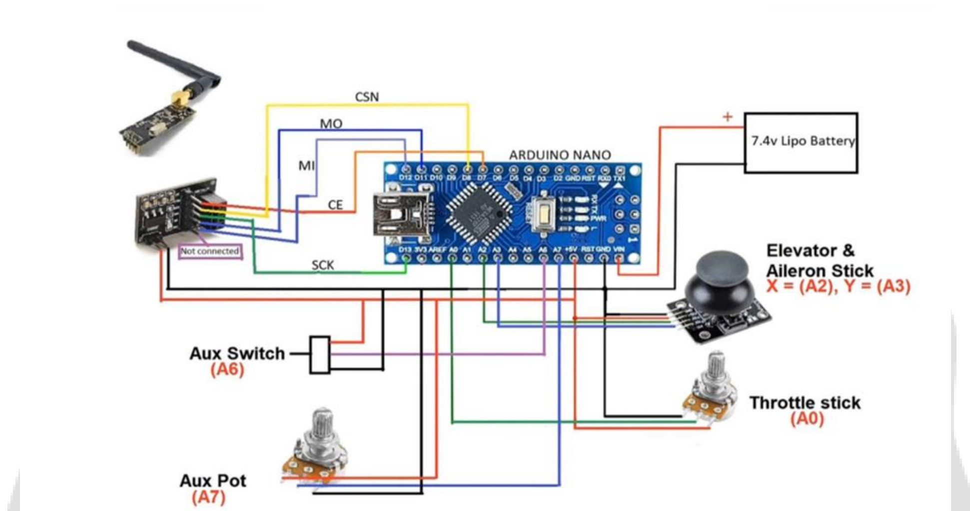

Fig (1) Transmitter

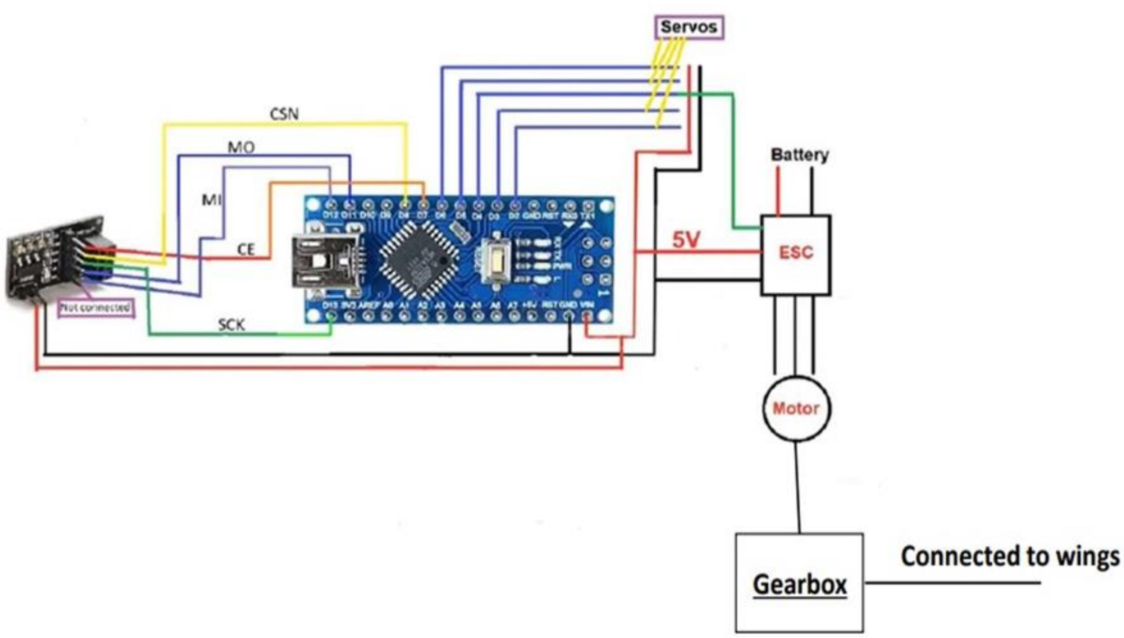

Fig (2) Receiver

3. CONCLUSIONS

The working of an ornithopter involves complex interactions between the mechanical flapping of its wings, the power system driving this motion, and the control mechanisms that stabilize and navigate the flight. By mimicking the natural flight of birds and insects, ornithopters achieve efficient and agile flight, making them suitable for a range of applications from surveillance and environmental monitoring to educational tools and hobbyist projects.

4. ACKNOWLEDGEMENT

We would like to express our sincere gratitude to all those who contributed to the development and implementation of the: Remote Control Flying Robo Brid (a.k.a Ornithopter) and the success of this research project. Special thanks to [Insert Names or
Organizations] for their invaluable support, guidance, and resources throughout the duration of this study. Additionally, we acknowledge the contributions of [Insert Names of Research Team Members] for their dedication and hard work in conducting experiments, collecting data, and analyzing results. This research would not have been possible without the collective effort and collaboration of everyone involved.

5. REFERENCES

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