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PAVING THE WAY FOR SUSTAINABLE AIR TAXIS USING SOLAR POWER

Srushti Dagade[1], Abhishek Kadam[2], Pratiksha Yadav[3], Swamini Bhange[4] and Naved Ahmad Niyaz Ahmad[5].

{12345}Pune Institute of Aviation Technology, affiliated with savitribai Phule University, Pune, India

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ABSTRACT:

The following paper explores the integration of drones in the aviation industry, covering the application, safety considerations and potential benefits using sustainable resource. Drones (Air taxi) equipped with solar panels are environmentally friendly solution for urban air mobility, utilizing solar energy, battery storage, and electric propulsion to promote sustainable transportation. Photovoltaic panels capture solar energy, which is then stored in batteries (high-efficiency batteries) to power electric rotors, allowing for vertical take-off and landing (VTOL).

The paper examines application of drone (Air Taxi) to carry payload and deliver them to their designated locations which can be very important to aviation industry. Charging is facilitated by solar-powered vertiports, minimizing the need for conventional energy sources. This innovative technology aims to deliver zero-emission, cost-effective, and congestion-free air travel, revolutionizing urban mobility while decreasing carbon footprints and reducing reliance on fossil fuels.

Keywords: Solar Power, Renewable Energy, Sustainability, Clean Technology, Smart Design, Emissions Reduction, Future Transportation.

1. INTRODUCTION

Drones (Air Taxi), also known as unmanned aerial vehicles (UAVs), have revolutionized various industries, and their applications in the aviation industry have garnered significant attention. The aviation industry, which encompasses activities such as aircraft operations, airport management, and air transportation, has found drones to be valuable tools for enhancing efficiency, safety and sustainability

Aerial vehicles powered by solar energy are the latest innovation in urban transportation. They promise a great return on mobility investment without polluting the Earth. These modern air taxis come equipped with solar panels that are embedded into their structures. The propulsion system of the air taxis is also powered by electricity produced by photovoltaic cells mounted on the outer surface, ultimately alleviating the reliance on fossil fuels and aiding in lowering carbon footprints.

Solar-powered air taxis are also in line with the global sustainability agenda tackling urban sprawl, air quality, and even the energy problem. These air taxis will harness renewable energy making them environmentally friendly and less noisy alternative means of transport in the concrete jungle. Furthermore, solar technologies and energy storage system improvements now permit these planes to work during low sunlight or at night.

Solar-equppied drones (air taxis) offer a much more reasonable travel time as they do not have to deal with traffic, which in turn supports the view that they are the future of flying vehicles. This aspect also makes them much more appealing to the public as noise is one of the major contributors to decreased urban living standards. Cities looking to make a big

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impact regarding their environmental goals should look to adopt air taxis powered by solar energy.

In this project we deals prospect by building a cabin to the drone for purpose of carring a payload which can further utilise in avation industry.
This project can pave the way for effective utilization of innovative technology.

This project can be utilized for more efficient maintenance, documentation, medical emergencies and so on depending upon the user's capability of extracting value from it while maintaining safety as the first priority

2. METHODOLOGY:

A solar-powered air taxi is an innovative urban mobility solution that uses solar energy to make sustainable, efficient, and autonomous aerial transportation possible. The methodology consists of the following key components:

1. Solar Energy Harvesting: Photovoltaic (PV) panels are integrated into the wings and fuselage of the air taxi. High-efficiency solar cells store excess power in on-board batteries, ensuring continuous operation even in low sunlight conditions.

2. Energy Storage & Management: Collected energy is stored using advanced lithium-ion or solid-state batteries, which are regulated by a smart power management system. That ensures optimal energy distribution between propulsion, avionics, and auxiliary systems.

3. Electric Propulsion System: DEP is in the form of multiple rotors, ducted fans, or both, and will facilitate the ability of air taxis to take off and land vertically. Air taxis can fly in urban areas without need for long runways.

4. Autonomous Navigation: AI-driven flight control systems with integration of GPS, LiDAR, and computer vision, for precise navigation, collision avoidance, and coordination of traffic in urban airspaces.

5. Infrastructure & Operations: Charging hubs with solar micro grids enable vertiports to operate independently with minimal dependency on conventional power grids. This methodology is envisioned to create zero-emission, cost-effective, and efficient urban air mobility with reduced congestion and environmental impact and providing an alternative to traditional ground transport.

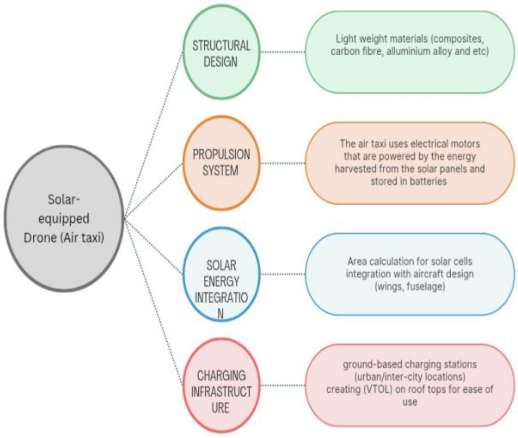

Chart 1

3. DESIGN:

The solar-powered air taxi is a design that integrates solar energy, electric propulsion, and autonomous technology to make sustainable urban air mobility possible.

1. Aerodynamic Frame – (Glass Fibre and Polyamide Frame) A lightweight, composite fuselage minimizes drag and maximizes energy efficiency.

2. Solar Panels – High-efficiency photovoltaic (PV) cells on the arms (wings) and fuselage of drone to capture solar energy.

3. Energy Storage – Advanced lithium-ion or solid-state batteries store solar energy for continuous operation.

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4. Electro Propulsion system – Multiple rotor electric propulsion design allows for a VTOL Capability.

5. Autonomous Flight Platform – AI flight navigation, along with GPS LiDAR Sensors, ensures very safe and high-precision in-flight operations.

6. Cabin – Seating capacity designed for 2-4 seats, compact but ergonomic.

7. Charging Architecture – Solar panels at vertiports for top-up energy before take-off

This design produces zero-emissions, efficient urban air travel through reduced congestion that is less fuel-dependent on fossils that is less fuel-dependent on fossils.

3.1 Basic components:

The components which we used are follows:

(a) Glass fibre and polyamide frame this component was selected due to its strength and light weight properly

(b) 1000kv Drone motor

Brushless motor were chosen due to their reliability, power and torque 1000kv provide optimum amount of power and torque for the intended use of the project

(c) KK.2.1.5 Control Bot

Control board was chosen according to necessary weight and due to its facility of integrated gyro and accelerometer sensor.

(d) 4×30A ESC (Electronic speed controller)

To control the speed of the motors.

(e) 2.4G radio Transmitter

To transmit control signals to the drone

(f) A6B receiver

To receive control signals from the transmitter

(g) Battery strap for holding battery in place.

(h) Cable ties for cable management.

(i) 1045 propellers 2 clockwise (cw) and 2 counter clockwise (ccw)

For providing optimum thrust and torque

(j) 12v 2200mah 3S Lipo battery for power.

(k) B3 Balance Charger for charging of battery.

(I) Allen keys for assembly.

(m) Screws for assembly.

(n) Solar Panel Output Calculation:

We need solar panels that can generate at least 800-1000W in peak sunlight conditions. Typical solar panels provide 150-200W per square meter. at least 1000W of solar power to sustain flight.

3.2 Selection of components:

Drone type: Quad-copter

Thrust by each motor= 900g approx.

Total Thrust= 4×900=3600g approx.

Max safe weight that can be lifted by rotors = 50% of 3600g= 1800g.

Weight of drone= 1400g.

Max safe payload= 1800g-1400g= 400g.

Solar panels: not more than 400g

Cabin weight: 200g

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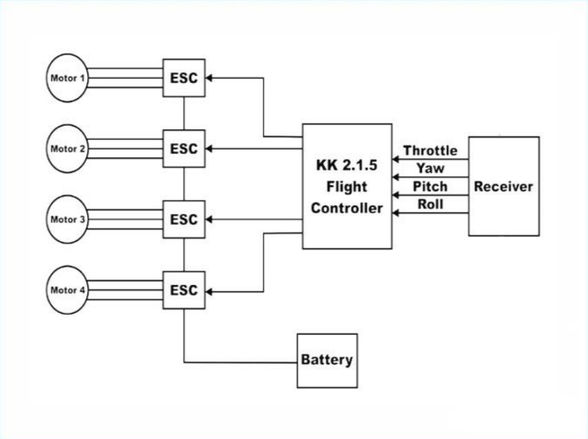

Fig -1: Wiring Diagram of Drone

4. IMPLEMENTATION:

The implementation of a solar-powered air taxi consists of several important stages that combine solar energy, electric propulsion, and autonomous technology to create an efficient and sustainable mode of urban air transport.

1. Technology Development – Research is directed towards creating high-efficiency solar panels, using lightweight materials, and developing advanced battery storage systems to maximize energy use.

2. Prototype Testing – The initial prototypes are subjected to aerodynamic testing, battery performance assessments, and evaluations of flight stability to guarantee safety and efficiency.

3. Infrastructure Setup – Vertiports equipped with solar charging stations, maintenance facilities, and AI-driven traffic management systems are constructed.

4. Regulatory Compliance – Working closely with aviation authorities ensures that all air traffic control, safety regulations, and certification requirements are met.

5. Market Deployment – The rollout starts in busy urban areas, concentrating on short-range and high-demand routes to demonstrate feasibility.

6. Scaling & Public Adoption – A gradual expansion of the fleet, along with cost reductions and integration into smart city frameworks, promotes widespread acceptance.

5. WORKING:

A solar-powered air taxi functions by harnessing solar energy, utilizing advanced battery storage, and employing electric propulsion to facilitate sustainable urban air travel.

1. Solar Energy Collection – The taxi is equipped with high-efficiency photovoltaic (PV) panels on its wings and fuselage that capture sunlight.

2. Energy Storage & Management – The solar energy collected is stored in lithium-ion or solid-state batteries, managed by an optimized power management system.

3. Electric Propulsion – This stored energy powers distributed electric propulsion (DEP), allowing for vertical take-off and landing (VTOL).

4. Autonomous Navigation – AI-driven autopilot systems, along with GPS and LiDAR, ensure safe navigation and obstacle avoidance during flight.

5. Passenger Transport – The air taxi operates along designated urban air routes, making stops at solar-powered vertiports for recharging. Vertiports are specialized hubs enabling vertical take-off and landing (VTOL) for drone air taxis.

They include landing zones, charging infrastructure, passenger terminals, and air traffic management systems. Vertiports ensure safe operations, facilitate efficient passenger transfer, and support maintenance. They are essential for advancing urban air mobility and sustainable transportation.

This innovative system promotes zero-emission, cost-effective, and intelligent air mobility, helping to alleviate congestion and minimize environmental impact.

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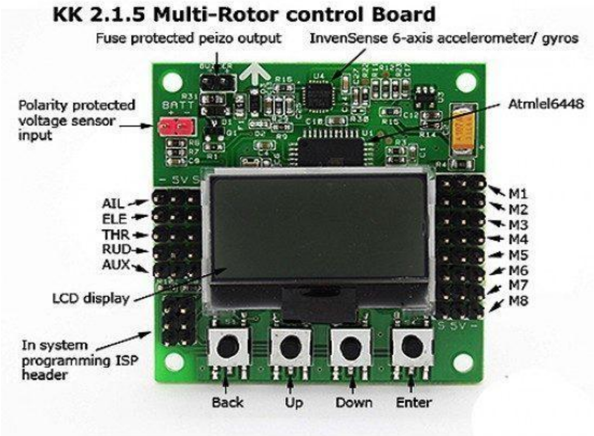

Fig 2: Pin Diagram of flight controller

M1 to M8 is for ESC connections to motors

AIL is channel for rolling

ELE is channel for pitching

THR is channel for altitude

RUD is channel for yaw

AUX is for additional functionality

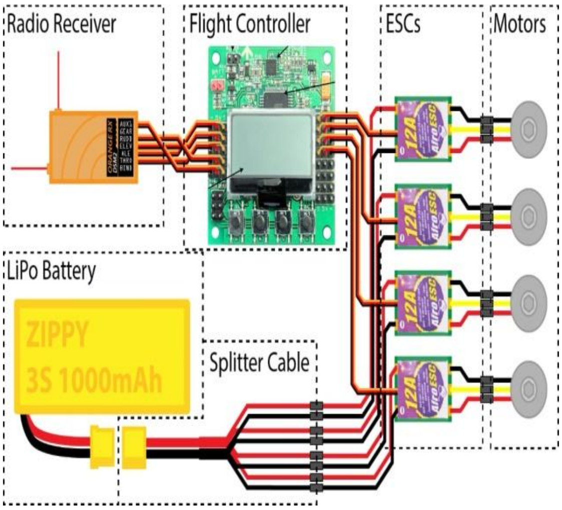

Fig 3: Wiring Diagram of flight controller

5 .1 Assembly:

(a) Frame Selection: X frame for quad-copter.

(b) Motor & ESC Installation: Install the 1000Kv motors and 30A ESCs to the arms of the frame. Solder the motor wires to the ESCs and connect the ESCs to the power distribution board.

(c) Propeller Attachment: Attach the 1045 propellers to each motor, ensuring they are secured tightly and mounted in the correct direction.

(d) Flight Controller Installation: Install the KK2.1.5 flight controller to the centre of the frame. Connect the ESCs to the corresponding ports on the flight controller.

(e) Receiver Installation: Install the receiver to the drone and connect it to the flight controller.

(f) Power Distribution Board Installation: Install the power distribution board to the drone and connect it to the battery.

g) Battery Attachment: Choose a 12V battery that is compatible with the components and attach it to the power distribution board.

(h) Test Flight: Before flying, test the drone in a controlled environment to ensure all components are working correctly. Adjust the flight controller settings as necessary.

(i) Trimming: To fly the drone in a level and balanced way, trimming is necessary. The drone inputs are trimmed in such a manner that any natural misbalance is countered.

(j) Attaching of payload: A cardboard box is attached to carry the payload (glass fiber or polyamide). The payload box is attached at the bottom by means of zip ties.

(k) Solar panels: 150w capacity panels to charge the battery of 12 volt are mounted on the frame and top of the Zip ties.

(l) Final flight test: A final flight test is done to ensure that the drone is operating safely and flying in a level and balanced manner

6. CONCLUSION:

The solar-powered air taxi is a revolutionary step forward in sustainable urban transportation, combining solar energy, electric propulsion, and autonomous navigation to provide a zero-emission travel option. By utilizing high-efficiency solar panels, advanced battery systems, and AI-based flight control, these air taxis aim to minimize carbon emissions, alleviate traffic congestion, and reduce reliance on fossil fuels.

While there are hurdles to overcome, such as weather conditions, regulatory challenges, and the need for infrastructure development, ongoing improvements in solar technology, battery performance, and vertiport systems will make this concept more viable. Partnerships among governments, private companies, and tech innovators will help speed up the adoption and integration into the market.

With the ability to revolutionize urban transport, solar-powered air taxis present efficient, cost-effective, and eco-friendly travel solutions. As this technology advances, it will play a crucial role in the evolution of smart cities, cutting down pollution and improving urban mobility. This innovation sets the stage for a cleaner, smarter, and more interconnected future.

However, it is crucial to acknowledge that the adoption of drones in the aviation industry requires careful consideration of safety protocols, adherence to regulations, and respect for privacy concerns. Collaboration among aviation authorities, industry professionals, and drone manufacturers is essential in establishing comprehensive guidelines and standards that ensure responsible drone operations.

As technology continues to advance, further advancements in drone capabilities, such as longer flight times, increased payload capacities, and improved obstacle detection systems, will further expand the possibilities for their use in aviation.

7. ACKNOWLEDGEMENT:

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