DESIGN AND DEVELOPMENT OF RC PLANE

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Introduction:

Background:

Unmanned aerial systems are increasingly used in defense, agriculture, surveillance, and education. Radio-controlled (RC) planes provide a low-cost, accessible platform to learn aerodynamics, propulsion, and control systems.

Project Focus:

The project *"Design and Development of RC Plane"* involves conceptualization, fabrication, and testing of a fixed-wing aircraft using foam board and commercially available electronic components.

- **Key Features:**
    - Lightweight foam board construction (810 mm wingspan, 640 mm fuselage length, ~900 g).
    - Brushless DC motor with ESC and Li-Po battery for 30–45 minutes endurance.
    - Control via 2.4 GHz transmitter–receiver with servo-actuated rudder, elevator, and ailerons.
    - Modular design allowing upgrades (GPS, autopilot, extended payloads).
- **Purpose:**

  To provide an affordable, replicable platform for students and institutions to gain hands-on experience in aircraft design, testing, and applications such as surveillance and environmental monitoring.

Objectives:

1. **Campus Monitoring**
    i. To capture aerial views of college events, sports meets and cultural activities for documentation and promotional purposes.
2. **Safety & Security**
    a. To identify and monitor potential fire accidents, unauthorized entries, or hazardous situations within the campus area.

3. **Environmental Observation**
    a. To observe greenery, plantations, and water resources in the campus for conservation and maintenance purposes.
4. **Disaster Awareness**
    i. To provide quick situational awareness during emergencies like fire, flood, or accidents in and around the institution.
5. **Educational Demonstration**
    i. To serve as a live teaching tool for aerodynamics, control engineering, and propulsion systems for future students.
6. **Research & Innovation Platform**
    i. To act as a testbed for experimenting with sensors, autopilot systems, and control algorithms and in future (UAV) unmanned aerial vehicle - related projects.

Methodology:

The methodology adopted for the design and development of the radio-controlled (RC) plane follows a systematic engineering approach, ensuring that each stage of the project contributes to the successful realization of the objectives. The process begins with the identification of the problem, where the need for a low-cost, lightweight, and modular RC aircraft was established. Conventional drones and UAVs were found to be expensive and complex, which created barriers for students and institutions with limited resources. This recognition formed the basis for developing a simplified RC aircraft that could be fabricated using foam board and readily available electronic components.

Following problem identification, a comprehensive literature review was conducted to study existing RC aircraft designs, propulsion systems, and control mechanisms. This review provided valuable insights into material selection, aerodynamic considerations, and component integration, which guided the design of the present project. Based on the findings, a requirement analysis was carried out to define the performance parameters of the aircraft, including wingspan, fuselage length, thrust-to-weight ratio, endurance, and payload capacity. These requirements were then used to finalize the specifications of the motor, electronic speed controller (ESC), Li-Po battery, servo motors, and transmitter-receiver system.

The design and planning stage involved creating CAD models of the fuselage, wings, stabilizers, and control surfaces to ensure aerodynamic efficiency and structural stability. The design emphasized modularity, allowing components to be easily replaced or upgraded in the future. Once the design was finalized, fabrication of the airframe was carried out using foam board due to its lightweight and easy-to-cut properties. Adhesives, reinforcements, and linkages were used to assemble the structure, while provisions were made for mounting the motor, servos, landing gear, and other subsystems.

Integration of the propulsion, power, and control systems was the next step. The brushless motor, ESC, and propeller were installed to provide thrust, while the Li-Po battery supplied power to all components. Servo motors were connected to the rudder, elevator, and ailerons, and linked to the 2.4GHz transmitter and receiver system to enable remote operation. Electrical wiring and connectors were arranged carefully to ensure safety, reliability, and ease of maintenance.

The testing and calibration phase involved a series of evaluations to verify the performance of the aircraft. Static checks were conducted to test motor thrust, servo response, and control surface deflection. Glide tests were performed to confirm balance and center of gravity, followed by powered flight trials to assess stability, maneuverability, and endurance. The results of these tests were analyzed to validate the design and identify areas for improvement.

Result and Conclusion:

The design and fabrication of the radio-controlled (RC) aircraft were successfully completed by following a systematic methodology that included design calculations, CAD modelling, material selection, fabrication, and testing. The results obtained from the fabrication and flight trials demonstrate that the aircraft meets the intended objectives of being lightweight, cost- effective, and capable of stable flight.

The **structural integrity** of the foam board airframe proved to be satisfactory, withstanding the stresses of take-off, flight, and landing. Reinforcements at critical joints, such as the wing-fuselage connection and landing gear mounts, ensured durability. The **aerodynamic performance** of the wing, designed with a flat-bottom airfoil, provided sufficient lift to sustain flight while maintaining stability. The calculated aspect ratio of 5 contributed to efficient gliding performance and reduced induced drag.

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Future Scope:

The present RC aircraft serves as a foundation for further development and innovation. The following future enhancements can be considered:

- **Autonomous Flight:** Integration of autopilot systems and GPS modules to enable autonomous navigation and waypoint-based missions.
- **Extended Endurance:** Use of higher-capacity Li-Po batteries or hybrid power systems (solar-assisted charging) to increase flight duration.
- **Payload Expansion:** Modification of the fuselage to carry additional payloads such as environmental sensors, thermal cameras, or small delivery packages.
- **Advanced Materials:** Replacement of foam board with lightweight composites such as carbon fiber or fiberglass to improve strength-to-weight ratio.
- **Safety Features:** Incorporation of return-to-home (RTH) functionality, obstacle avoidance sensors, and emergency parachute systems.
- **Research Applications:** Use of the aircraft as a testbed for aerodynamic studies, control algorithms, and UAV-related research projects.