Design and Development of an Innovative Novel Hybrid Ionic-Electric Fixed Wing UAV: For Low-Noise, Sustainable, and Energy-Efficient Electric Aircraft Propulsion

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Currently aviation produces considerable carbon emissions and high operating costs, making sustainable flight a key focus. Electric aircraft are widely viewed as an alternative due to their zero operational emissions and lower maintenance needs. However, their usefulness is limited by low battery energy density, which restricts range, endurance, and overall viability. Ionic propulsion has previously been explored as a primary thrust method, but existing systems produce low thrust for practical fixed-wing flight. My research instead investigates ionic thrust as a method of accelerating air over a wing to improve aerodynamic efficiency rather than generate primary thrust. The proposed hybrid system was designed and evaluated using computational fluid dynamics (CFD). Results showed a 15.10% reduction in drag and a 14.5% increase in lift compared to a conventional airfoil. This revealed an estimated 34.27% increase in overall aerodynamic efficiency, a 6.3% reduction in stall speed, and an estimated extension of flight endurance from 75 minutes to approximately 100 minutes under ideal conditions. A fully functional prototype aircraft was then constructed, incorporating the hybrid wing design, custom high-voltage circuitry, and GPS-assisted autonomous flight logging to measure battery endurance. The aircraft consists of a 1.6 m wingspan, weighs approximately 1.5 kg, and was built at one-sixth the cost of comparable small military aircraft of similar size, which often cost thousands of dollars. A recent review of literature indicates no fixed-wing aircraft has been built using this configuration. This research sets a new standard in next-generation efficient and sustainable aircraft design.

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