Indigenous Development of Core Electronic Subsystems for Lightweight Unmanned Aerial Platforms

Abstract

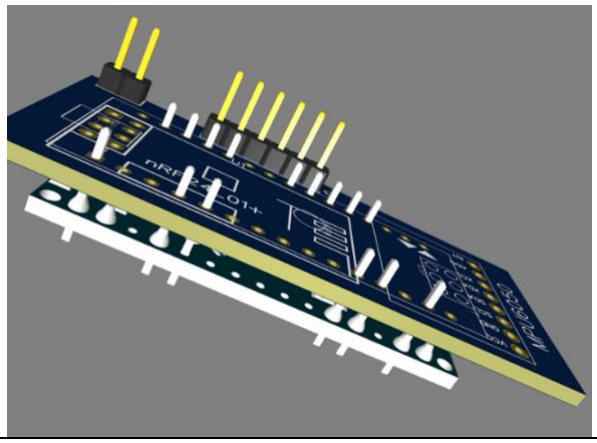
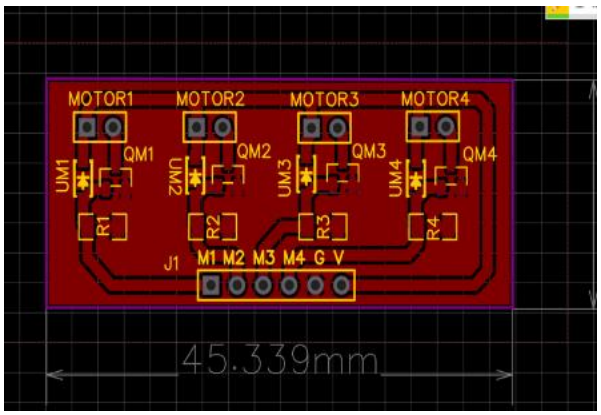
Lightweight unmanned aerial platforms currently rely **heavily on imported**, proprietary electronic subsystems such as flight controllers (FC), electronic speed controllers (ESC), and brushless DC (BLDC) propulsion components, limiting customisation, supply chain reliability, and system-level transparency.

This project focuses on the **indigenous design and development** of these critical subsystems through in-house hardware and firmware development, aiming to reduce dependence on closed and foreign drone electronics. The work emphasises real-time control, efficient power conversion, thermal robustness, and fault-safe operation at the component and subsystem levels. The developed FC, ESC, and BLDC propulsion system will be integrated and tested under representative operating conditions to evaluate electrical performance, control stability, and propulsion efficiency. The project represents an applied research effort progressing from component-level prototyping toward integrated subsystem validation, laying a robust foundation for self-reliant aerial robotics and unmanned system development.

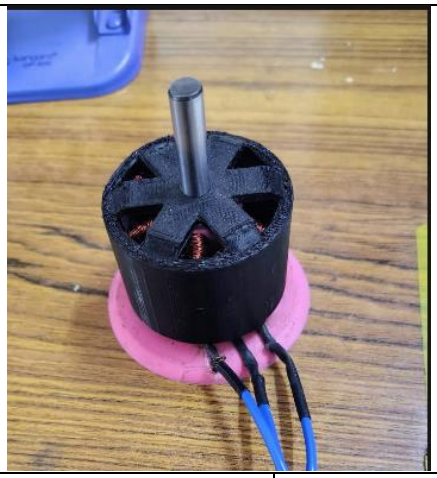
Technology Readiness Level

The project has completed **TRL 3/4**, where analytical and experimental proof-of-concept have been demonstrated. Core hardware architectures for the flight controller, ESC, and BLDC motor drive have been designed and validated through simulations, schematic development, and lab-scale prototypes. Embedded firmware for real-time control, sensing, and actuation has been implemented and tested under controlled conditions. Key technical risks related to power electronics, control stability, thermal behaviour, and fault handling have been identified and mitigated, establishing readiness for integrated subsystem validation and progression toward TRL 5/6.

Technology Readiness Level 3

Flight controller	Electronic Speed controller
	

Indigenously developed BLDC Motor



3D printed drone	Flight Controller