

Project Title: Lightweight & Optimization of Hydrogen Fuel Cell for Flight Endurance of Unmanned Aerial Vehicle

Funded by ;

DASSAULT SYSTÈMES LA FONDATION

Plot No. 15B, Pune Infotech Park, M.I.D.C. Phase-1,
Hinjewadi, Pune, Maharashtra – 411057

Executive Summary

The Department of Aeronautical Engineering, Nitte Meenakshi Institute of Technology (NMIT), Bengaluru, successfully completed the project titled "**Development of Green Hydrogen Fuel Cell for Unmanned Aerial Vehicle (UAV)**" with the support of **La Fondation Dassault Systèmes**.

The project was conceived to address the growing need for sustainable and environmentally friendly aviation technologies. By integrating hydrogen fuel cell technology with UAV systems, the project demonstrated a clean-energy alternative capable of reducing carbon emissions while enhancing endurance and operational efficiency.

The successful completion of the project represents a significant milestone in sustainable aerospace research and has provided valuable educational, research, and societal benefits.

Project Manager

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Deputy Project Managers

- Mr. Mallappa Jabade, Assistant Professor, Department of Aeronautical Engineering
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Project Status: Completed

Objective and Intent of the Project

The primary objective of the project was to develop and demonstrate a hydrogen fuel cell-powered unmanned aerial vehicle capable of operating using clean and renewable energy.

The project aimed to:

- Promote sustainable aviation technologies.
- Reduce dependence on fossil-fuel-based propulsion systems.
- Develop indigenous expertise in hydrogen fuel cell integration.
- Provide experiential learning opportunities for students.
- Create awareness about green energy solutions for future aerospace applications.
- Support national and global sustainability goals.

Journey of Project Development

The project was executed through a systematic development process comprising the following stages:

Phase 1: Research and Concept Development

- Literature survey on hydrogen fuel cells and UAV technologies.
- Identification of suitable fuel cell systems.
- Initial UAV configuration studies.

Phase 2: Design and Engineering

- System architecture development.
- Structural design of UAV platform.
- Power management system design.
- Hydrogen fuel storage and integration planning.

Phase 3: Prototype Development

- Fabrication of UAV components.
- Integration of a hydrogen fuel cell system.
- Development of control and monitoring systems.

Phase 4: Testing and Validation

- Ground testing of fuel cell performance.
- Power system validation.
- Flight readiness assessment.
- Safety and operational evaluations.

Phase 5: Demonstration and Performance Evaluation

- Successful demonstration of hydrogen-powered UAV operation.

- Data collection and performance analysis.
- Documentation of outcomes and lessons learned.

Project Outcomes Achieved

The project successfully achieved the following outcomes:

- Development of a functional Green Hydrogen Fuel Cell UAV prototype.
- Successful integration of hydrogen fuel cell technology into an aerial platform.
- Demonstration of clean-energy-powered flight capability.
- Validation of hydrogen as a viable energy source for UAV applications.
- Establishment of research capability in hydrogen-powered aviation systems.
- Creation of educational resources and practical learning opportunities.

Impact on Society

The project contributes to society in several meaningful ways:

Environmental Monitoring

Hydrogen-powered UAVs can support monitoring of forests, water resources, agricultural lands, and environmental conditions.

Disaster Management

The technology can assist emergency response teams by providing aerial surveillance during floods, earthquakes, and other natural disasters.

Sustainable Transportation Research

The project contributes to the development of future clean-energy aviation systems.

Public Awareness

The initiative has increased awareness among students and the community regarding renewable energy technologies and environmental sustainability.

Impact on Environment and Sustainable Future

The project aligns with global sustainability initiatives by:

- Promoting zero-emission energy systems.
- Reducing carbon footprint associated with aviation activities.
- Encouraging adoption of renewable energy technologies.
- Supporting research into clean transportation systems.
- Demonstrating environmentally responsible engineering practices.

The hydrogen fuel cell system produces electricity with water as the primary by-product, making it a cleaner alternative to conventional fossil-fuel-based propulsion technologies.

Direct Beneficiaries

Students

- Undergraduate and postgraduate students involved in research activities.
- Students gaining hands-on experience in aerospace systems and renewable energy technologies.

Faculty Members

- Faculty researchers engaged in advanced aerospace and hydrogen energy research.

Research Community

- Researchers working in UAV systems, fuel cells, and sustainable aviation.

Indirect Beneficiaries

- Aerospace industry.
- Environmental agencies.
- Disaster management organizations.
- Future entrepreneurs and innovators.
- Society at large through cleaner technologies and sustainable solutions.

Student Skill Development

One of the major achievements of the project was the development of multidisciplinary technical skills among students.

Students gained expertise in:

- UAV design and development.
- Hydrogen fuel cell technology.
- CAD modelling and simulation.
- System integration and testing.
- Aerospace structures.
- Power electronics and energy systems.
- Project management.
- Technical documentation and research publication.

The project provided a real-world engineering environment that strengthened practical learning beyond classroom education.

Contribution to Student Career Aspirations

Participation in this project significantly enhanced students' career readiness.

The project enabled students to:

- Work on emerging technologies relevant to future industries.
- Build strong research and innovation portfolios.
- Improve employability in aerospace, defence, renewable energy, and UAV sectors.
- Develop problem-solving and teamwork skills.
- Pursue higher studies and research opportunities in advanced engineering domains.

Several students have expressed increased interest in careers related to sustainable aviation, hydrogen technologies, and advanced aerospace systems as a result of their involvement in the project.

Conclusion

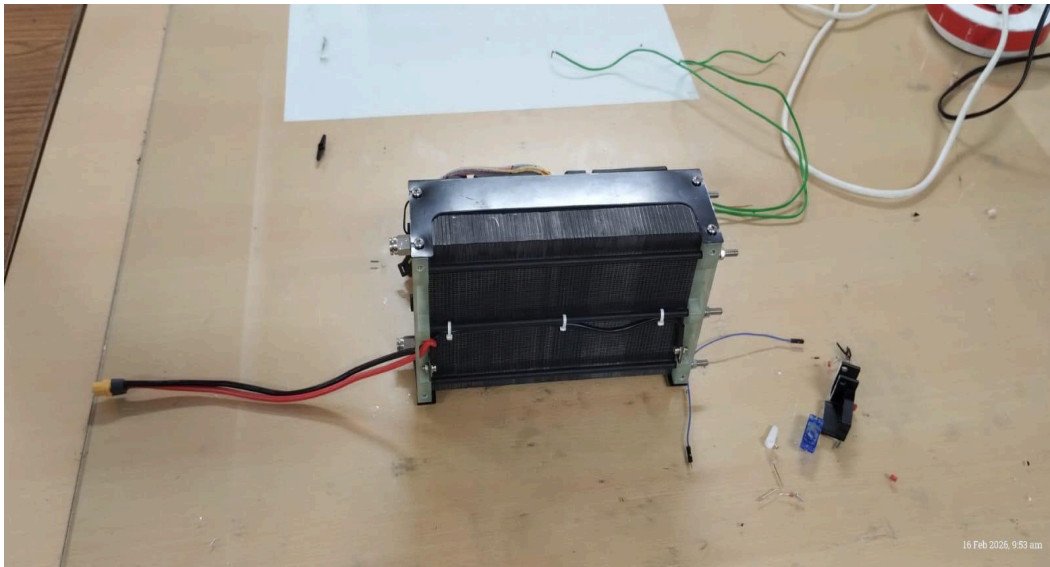
The "Development of Green Hydrogen Fuel Cell for Unmanned Aerial Vehicle (UAV)" project successfully demonstrated the feasibility of integrating clean hydrogen energy systems with UAV technology. The project has generated significant educational, technological, environmental, and societal benefits while contributing to the advancement of sustainable aviation research.

The support provided by La Fondation Dassault Systèmes has played a vital role in enabling this innovative initiative and fostering the next generation of engineers, researchers, and technology leaders.

Image of Hydrogen Fuel Cell UAV Prototype



An advanced hydrogen fuel cell-powered UAV developed by the Aero R&D Center to support research in clean propulsion technologies, long-endurance flight, and intelligent autonomous aerial platforms.



Indigenously Developed Hydrogen Fuel Cell Stack

A hydrogen fuel cell stack developed at the Aero R&D Center, Department of Aeronautical Engineering, Nitte Meenakshi Institute of Technology (NMIT). The fuel cell serves as the primary power source for hydrogen-powered unmanned aerial vehicles (UAVs), supporting research in clean energy propulsion, extended-endurance flight, and sustainable aerospace technologies.



Demonstration of Hydrogen fuel cell UAV Developed at the Aero R&D Center.

Faculty members, researchers, and student innovators of the Aero R&D Centre, Department of Aeronautical Engineering, Nitte Meenakshi Institute of Technology (NMIT), with the indigenously developed heavy-lift unmanned aerial vehicle (UAV) following a successful demonstration and technical evaluation on the institute campus.

Single Point of Contact

Project Coordination and Media Communication

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The Project Coordinator shall serve as the single point of contact for coordination between La Fondation Dassault Systèmes, the media agency, project team members, and the institution.