جامعة المنوفية

Innovative Hybrid Darrieus-Savonius Wind Turbines: Design, Fabrication, and AI-Based Optimization

GRADUATION PROJECT PROPOSAL

ABOUT US

The project aims to innovate in the field of renewable energy by focusing on the design, fabrication, testing, and optimization of hybrid Darrieus-Savonius wind turbines. By combining the strengths of both turbine types, the project seeks to enhance energy capture efficiency, especially in varied wind conditions. The Darrieus turbine, known for its high efficiency at higher wind speeds, is integrated with the Savonius turbine, which performs well in low-speed winds and offers a simple construction. This hybrid approach aims to maximize performance across a broader range of wind conditions. The culmination of this project is the development of a working prototype of the hybrid Darrieus-Savonius wind turbine. This prototype aims to serve as a benchmark for future research and development in wind energy technologies, contributing to a sustainable energy future.

Professors

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Our Mission

Design of the turbine. Simulation results. Manufacture prototype of Darrius-Savonius wind turbine. Wind turbine characterization parameters. AI model.

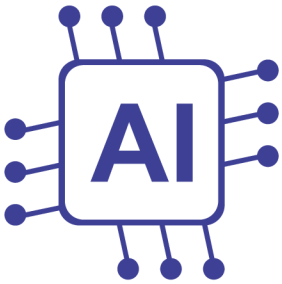
OBJECTIVES

Intermittent Energy Generation:

Traditional wind turbines can struggle in low-wind conditions, while solar panels depend on sunlight. The hybrid Darrieus-Savonius design mitigates this by ensuring that energy generation can occur across a broader range of wind speeds, thus improving overall reliability

Efficiency in Urban Environments:

The compact design of hybrid turbines can be more suitable for urban areas where space is limited. This project provides an effective solution for energy generation in locations where traditional turbines might not be feasible.



Variable Wind Conditions:

By combining the two turbine types, the project addresses the challenge of variable wind conditions, maximizing energy capture and efficiency throughout the day and across different seasons.

Sustainability and Energy Security:

Enhancing the efficiency of wind energy contributes to reducing reliance on fossil fuels and promotes a more sustainable energy mix.

1. SDG 7: Affordable and Clean Energy

Contribution: The project aims to develop efficient hybrid wind turbines, increasing access to renewable energy sources. By optimizing energy capture in various wind conditions, it enhances the reliability and affordability of clean energy.

2. SDG 9: Industry, Innovation, and Infrastructure

Contribution: The integration of artificial intelligence in the design and optimization processes promotes innovation in the renewable energy sector. It encourages the development of resilient infrastructure by supporting advanced manufacturing techniques and smart technologies.

3. SDG 11: Sustainable Cities and Communities

Contribution: The project's focus on compact and efficient turbine designs makes it suitable for urban environments, helping cities transition to sustainable energy sources and reducing their carbon footprint.

4. SDG 12: Responsible Consumption and Production

Contribution: By optimizing the design and fabrication processes of wind turbines, the project aims to reduce waste and promote sustainable manufacturing practices, contri

5. SDG 13: Climate Action

Contribution: The development of hybrid wind turbines directly contributes to reducing greenhouse gas emissions by providing an alternative to fossil fuels. This project supports global efforts to combat climate change through sustainable energy solutions.

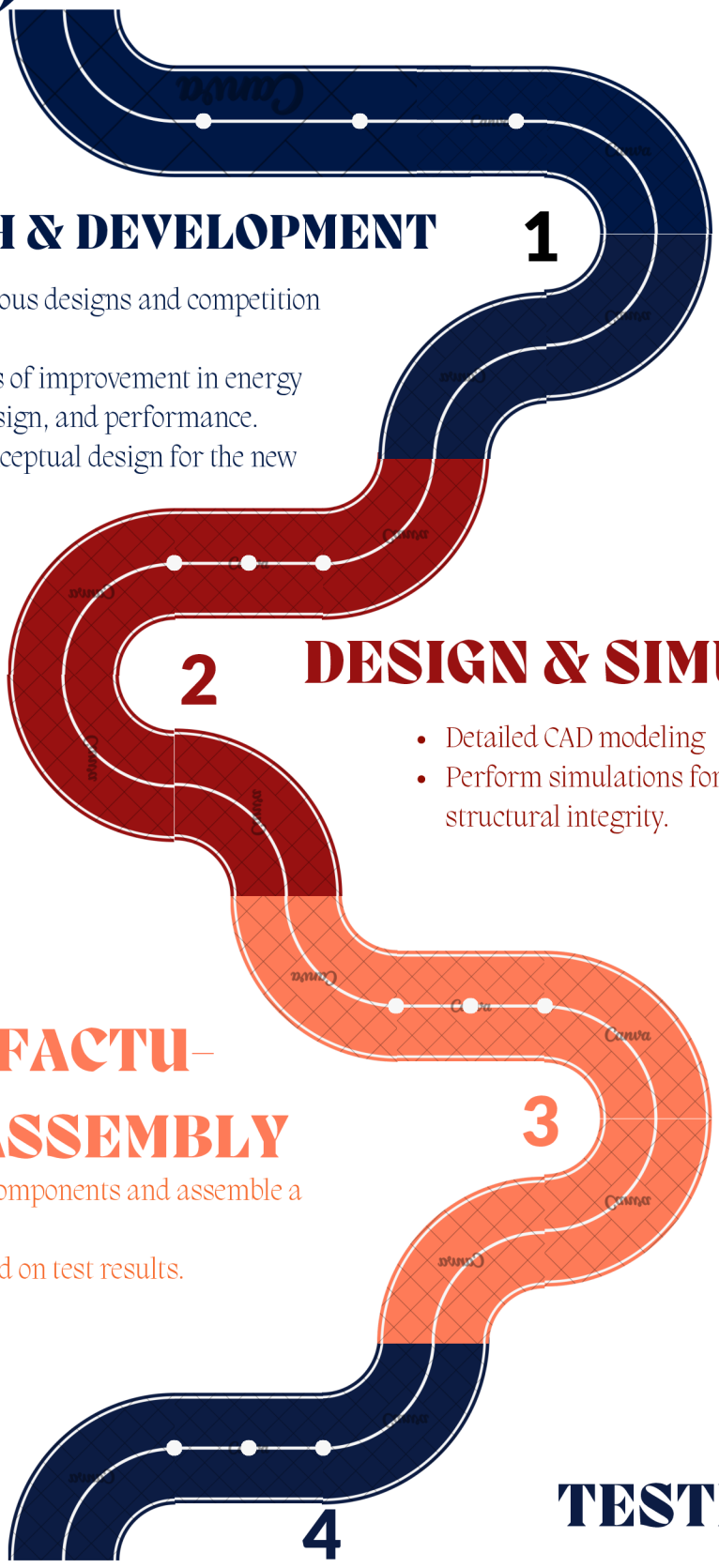
6. SDG 15: Life on Land

Contribution: Efficient energy generation from wind turbines helps preserve terrestrial ecosystems by reducing the reliance on land-intensive fossil fuel extraction. Sustainable land use practices associated with wind energy can also benefit local biodiversity.

7. SDG 17: Partnerships for the Goals

Contribution: The project encourages collaboration between academia, industry, and government to advance renewable energy technologies, fostering partnerships that can enhance knowledge sharing and resource mobilization.

Project Timeline



RESEARCH & DEVELOPMENT 1

- Analyze previous designs and competition results.
- Identify areas of improvement in energy efficiency, design, and performance.
- Develop a conceptual design for the new electric car.

2 DESIGN & SIMULATION

- Detailed CAD modeling
- Perform simulations for aerodynamics, structural integrity.

MANUFACTU-RING & ASSEMBLY 3

- Manufacture key components and assemble a prototype.
- Adjust design based on test results.

4 TESTING

- Perform final tests, including ,handling, and energy efficiency tests.
- using Ai to improve the efficiency

Environmental impacts

1. Reduction of Greenhouse Gas Emissions

By optimizing the efficiency of wind turbines, the project promotes the use of renewable energy, which significantly reduces reliance on fossil fuels. This shift helps lower greenhouse gas emissions, mitigating climate change and its associated impacts on the environment.

2. Conservation of Natural Resources

Wind energy is a renewable resource that does not deplete over time. By harnessing wind energy through efficient turbine designs, the project helps conserve non-renewable resources, such as coal and natural gas, which are harmful to the environment when extracted and burned.

3. Minimized Land Use Impact

The hybrid design of Darrieus-Savonius turbines can be more space-efficient compared to traditional wind farms, making them suitable for urban and rural areas without extensive land disruption. This approach helps maintain the integrity of natural habitats and reduces habitat fragmentation.

Environmental impacts

4. Enhanced Biodiversity Protection

Efficient turbine designs can reduce bird and bat mortality rates, which are often concerns with conventional wind turbines. By developing quieter and more effective turbines, the project aims to lessen the impact on local wildlife, thereby contributing to biodiversity conservation.

5. Sustainable Manufacturing

Possibility of hosting branded giveaways or contests.
The project's focus on optimizing fabrication processes may include reducing material waste and using sustainable materials, thus promoting environmentally friendly manufacturing practices. This can lower the overall environmental footprint of wind turbine production.

6. Local Environmental Benefits

The implementation of hybrid wind turbines can provide clean energy to local communities, reducing air pollution and improving overall public health. By decreasing reliance on polluting energy sources, the project contributes to cleaner air and water resources.

Environmental impacts

7. Support for Circular Economy

By focusing on optimizing designs and potentially enhancing the lifecycle of turbine components, the project encourages practices that align with the principles of a circular economy—promoting reuse, recycling, and reducing waste in the wind energy sector.

8. Promotion of Sustainable Energy Policies

As the project advances knowledge and technology in wind energy, it can inform policymakers and stakeholders about the benefits of renewable energy, leading to more supportive policies and regulations that protect the environment.