Oceanic Energy Harvesting Platforms

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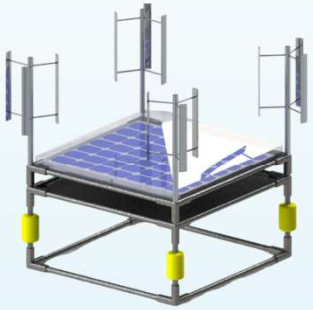
Introduction/Background

- **Problem Statement:** The Oceanic Energy Harvesting Platform delivers reliable, renewable power by harnessing wave, wind, and solar energy, ensuring stability and minimal environmental impact.
- **Project Scope:** The objective is to create an Oceanic Energy Harvesting Platform that integrates wind, solar, and wave energy to provide efficient renewable energy. The platform combines multidisciplinary contributions to ensure performance and durability, adhering to relevant standards.



- **Constraints:**
  - Limited testing due to reliance on a scaled prototype.
  - Multidisciplinary integration challenges across mechanical, electrical, and software components.
  - Marine environment conditions such as saltwater corrosion and wave impact.
  - Sensor accuracy affected by environmental variations like wind speed and wave height.
- **Specification:**
  - Integration of three renewable energy sources: wind, solar, and wave energy, with efficiencies of 30-38% for wind turbines, 20-22% for solar panels, and 35-45% for wave energy converters.
  - Continuous data monitoring and analysis using Raspberry Pi with real-time updates and data transmission in less than 2 seconds.
  - Energy forecasting with less than 5% deviation under controlled conditions.
  - Scalable and modular design for adaptation to different marine environments.
  - 24/7 uninterrupted energy generation and monitoring.

Equations

1. **Energy from Wind:**

$$P_{\text{wind}} = \eta_{\text{wind}} \cdot 0.5 \cdot \rho \cdot A \cdot V^3$$

   - Efficiency: $30\% - 38\%$, $V = 6\,\text{m/s}$.
2. **Energy from Solar Panels:**

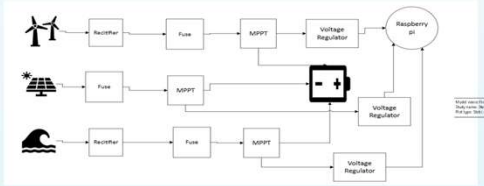
$$P_{\text{solar}} = V \cdot I \cdot \text{Sunlight Hours}$$

   - Panel efficiency: $20\% - 22\%$.
3. **Energy from Wave:**

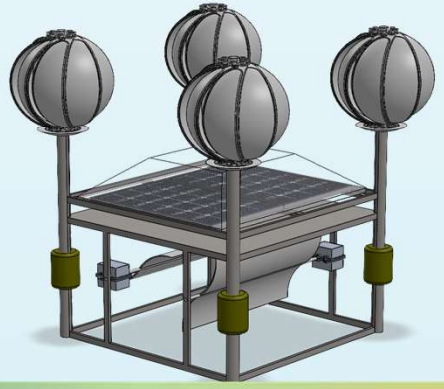
$$P_{\text{wave}} = \eta_{\text{wave}} \cdot 0.5 \cdot \rho \cdot g \cdot h^2$$

   - Efficiency: $35\% - 45\%$, where h is wave height.
4. **Overall Electricity Output:**
   - Wind turbines: $4 \times 36\,\text{W} = 144\,\text{W}$.
   - Solar panels: $2 \times 36\,\text{W} = 72\,\text{W}$.
   - Wave fins: $2 \times 36\,\text{W} = 72\,\text{W}$.
   - Total potential output: $360\,\text{W}$.

Connections

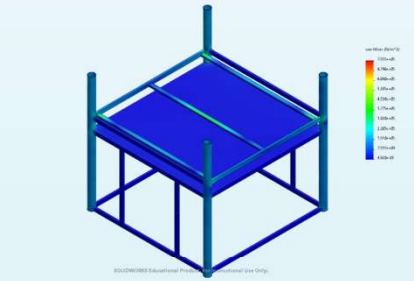


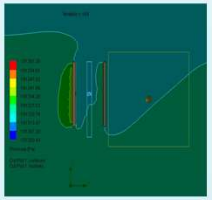
Prototype Design

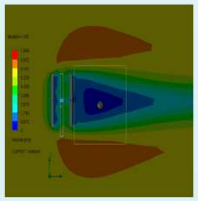


Oceanic Energy Harvesting Platform performance measures:

Frame & VAWT Simulation:







Testing/Validation

Based on analysis that showcase current optimized condition.

Measurement	Test Results
Wind Turbine Efficiency	Achieved 32%-38%
Wave Energy Conversion Efficiency	Achieved 35%-45%.
Solar Panel Efficiency	Achieved 20%-22%.
Energy Output:	Total: 360 W.
Real-Time Data Transmission	Achieved under 2 seconds.
Material Performance	Ensured durability in harsh marine environments, with structural integrity verified under simulated conditions.

Recommendations

What could we improve:

- Develop AI models to predict energy output using weather data.
- Enhance gear ratios for better wave energy efficiency.
- Improve wind turbine blade design for higher performance.
- Research lightweight, corrosion-resistant materials.
- Conduct studies on smart city technologies in Saudi Arabia.

Conclusion

A multidisciplinary platform was designed integrating wind, solar, and wave energy, focusing on optimizing energy generation and real-time data monitoring.

Acknowledgements

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