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Fuel Cell And Solar Powered Hybrid Charging Station For Micromobility And Stem Education

UTTyler THE UNIVERSITY OF TEXAS AT TYLER

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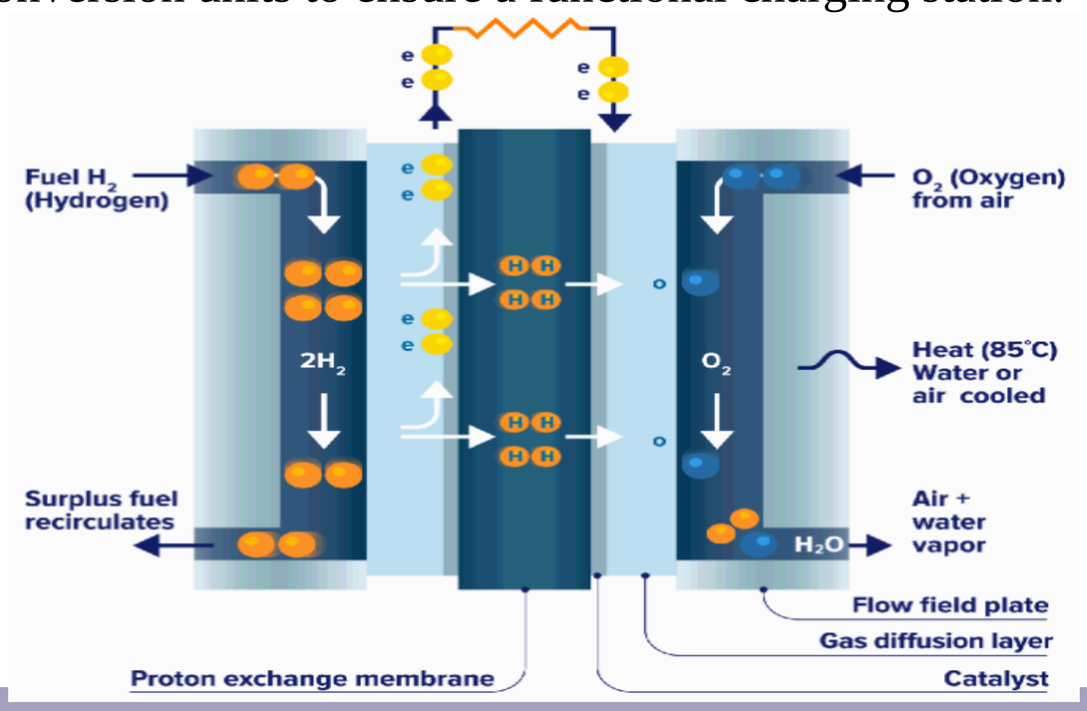
INTRODUCTION & AIM

- **Sustainability**: Utilizing renewable energy sources reduces the dependence on fossil fuels and decreases greenhouse gas emissions.
- **Autonomy**: The hybrid system can operate independently of the grid, providing a reliable power source in remote or off-grid locations.
- **Educational Value**: Demonstrates the practical application of renewable energy technologies, serving as a valuable educational tool for STEM students.
- **Economic Efficiency**: Reduces operational costs associated with electricity consumption from the grid.
- **Innovation in Energy**: demonstrating a cutting-edge approach to energy use.

METHOD

- **System Components**: Integrates solar panels, MPPT controller, battery storage, inverters, hydrogen generator, fuel cell stack, and voltage converters for a complete charging system.
- **Testing Procedure**: Employs hydrogen generators at varying flow rates, connected to a fuel cell stack, with performance measured by multimeter and electric load tests.
- **Structure Verification**: Confirms the support structure's capacity to hold all components securely.
- **Assembly and Configuration**: Details the optimal setup of solar panels, connection to the charge controller, and battery bank configuration for efficient energy management.
- **Operational Setup:** Describes the setup of the hydrogen generator, flow control, fuel cell stack, and power conversion units to ensure a functional charging station.

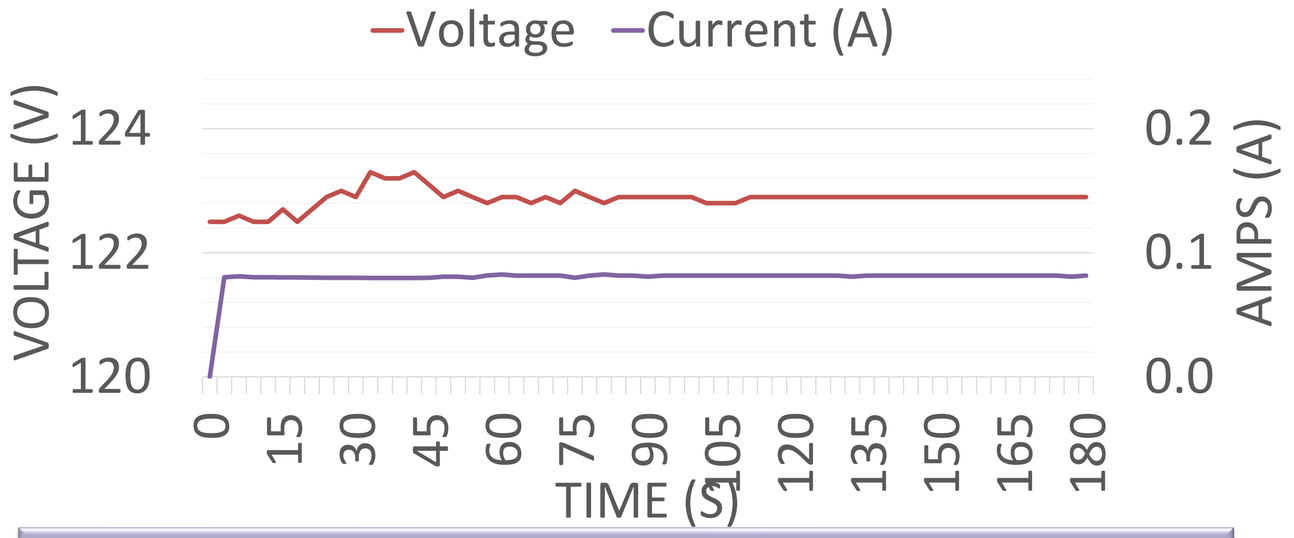


RESULTS & DISCUSSION

Test 1: Hydrogen Generator Rated for 500ml/min Flow

Device	With Load	H_2 Flow Rate	Fuel Cell Display
Fan	2.9W, 12.24V, 0.24A	470 – 510ml/min	~33V (assumed 0.087A and 2.9W load)
Water Pump	13.4W, 12.17V, 1.1A	490 – 510ml/min	~27V (assumed ~0.5A and 13.4W load)
Omega Flow Controller	11.92W, 23.84V, 0.5A	510ml/min	~27.9V (assumed 0.427A and 11.92W)
iPhone 11	18W, 9V, 2A (adapter information)	510ml/min	~26V (assumed 0.8A and 20W load)
12V 10Ah Lithium-Ion Battery	30W, ~10V, 3A	510ml/min	21 - 25V (assumed 1.43A and 30W load)
Electric Load Simulation	Start: 12.2V & 0.5A, Max: 12.2V & 1.5A	-	Warnings: 21.6V & 1.0A

Test 2: Graph for Solar Panel Charging of iPhone 11 with AC current



CONCLUSION

Significant advancement in sustainable energy solutions, integrating solar power with H_2 FCs to support micro-mobility and STEM education. Despite challenges like low H_2 pressure affecting fuel cell efficiency, our hybrid charging station has successfully powered various devices, demonstrating its potential.

FUTURE WORK / REFERENCES

- **Extended Testing:** Longer tests for sustained performance.
- **Optimization:** Enhance solar panel and battery capacity.
- **Maintenance:** Regular upkeep of panels, controller, and batteries.

Solutions, E. and E. (2000, October 31). *Fuel Cell Handbook, Fifth Edition*. Fuel Cell Handbook, Fifth Edition (Technical Report) | OSTI.GOV.