Wright Electric -- Exotic Battery Management System

This project is in cooperation and partnership with Wright Electric Inc. located in Los Angeles, California. The lead is Aaron Rowe.

Wright Electric is a seed stage startup company aimed at developing large airliners that make use of electric propulsion systems. The team at Wright includes alumni from Airbus, Lehman Brothers, and Fitbit. Wright completed the Y-combinator accelerator program.

Project Description

Lithium ion batteries may allow aircraft to fly 80 nautical miles or more. Lithium metal batteries may allow an aircraft to reach a 250 to 600 mile range. For long distance flights, a different battery chemistry such as molten salt or molten air will be necessary.

The aim of this project is to generate a circuit board and firmware capable of controlling the support systems for a molten salt or molten air battery.

Statement of the Problem

Many chemistry laboratories are working to develop new formulas for molten salt batteries, but few laboratories are working to construct the electronics that activate a molten salt battery and manage its performance.

Molten salt batteries must be kept in a tight temperature range around 200°C while in use. Some molten salt batteries require a carefully controlled air flow over their cathode.

Students must design a circuit board, heating element, cooling element and reserve power system that fit within a 3D printed enclosure. The total system weight must be no more than 5x the weight of the molten battery active materials. The total weight of the battery vessel and support system cannot exceed 4x the weight of the battery active materials.

Wax, ice, or a similar substance will be used in place of molten metal to ensure student safety.

The students are challenged with designing a system that is lightweight, compact, and controlled by a simple interface.

Solution Concept

Students will design an arduino shield capable of activating, managing and monitoring a liquid metal battery cell.

Prior to system design, students should:
Model the amount of energy used to bring the battery up to temperature.
Model the amount of energy needed to bring wax up to temperature.
Model the maximum allowable component weight.
Thoroughly study the state of the art in molten salt batteries.

The system must:

Activation: Provide an initial pulse of heat to melt the active battery components.
Heat may be delivered to the battery via a ceramic heating element and ultracaps.
Log voltages from a dummy battery stored within the vessel in CSV format.
Measure cell temperature and external temperature.
Control air flow over a dummy cathode. Measure air flow rate and air temperature.
Activate a liquid cooling loop if the battery exceeds its operating temperature.
Trigger an emergency cooling system the cell temperature reaches a secondary threshold.
Allow recharging of the energy reserve that is used for cell activation.

Fall
Molten metal and molten air battery concept study.
System breadboarding.
Test of temperature control loops and heating rate.
Test control of air flow system.
Video of system operation.

Winter
First board layout. Optimization of heating rate. Handling of edge cases.
Video of updated system operation.

Spring
Second board layout, system refinement. User interface development.

Ideal Student Qualifications
— Interest in cleantech
— PCB design experience
— Motor control experience
— Algorithm development experience
-- Python programming experience.

Student Requirements
Team participants must sign a nondisclosure agreement and an invention assignment agreement.

Assets Provided by Company
— Educational material
— 3D printed vessel
— all necessary components
— two cycles of PCB fabrication

Company Website	https://weflywright.com
Contact	aaron@weflywright.com