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Executive Summary

Problem Definition

- Batteries are prone to rapid discharge during extreme weather & terrain conditions
  →Battery performance decreases
- No battery cooling methods in market

Project Objectives

- Develop a cooling system to extend the range of E-Bikes.
- Implement thermal management to mitigate impact of environmental conditions on discharge rates
- Conduct testing and validation protocols to ensure effectiveness of optimized system
- Optimize battery design to maximize battery efficiency

Design Solution

- Brainstorm improvement ideas & research/consider existing technologies & essential factors
- Test by simulating different environmental conditions
- Prototype & conduct real-world testing via UCI Battery Lab
- Iterate & refine to meet objectives
- Assemble & complete documentation

Overall Success of the Project

- Accomplishing primary objectives & meeting stakeholder needs
- Staying w/in budget and timeline

Team Contribution

- Project Leadership

Christine Joy led project coordination, communication, & task management

- Research & Development

All members completed background research & trade studies & performed individual analysis

- Prototype

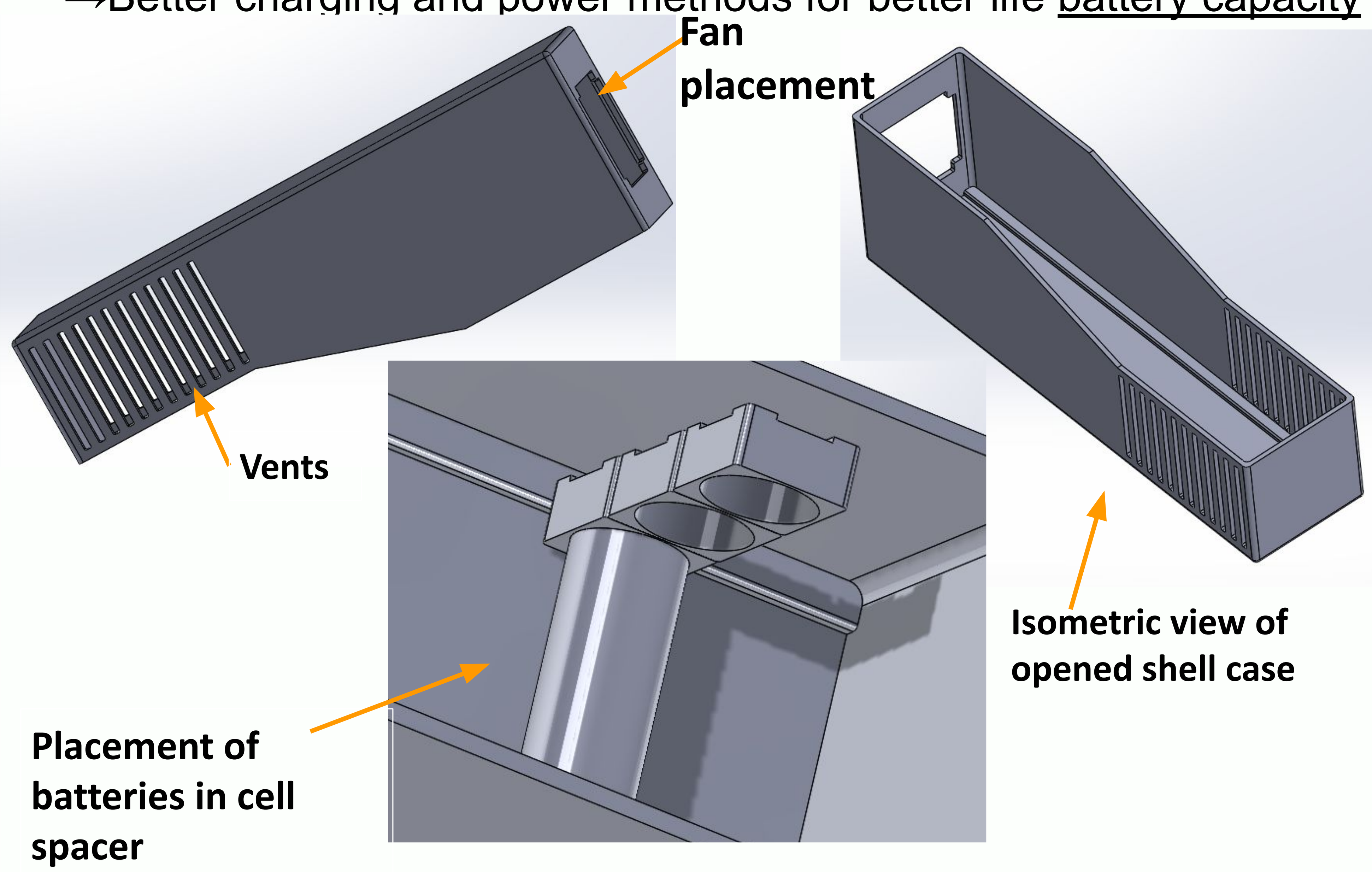
Wen & Kevin led modeling of E-Bike battery and in charge of creation

- Data Analysis
- Andrew & Christine Joy led analization of various factors including temperature dynamics and discharge rates

Progress

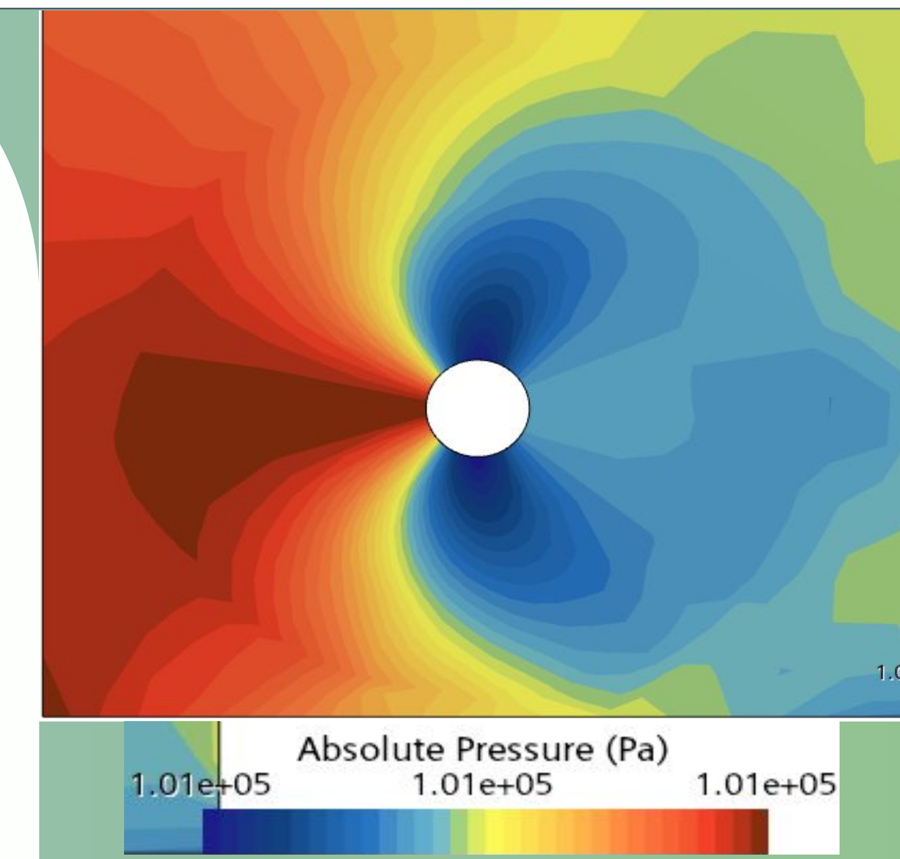
Highlights

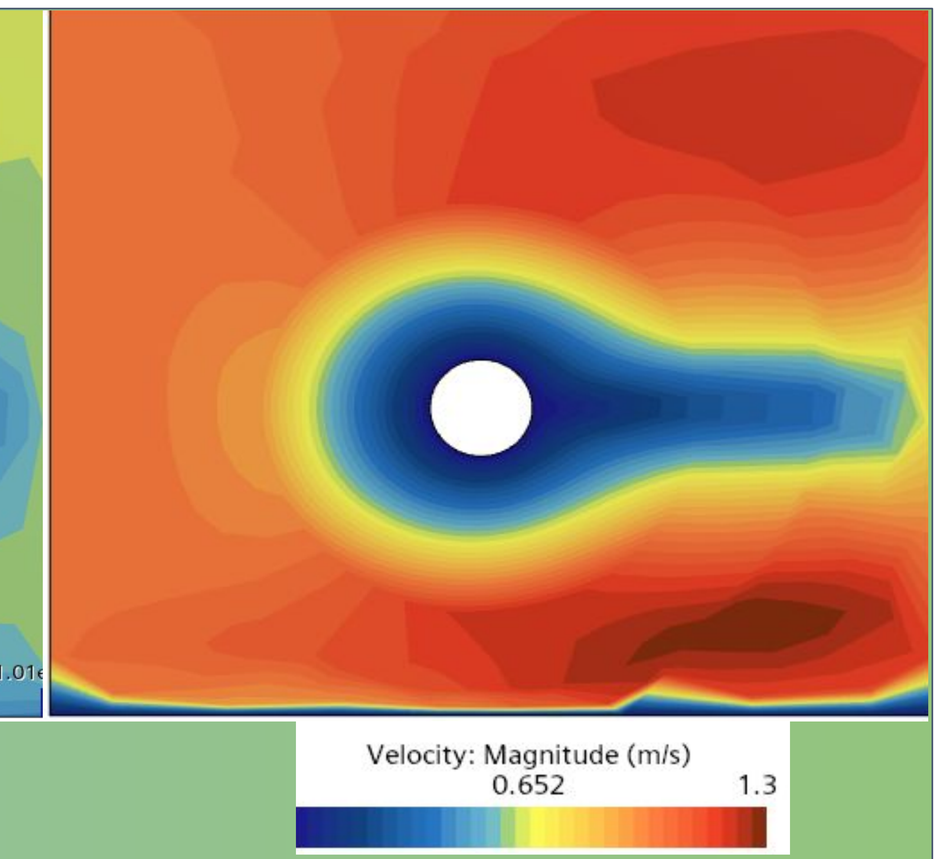
- Round extrusion on surface
  →Increases surface area for better cooling
  →Allows more space for more cells to be added generating more total battery capacity
- Battery cell configuration
  →Honeycomb configuration for better cooling and fitting more cells within the shell
- Directional intake/exit vents
  →Directs air to cool the cells and have a constant flow of air at all times
- Intake fan
  →Helps direct air intake airflow to the exit vents so that there is not a buildup of pressure within the battery shel
- Improved BMS (Battery Management System)
  →Better charging and power methods for better life battery capacity

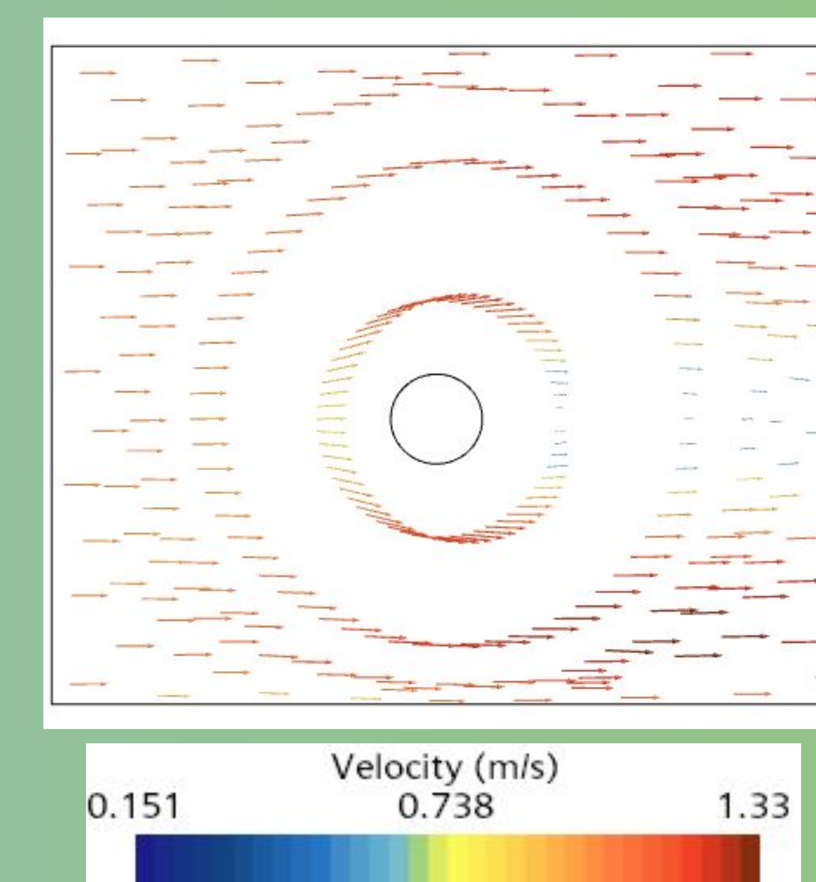


Analysis

- The analysis shows a simulation of a single battery cell encountering a 5 m/s air flow
- Temperature difference for a regular battery cell is cooled
  →Helps the battery have a stabilized temperature for optimal performance
- The velocity of the tail part of the air flow will then hit the battery behind it and cool it







Computational Fluid Dynamics (CFD) to represent air flowing through cylinder at 5 m/s

Looking Ahead

Proof of Concept

- Prototype E-Bike Battery via DIY kit
- Perform hand calculations & show adherence to simulation
- Identify & demonstrate real world tests

Future Improvements

- Optimize cooling configuration based on simulations through Heeds
- Explore different materials
- Develop improved heat sink

Societal & Environmental Impact

- Adherence to UL2271 standards for E-Bike batteries
- Reduce frequency of battery waste
- Mitigate pollution associated with battery production

Contact

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