San Jose State University
Mechanical Engineering Department

ME 195B Senior Design Project Summaries

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Battery Thermal Management Simulation using Passive Cooling Methods

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Faculty Advisor:
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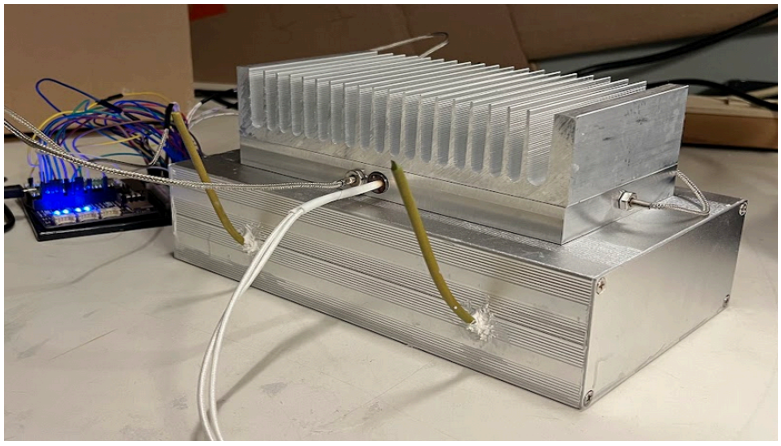

Project Objective:
The overarching goal of this project is to design a passive cooling system that can effectively cool a lithium-ion battery to manage thermal conditions. The specific objectives are as follows:

1. The first specific objective is to design a configuration that will make use of a heatsink, heatpipes, and phase change material (PCM).
2. The second specific objective is to come up with a method that simulates the heating of a lithium-ion battery under high load conditions.
3. The third specific objective is to create a data acquisition system to acquire temperature readings.
4. The fourth specific objective is to fabricate all mentioned components to test the passive cooling methods.

Significance:
The significance of this project is to effectively cool lithium-ion batteries to prevent dangerous conditions. This project promotes a more sustainable environment as passive cooling is much more energy efficient compared to active cooling.

Project Results:
1. Successfully designed a configuration using a heat sink, heat pipes and PCM.
2. Successfully came up with a method to simulate the heating of a battery using aluminum and a cartridge heater.
3. Successfully created a data acquisition system using a Raspberry Pi Pico board with thermocouples.
4. Successfully fabricated a cooling system and battery heating replication to run experiments.

Sponsors:
Dr. Vimal Viswanathan
Dr. Syed Zaidi

Design and Development of In-Hub Motors for the Spartan Racing Electric Car

Student Team Members:
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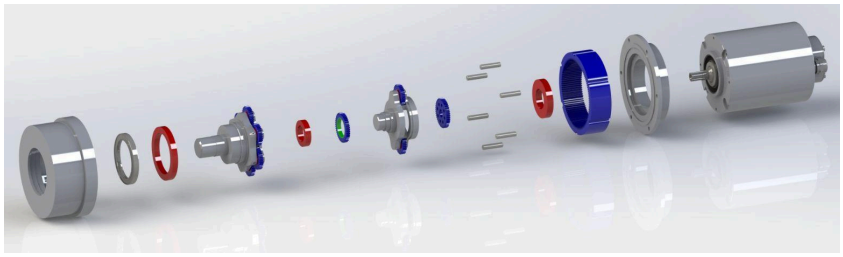
Faculty Advisor:
Dr. Vimal Viswanathan



Project Objectives:
Design a high-performance in-hub motor and gearbox assembly to enhance acceleration, handling, and competitiveness for Spartan Racing's Formula SAE Electric racecar.

1. Design and optimize a compact, lightweight planetary gearbox using theoretical analysis and simulations to achieve a sub-2-second 0–60 mph acceleration goal while compliant to FSAE rules.
2. Develop a functional prototype of the in-hub motor and gearbox assembly, integrating it with the vehicle's suspension upright for testing and validation.
3. Conduct experimental testing to validate the performance of the in-hub motor, measuring key metrics such as torque, acceleration, and durability under race-like conditions.

Significance:
This project promotes innovation in electric vehicle design, advancing engineering knowledge while contributing to sustainability and energy efficiency. By enabling faster, more agile electric racecars, it lays groundwork for future applications in consumer and commercial EV technology.

Project Results:

1. Developed a gear ratio tool and validated the design with CAD models and FEA simulations.
2. 3D-printed a gearbox prototype and ensured integration with the vehicle system.
3. Tested gearbox functionality with a brushless DC motor, completing gear rotation validation.
4. Demonstrated proof-of-concept functionality, setting the foundation for more extensive testing and refinement.

Sponsors:
- **Organizations:** Spartan Racing, Cadence Design Systems, Lucid Motors
- **Individuals:** Shinika Balasundar, Gabriella Khanitsky, and Dr. Vimal Viswanathan for guidance and mentorship.

Design and Prototyping of a Portable Teaching Demo System for Dynamics Instruction

Student Team Members:
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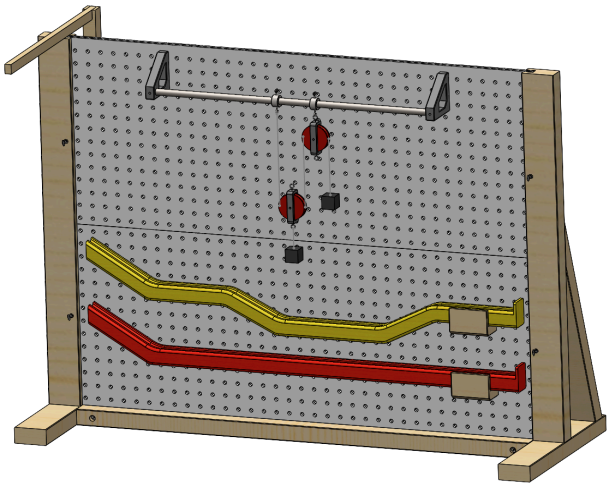
Faculty Advisor:
Prof. Viswanathan



Project Objectives:
The objective of this project is to design a teaching demonstration for physics and engineering teachers to help teach dynamics class. The following criteria was important to our demo:

1. The design must be modular and able to incorporate many experiments in one package.
2. The design must be cheap, easy to produce, durable and portable, while capable of conveying the relevant dynamic subjects in an easy to understand and entertaining manner.
3. The design will be under 40 lbs, under 5 minutes assembly time, and teach a minimum of 3 different dynamics subjects.

Significance:
Dynamics is difficult to grasp and understand without visual aids. Our hopes in designing this product to assist in teaching these concepts is to improve the base understanding of future students in said dynamics class to potentially improve their grades and consequently their passing and graduation rates. In addition, we hope it will make the subject much more fun and interesting thereby increasing students enjoyment for learning.

Project Results:

1. Designed and built a modular demo cable of 4 experiments teaching 4 different subjects.
2. The demo is highly portable being lightweight (<25lb) and can be set up in under 5 minutes.
3. The demo is disassemblable and reconfigurable. This makes it easy to upgrade, add new experiments, and be tucked away neatly when not in use.

Sponsors:
San Jose State University, Dr. Vimal Viswanathan

Passive Thermal Management of LEDs Used in Indoor Agriculture

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Faculty Advisor:
Dr. Vimal Viswanathan

Project Objectives:
The goal of this project has been to develop a completely passive thermal management system that can adequately cool LED panels commonly found in indoor agriculture.

1. When tackling this problem, we aimed to cool the surface temperature of the LED panel to around 40℃.
2. Our second objective was for the cost of the system to be under $500, provided by the Mechanical Engineering Department.
3. Our third objective was for the system weight to be under 25 lbs.

Significance:
The significance behind our project is that it allows us to reduce energy consumption, as well as cutting the cost of the bill. We also gain the ability to grow plants that are out of season at any time in a more cost effective manner, since LED panels are known to be much more effective than traditional lamps in indoor agriculture farms.

Project Results:
1. Our system cools the surface of the LED panel to 40℃-45℃.
2. The total cost of the project is $483.70.
3. The weight of our thermal management system and the panel is 17.7 lbs.
4. Our system provides a more uniform distribution of heat along the LED panel.

Sponsors:
Mechanical Engineering Department at SJSU

Portable Squeezing Device to Ease and Optimize the Use of an Eyedropper Bottle

Student Team Members:
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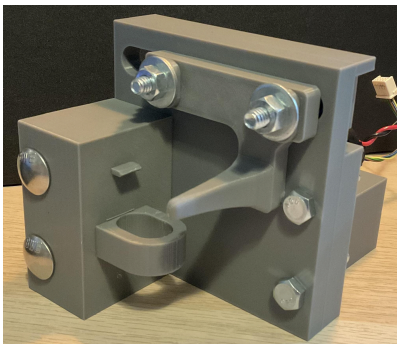
Faculty Advisor:
Dr. Vimal Viswanathan



Project Objectives:
The overarching goal of this project is to design an intuitive, affordable device that ensures accurate and sterile application of eye medication for elderly and visually impaired users. Specific objectives:

1. Develop a mechanism capable of consistently and precisely dispensing medication from a standard eyedropper bottle, regardless of the bottle size or content level.
2. Create and assemble a functional dispensing mechanism, integrating a proof of concept for the filter paper dispensing mechanism.
3. Conduct experimental trials to validate dosage accuracy, user-friendliness, and sterility of the device under simulated real-world conditions.

Significance:
This project addresses critical challenges in eye medication use, particularly for elderly and visually impaired individuals. Traditional eyedropper bottles often lead to inaccurate or missed doses and contamination risks, all of which compromise treatment effectiveness and patient safety. This project enhances accessibility to eye care by designing an intuitive, affordable device, ensuring users can apply medication accurately and hygienically without assistance. The inclusion of a biodegradable paper applicator system will maintain sterility while also being eco-friendly. Furthermore, this project will extend the doses given from a single eye dropper bottle, reducing the number of single-use plastics needed.

Project Results:

1. Developed a rack and pinion design that consistently dispenses a drop from almost all bottle sizes and volumes of liquid.
2. Created a working 3D printed prototype with Arduino controller.
3. Documented droplets over time as well as weight of the droplets to observe if consistent droplets were dispensed everytime.

Sponsor:
Drop Mate: Dr. Vikram Shankar