Department of Mechanical Engineering
College of Engineering

Presentations of

Senior Design Projects

10:00 AM - 3:30 PM
Monday, December 8, 2025
Student Union Theater (Section 1) or Industrial Studies Building IS 216 (Section 2)

Mechanical Engineering Department - Fall 2025 Senior Project Conference Schedule
December 8, 2025

TRACK 1: ME 195B-01 (Instructor: Dr. Vimal Viswanathan)
Location: Student Union (SU) Theater

Start Time	End Time	Team (sponsor in parantheses)	Members
10:00 AM	10:30 AM	Enhancement of a Power Wheelchair for Users and Caretakers (ASME)	Sairam Balakumar
			Vince Lakilak
			Thanh Ma
			Heriberto Perez
			Fernanda Tapia Marin
10:30 AM	11:00 AM	Extruder Design for Fiber Reinforced 3D Printing	Connor Jamison
			Mahadev Nair
			Kai Rehbinder
			Ethan Ross
			Charlie Warner
			Aitrieus Dominic Wright
11:00 AM	11:30 AM	ASME Human Powered Vehicle Trailer Design	Eric Funada
			Alonso Portillo Martnez
			Angel Rivera Calva
			Makaiah Tham
			Salvador Toribio Barrera
LUNCH BREAK - SHOW CASE SETUP			
1:30 PM	2:00 PM	Designing and Building a Polar Coordinate 3D Printer	Matthew Joseph Figueroa
			Marco Hollero
			Simon Hsueh
			Evan Peterson
			Evan Tran
2:00 PM	2:30 PM	Robotic Arm For University Rover Challenge (Robotics Club)	Giorgio Berrospi
			Brett Higginbotham
			Sreevatsava Kavuru
			Francisco Quiroz Coria
			Samuel Grayson Spangenberg
2:30 PM	3:00 PM	Design and fabrication of an eVTOL Aircraft for demonstration purposes	Eric Brighton
			Jesus Gomez Nava
			Calvin Kwok
			Leo Lebedenko
			Erick Quiroz
3:00 PM	3:30 PM	Restoration of Carrousel and Addition of Animatronic Penguins to a Christmas in the Park Display	Mark Bennett
			Derek Do
			Daniel Jimenez Hernandez
			Bradly Karr
			Zachary Mcgee
			Cesar Romero Callejas

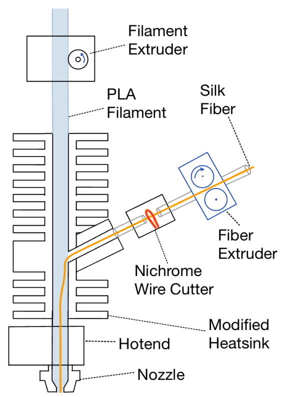
TRACK 2: ME 195B-02 (Instructor: Dr. Keith Yi)
Location: Industrial Studies Building (IS) 216

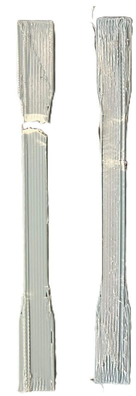
Start Time	End Time	Team	Members
10:00 AM	10:30 AM	Design and Development of the Universal Assistive Bathing Technology	Kevin Chow
			Monica Corona
			Mel Marc Angelo Felipe
			Colin Fung
			Estevan Gonzalez
			Zen Wynn
10:30 AM	11:00 AM	Designing an electronic cooling chassis to investigate cooling methods	Diego Baca
			Mark Blackburn
			Robin Kirschner
			Fabian Magallan Becera
			Genaro Rojo-Marquez
11:00 AM	11:30 AM	Design and Prototyping of a test bench for the InfiniGear (CVT) Transmission	Ales Branik
			Nelson Cabutotan
			Bach Ho
			Janelle Macaya
			Richard Sanchez
			John Steinbach
LUNCH BREAK - SHOW CASE SETUP			
1:30 PM	2:00 PM	Improving the Experience of Recreational Mini-Basketball Through Mechanical and Mechatronics Design	Ibrahim Ashraff
			Nathan Biggs
			Angelo Ferrer
			Omar Kaddoura
			Sami Lazkani
			Mattheus Nguyen
2:00 PM	2:30 PM	Design & Evaluation of Drop Test Packaging Methodology for Electronics	Kyle Chan
			Ismael Khan
			Vincent Lam
			Vanessa Le
2:30 PM	3:00 PM	Reducing Energy Costs Using Thermal Mass in Refrigerator	Matthew Manuel
			Brent Robert Marin
			Caleb Mok
			Isabel Price
			Kalino Ruiz

Extruder Design for Fiber Reinforced 3D Printing

Student Team Members:
Connor Jamison
Mahadev Nair
Kai Rehbinder
Ethan Ross
Charlie Warner
Aitrieus Wright

Faculty Advisor:
Prof. Vimal Viswanathan





Project Objectives:
The overarching goal of this project is to design a 3D printer extruder that linearly embeds a continuous natural fiber into the molten polymer bead. The specific objectives are as follows:

1. The extruder should be capable of successfully producing prints that enhance its mechanical properties—particularly achieving at least a 10% increase in tensile strength–when compared to a control print made with non-reinforced PLA filament.
2. The extruder should integrate a reliable fiber-cutting feature and accompanying fiber-handling path that can be packaged within the printer's toolhead area without obstructing normal printing functions, travel, or homing sequences.
3. The overall system should include proper electronic and software integration to facilitate the new feeding, cutting, and printing operations in a reliable and repeatable manner which minimizes the amount of manual inputs.

Significance:
Integrating natural fibers into 3D printer filament promotes sustainable, biodegradable manufacturing and helps reduce plastic waste in toy production and additive manufacturing. This approach also demonstrates a modular strategy for enhancing 3D printers, valuable for research and education.

Project Results:

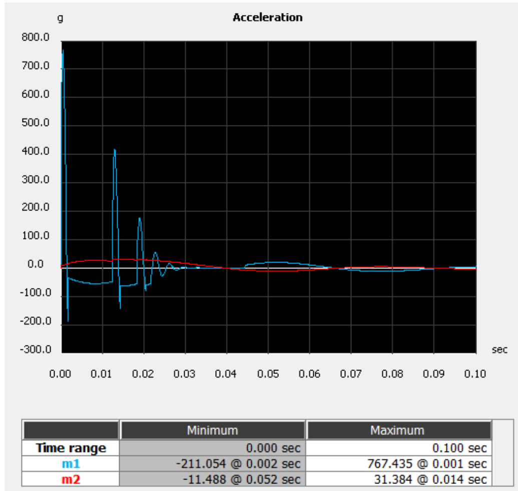
1. Achieved a 19.6% average tensile strength increase in ASTM D638 samples compared to non-reinforced PLA controls, nearly doubling the original 10% goal.
2. Developed a passive thermal nichrome wire cutter that reliably severed the fiber on every cycle, and achieved automatic refeeding and reintegration of the loose fiber end.
3. Achieved fully automated fiber control by implementing Klipper and custom Python-modified G-code. The printer reliably performed all cut, refeed, and reintegrate cycles triggered by Z-hops, including automatically recapturing the loose fiber end and resuming reinforced extrusion without user intervention.

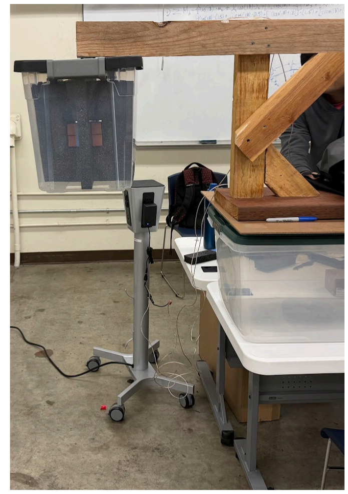
Sponsors:
This project was supported by Dr. Vimal Viswanathan's research fund through the Mechanical Engineering Department. Special thanks to DEXMAT, Dr. Yanika Schneider, Viswanath Aditham, Allen Siaotong, Vinh-Doan Thoi, and Lydie Rashel for their help, and to our co-advisor, Dr. Samuel Kidane, for his expertise.

Drop Test Packaging Methodology for Electronics

Student Team Members:
Vincent Lam
Kyle Chan
Ismael Khan
Vanessa Le

Faculty Advisor:
Prof. Keith Yi





Project Objectives:

The overarching goal of this project is to create a design methodology which determines the optimal amount of foam to use in a package in order to protect sensitive products such as electronics from a four foot drop. The specific objectives are as follows:

1. Design a system that maintains a maximum experienced acceleration limit of 40 G's for electronics being packaged
    a. Perform material analysis of foam testing
    b. Simulate system as a 2 DOF spring mass system
    c. Iterate through varying contact areas and foam thicknesses for input variable K
2. Build a drop tester that performs consistent level package release
3. Build a model based on simulation results and test for design viability regarding 40 G acceleration limit from 48 inch drop height

Significance:

Creating a methodology to design packaging layout aids vendors in minimizing packaging material used to protect their products while keeping the safety factor during shipment and handling. By applying a structured package-design approach, vendors can reduce product damage in transit, resulting in less manufacturing materials used and decreased operational costs for returns and replacements. Overall, this project benefits both the vendors and the environment.

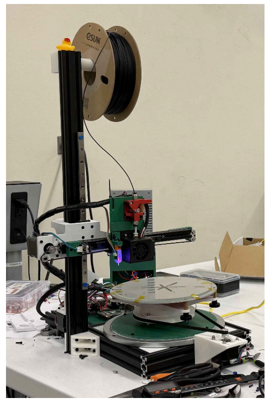
Project Results:

1. Created a spreadsheet based on foam material testing data to semi-automate K calculations for the three drop test orientations, which was used in tandem with Luxcalc to model the system's acceleration using a 2 DOF spring mass system.
2. Verification of the LuxCalc simulation with the drop stand was somewhat successful. Layouts with an additional 14 G's of leeway were successful. Otherwise, the impact indicator activated during tests that Luxcalc simulations predicted would pass. Modifications to the foam Young's modulus or simulation modal damping may be necessary for more accurate predictions.
3. A more accurate simulation program would be needed for predictable results at the cost of longer simulation time, and utilizing an accelerometer rather than an impact indicator.

Designing and Building a Polar-Coordinate 3D Printer

Student Team Members:
Matthew Joseph Figueroa
Marco Hollero
Simon Hsueh
Evan Peterson
Evan Tran

Faculty Advisor:
Dr. Vimal Viswanathan



Project Objectives:

The overarching goal of this project is to design a 3D printer that uses the polar coordinate system over the conventional Cartesian coordinate system. Other goals include creating a printer that costs less than the average Cartesian system 3D printer while being mechanically simpler and smaller in size. To meet these goals, our first objective is to match the print repeatability of the average consumer 3D printer, which is +/- 0.10 mm. Following that, our second objective is to keep the budget of the printer below $700 and the volume of the printer under 300x400x400 mm. Our last objective is to print a set of 10 disks, 3 cm in diameter and 1 cm in height, with a tolerance of +/- 0.10 mm.

Significance:

Polar coordinate-based 3D printers are rare on the consumer market, along with any open source support. This makes it challenging to produce an effective printer that can compete with conventional Cartesian coordinate printers. However, this project would give significant insight into how polar coordinate 3D printers can be easily manufactured with a low cost while also having other potential benefits like lower energy costs due to the use of fewer motors, cheaper manufacturing from hardware simplification, and the capability to print complex cylindrical shapes. With a more affordable entry-level 3D printer, hobbyists and academic institutions can invest in our printers as beginners in the field while exploring the unique benefits of printing in the polar coordinate system. Additionally, with the continuous motion of the rotating bed, prints can be created with less abrupt stops for the hot end, saving energy and time. Lastly, the project addresses the issues of previous polar coordinate designs in which print resolution decreased further from the origin and the lack of a heated bed.

Project Results:

1. The printer was able to achieve a 1-layer print(0.2mm); however, the group is working on improving its dimensional accuracy.
2. We successfully kept the project budget under $700 (specifically $676.93), excluding reordered parts due to user error.
3. The printer was able to print multiple layers and a successful test print was created.

Sponsors:

Funding for the project is sponsored by the San Jose Mechanical Engineering Department, with substantial help and assistance from Administrative Analyst Lydie Rashel.

Designing and Fabrication of an eVTOL for Demonstration

Student Team Members:
Eric Brighton
Jesus Gomez-Nava
Calvin Kwok
Leo Lebedenko
Erick Quiroz

Faculty Advisor:
Dr. Vimal Viswanathan

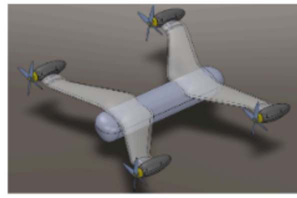


Figure 1 – Air Frame (Solidworks)

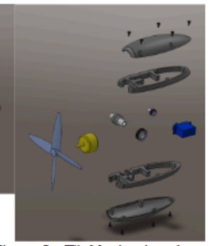


Figure 3 - Tilt Mechanism Assembly

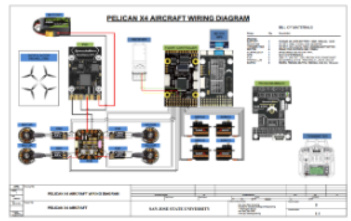


Figure 2 - Controls Wiring Diagram

Project Objectives:

The central objective of this project was to design and produce a small-scale eVTOL capable of achieving stable flight. To accomplish this goal, we established these objectives:

1. Demonstrate a stable hover for at least ten seconds.
2. Design and analyze an airframe capable of supporting our propulsion system.
3. Integrate all major electronics into a four-motor propulsion system capable of achieving flight.
4. Integrate directional actuation using servos to achieve a tilt mechanism system.

Significance:

As a technology, eVTOL is growing in worldwide importance and usefulness. Many automated applications utilizing small-scale aircraft, such as eVTOLs, stem from fields in the most lucrative and innovative industries. Through this project, we aim to contribute to this growing phenomenon.

Project Results:

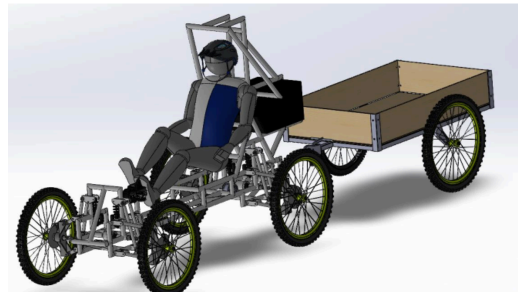
1. Designed and analyzed an airframe capable of supporting a four-motor propulsion system using a 3D-printed airframe.
2. Integrated all major electronics into a propulsion system and a tilt-mechanism system.
3. Demonstrated stable flight for at least ten seconds with our designed airframe and propulsion system.
4. Developed a tilt-mechanism to allow for directional actuation using servos controlled by the flight controller.

Acknowledgments:

- **Dr. Vimal Viswanathan**
- **Dr. Paul Kutler**
- **Dr. Ernest Thurlow**

Design and Fabrication of Trailer and Hitch System for the ASME eHPV Competition

Student Team Members:
Eric Funada
Alonso Portillo
Angel Rivera
Makaiah Tham
Salvador Toribio



Faculty Advisor:
Dr. Vimal Viswanathan

Project Objectives:
The goal of this project is to design and prototype a lightweight trailer and hitch system that safely carries a parcel through the ASME eHPV obstacle course.

1. Design a trailer frame, hitch, and torsion suspension that meets ASME load and size requirements.
2. Analyze the frame, hitch, and torsion arm using hand calculations and FEA to ensure all parts meet safety factors.
3. Prototype the hitch and torsion suspension using materials and tools available in the student shop.
4. Reduce cost through material optimization and reuse to meet the target budget of ≤ $600.

Significance:
This project enhances safe and sustainable transportation by providing an affordable trailer design that expands the load-carrying capability of human-powered and electric vehicles.

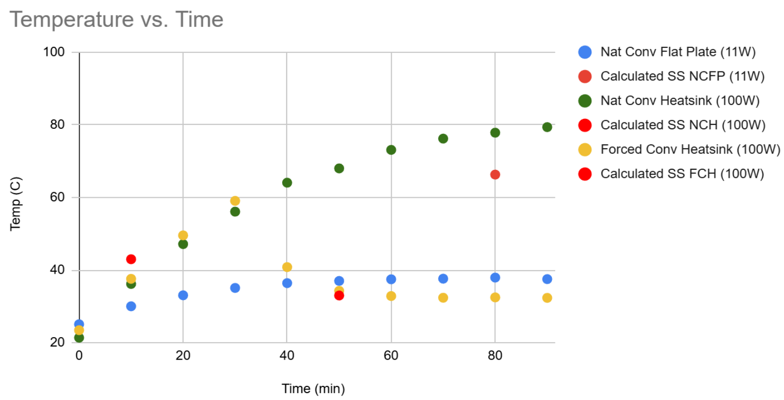
Project Results:

1. Completed CAD design of the trailer and hitch meeting ASME load and size requirements.
2. Developed torsion suspension using aluminum arms and TPU inserts for improved compliance.
3. Verified performance through hand calculations and FEA on the frame, hitch, and suspension.
4. Performed cost analysis and identified material optimizations to meet the $600 budget goal.

Sponsors: SJSU ASME – Provided project sponsorship, materials support, and access to past components.
Vinh-Doan Thoi – Assisted with manufacturing, fabrication, and advice of trailer components.

Designing an Electronic Cooling Chassis to Investigate Cooling Methods

Student Team Members:
Diego Baca
Mark Blackburn
Robin Kirschner
Fabian Magallan
Genaro Rojo-Marquez
Faculty Advisor:
Prof. Keith Yi



Project Objectives:
The overarching goal of this project is to design a chassis that effectively dissipates heat across a variety of different cases that we test in our experiments. The specific objectives are as follows:

1. Create a design that can be used to simulate an electronic component to investigate natural convection via an aluminum plate, natural convection via a heat sink, and forced convection as methods of cooling
2. Research a variety of materials that could reasonably be used within electronics to understand which ones are most effective in regard to their heat conduction and insulating properties, while being cost-effective and easy to work with.
3. Verify that our designed chassis can dissipate heat in such a way that its internal and surface temperatures are cooled enough to avoid exceeding our determined thresholds.

Significance:
Overheating is a major source of failures in electronics, making effective and efficient cooling a crucial component in designing reliable electronic devices. Since our project primarily focuses on different forms of cooling that are easily applicable, the research is applicable to a wide range of devices.

Project Results:

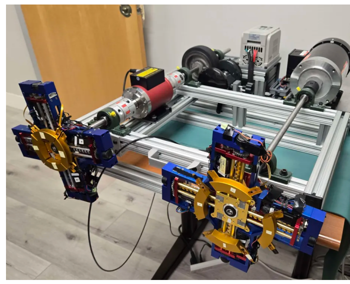
1. Objective one was mostly met as we built an enclosure that simulated electronic heat, allowing us to test for natural and forced convection cases, though we were not capable of measuring conduction cooling specifically.
2. We successfully found appropriate materials for the design, although manufacturing complications forced us to use slightly suboptimal materials for the prototype.
3. The forced convection iteration aligned really well with our theoretical calculations. However, the natural convection with a heatsink deviated from our theoretical values, producing inaccurate results. The first case, natural convection of an aluminum plate, was quite conservative as the plate ran cooler at a given wattage.

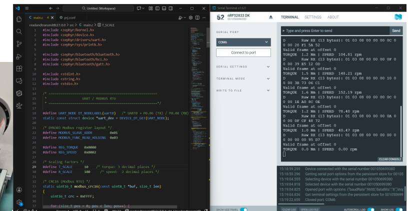
Sponsors:
San Jose State University Department of Mechanical Engineering

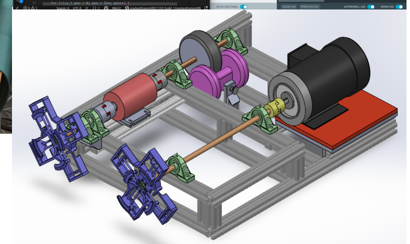
Design and Prototyping of a Test Bench for the InfiniGear (CVT) Transmission

Student Team Members:
Ales Branik
Nelson Cabutotan
Bach Ho
Janelle Macaya
Richard Sanchez
John Steinbach

Faculty Advisor:
Prof. Keith Yi







Project Objectives:
The overarching goal of this project was to design and develop a test bench to run with Sunman Engineering's InfiniGear Continuously Variable Transmission(CVT).

1. The first objective was to create a frame such that the mechanical and electronic components could be attached and run with minimal deflection.
2. The second objective was to be able to read the torque and speed parameters from the torque sensor and transmit the parsed data via bluetooth.
3. The third objective of this project was to attach a loading mechanism to simulate a load on the driven side of the transmission.

Significance:
The InfiniGear Continuously Variable Transmission is an assembly that reduces the amount of components of a traditional CVT. Sunman Engineering aims to utilize their technology and methodology within the world of powersports. In order to aid their efforts, the InfiniGear SJSU team has developed a test bench to bring them closer to their goals.

Project Results:

1. The final frame design of the test bench is able to hold all components modularly and with a factor of safety of 2 - 3.
2. Utilizing the Nordic Development Board (NRF52833DK), the speed and torque data was extracted via RS485 communication and was able to be transmitted via bluetooth to the NRF Connect App on a handphone.
3. When applying a load with the magnetic bike trainer pressing against the wheel, we were able to see a change of +- 0.6 Nm.
4. As speed increased, so did the amount of torque read by the torque sensor.

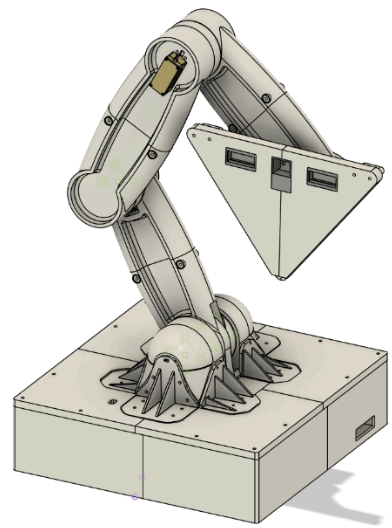
Sponsors:
Special Thanks: Allen Nejah and Neelima Surendran - SunMan Engineering

Improving the Experience of Recreational Mini-Basketball Through Mechanical and Mechatronics Design

Student Team Members:
Ibrahim Ashraff
Nathan Biggs
Angelo Ferrer
Omar Kaddoura
Sami Lazkani
Mattheus Nguyen

Faculty Advisor:
Prof. Keith Yi

Technical Advisor:
Prof. Ananda Mysore



Project Objectives:
Design and create a prototype for a mini-basketball hoop arm that is able to track shot attempts, makes, and time user attempts. This helps to create a more interesting and interactive experience when playing mini-basketball.

1. Provide real-time feedback on shot attempts and accuracy.
2. Introduce dynamic movement to the mini-hoop arm, making the activity more challenging.
3. Utilize a quick and easy setup procedure.

Significance:
This project aims to benefit society by improving upon existing technology and doing so at a cheaper price. Current market products do not include the dynamic movement that our system provides. Additionally, when compared to our product, other market products are more expensive to purchase.

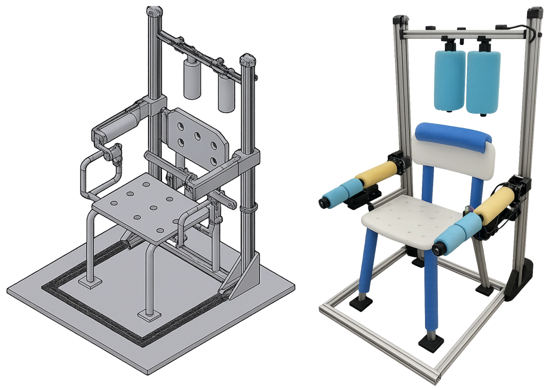
Project Results:

1. Real-time feedback was achieved by using two 4-digit 7-segment displays, a camera module, and break-beam sensors. These electronics track the ball as it reaches the hoop, determine if a shot has been made or not, and provide feedback to the user through the displays.
2. By integrating four 270-degree servos with different gear ratios at different locations within the assembly a smooth non-simultaneous motion was achieved without sacrificing structural integrity.
3. By using the Raspberry Pi 4 and a rocker switch the setup of the project is relatively simple as it will start the game and loop it while the switch is enabled and pause it once it is switched to the off position.
4. A result that was unplanned for was the time between movements not being counted by the code which allows more time for the player to focus on their shots than time trying to get the ball back and attempt another shot.

Design and Development of the Universal Assistive Bathing Device

Student Team Members:
Kevin Chow
Monica Corona
Mel Marc Felipe
Colin Fung
Estevan Gonzalez
Zen Wynn

Faculty Advisor:
Prof. Keith Yi



Project Objectives:
The overarching goal of this project is to design an assistive bathing device that facilitates the bathing process for the elderly and Individuals with limited mobility. The specific objectives are as follows:

1. Develop a safe semi-autonomous bathing device that implements mechanical, thermal/fluid, and mechatronics subsystems to deliver a complete wash cycle efficiently and reliably with minimal user interaction.
2. Integrate automated scrubbing, soap dispensing, and rinsing functions to enhance user independence and reduce caregiver involvement
3. Design for safety, accessibility, and fit for standard showers

Significance:
As a team, we believe everyone deserves independence, especially when it comes to bathing. We do not view this project as a requirement, but rather as an opportunity to create something for the benefit of the public. This project is meaningful to us because it brings us one step closer to creating a safe, accessible solution for those who need it.

Project Results:

1. We created a stable bathing chair system that stayed secure during movement tests and kept users properly supported throughout the wash cycle.
2. We integrated real-time controls for water temperature, scrubbing intensity, and soap flow, allowing users to customize their wash cycle to their comfort.
3. Our prototype consistently delivered water, soap, and scrubbing. Minimal user involvement needed.
4. Unexpectedly, our testing showed that even small automation features significantly reduced user effort, pointing to strong potential for real-world impact.

Sponsors:
Dr. Raymond Yee

Assistive Bathing Device
ABD

Restoration of a Christmas in the Park Carousel and Addition of Animatronic Penguins

Student Team Members:
Bradly Karr, Cesar Jair Romero Callejas, Daniel Jimenez Hernandez, Derek Do, Mark Bennett, Zachary McGee

Faculty Advisor:
Prof. Dr. Vimal K. Viswanathan

Project Objectives:
The goal of this project was to rebuild and modernize the Parachuting Penguins display so it operates reliably and is paired with animatronic models.

1. Design two functional animatronic penguins with different motions such as flapping arms, head turning, and leg movement mechanisms using servo motors driven by gear systems with smooth motion.
2. Fabricate two fully assembled animatronic penguins with housed mechanisms that fit within the epoxy penguins shells.
3. Test each mechanism for durability and smooth operation over continuous cycles to make sure no mechanical issues arise.

Significance:
Restoring this display brings back a once loved, nostalgic attraction to Christmas in the Park, improving community experience and preserving a piece of local holiday history to over 700,000 annual visitors.

Project Results:

1. Completed a full mechanical design for the flapping mechanism and arm movement paired with leg motion.
2. Built two operational animatronic penguins and installed a housing compartment with shafts, bearings, and moving linkages.
3. Completed functional testing of servo, linkage, and gear movements and confirmed a reliable continuous safe operation.
4. Developed a stable plaster reinforced internal mounting system to secure the housing compartment in the penguins shell.

Sponsors:
Christmas in the Park staff, Keith Peffer (Technical Lead), Jennifer (Creative Lead)

“Enhancement of a Power Wheelchair for Users and Caretakers”

Student Team Members:
Sairam Balakumar
Vince Lakilak
Thanh Ma
Heriberto Perez
Fernanda Tapia Marin

Faculty Advisor:
Dr. Vimal Viswanathan

Project Objectives:
The overall goal for this project is to redesign an old wheelchair that provides users with a more comfortable and independent experience than before. The specific objectives are as follows:

1. Implement a new seat to increase comfort and reduce the weight of the wheelchair.
2. Increase the reach around the chair for an individual user.
3. Improve upon user claims of weak brakes.
4. Improve user accessibility by reducing the distance between key features of the wheelchair and the user as well as reimagining existing features.

Significance:
The new chair enhances maneuverability, ergonomics, and user autonomy for wheelchair operators through engineering-led redesign and integration of modernized subsystems, improving accessibility and user quality of life.

Project Results:

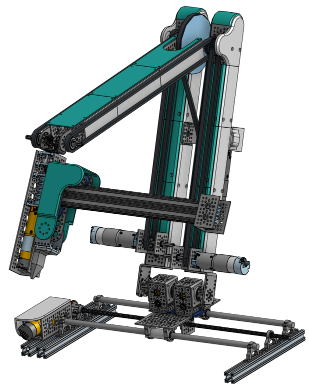
1. A repurposed flexible and breathable office chair that increased the comfort and reduced the weight of the chair overall.
2. An easy access swivel platform that rotates 90 degrees left and right and also allows for the chair to be removed.
3. Brakes were found to be operable, so emergency disk brakes were installed.
4. A charging port relocation to the side of the chair, a storage area built into the chair, and a redesign of the original control module to be more inclusive of ability as well as customizable.

Sponsors:
San Jose State University’s American Society of Mechanical Engineers

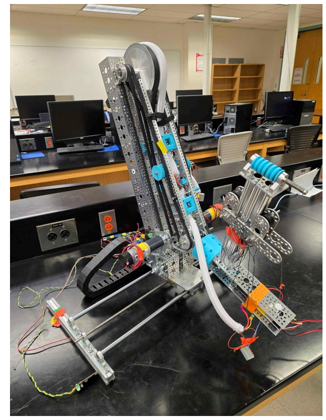
URC Rover Arm

Student Team Members:
Samuel Grayson Spangenberg
Brett Higginbotham
Sreevatsava Kavuru
Francisco Quiroz Coria
Giorgio Berrospi

Faculty Advisor:
Prof. Vimal Viswanathan



(Figure 1 CAD model of the Arm)



(Figure 2 Assembled 6 DOF Arm)

Project Objectives:
The overarching goal of this project is to design a high-precision 6-DOF robotic arm capable of performing complex manipulation tasks for the University Rover challenge.

1. Develop a complete mechanical design that meets torque, reach, and weight constraints, validated through CAD modeling and FEA showing >95% safety factor compliance across all critical joints.
2. Fabricate and assemble all arm components which includes worm-gear joints, linkages, and end-effector achieving assembly tolerances within ±0.5 mm and full mechanical mobility across all 6 DOFs.
3. Test the robotic arm to verify it can accurately manipulate 5 kg objects, perform required URC tasks, and achieve repeatability within ±3 mm during motion-tracking evaluation.

Significance:
This project serves as a sample for a practical, student-built robotics system. While supporting SJSU's participation in the University Rover Challenge. This project also provides hands-on experience in mechanical design, analysis and integration. This alone prepares students for careers in robotics and automation.

Project Results:

1. We successfully developed a mechanical design that met the torque, reach and weight requirements and validated the design. (Figure 1)
2. Successfully completed, assembled, and fabricated a robotic arm as per our design that met our desired level of craftsmanship.
3. We did not successfully test the robotic arm as while it met all requirements and our post assembly testing did show that the FEA analysis was accurate the integration between our project and the SJSU Robotics electrical and controls team's were not able to be completed so as to perform testing

Sponsors:
SJSU Robotics
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Reducing Energy Costs Using Thermal Mass in Refrigerator

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Project Objectives:
We implemented a passive cycle assembly to a refrigerator that blows air over a thermal mass to maintain a safe internal temperature during the peak utility rates, reducing electricity cost, and a microcontroller to control the active and passive modes.

1. Utilize thermal storage to shift load away from peak time of use duration while maintaining safe refrigeration temperatures
2. Evaluate performance through energy consumption of both active and passive cooling cycles
3. Calculate money saved through minimizing energy usage during peak hours
4. Evaluate the air velocity profile of the passive cooling cycle

Significance:
This smart refrigerator improves environmental sustainability through reducing electricity load and resulting carbon emissions during peak utility rate periods.

Project Results:
1. The fan successfully cycles on when the temperature is below 40°F until the chamber temperature lowers to 37°F.
2. The expected energy savings are 24.0 kWh/year based on initial tests.
3. The resulting cost savings are $12.60 per year.
4. The velocity profile was determined using an anemometer with an average velocity of 1.14 m/s.

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