ALFONSO RUIZ

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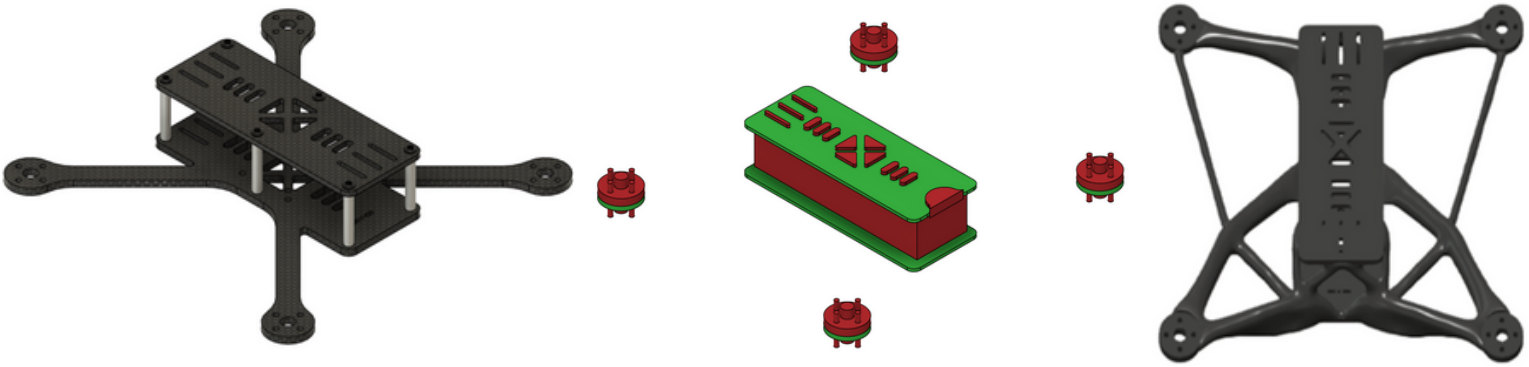
GENERATIVE DESIGN - DESIGN FOR 3D ENGRG. AND ADDITIVE MANUFACTURING CLASS



What?

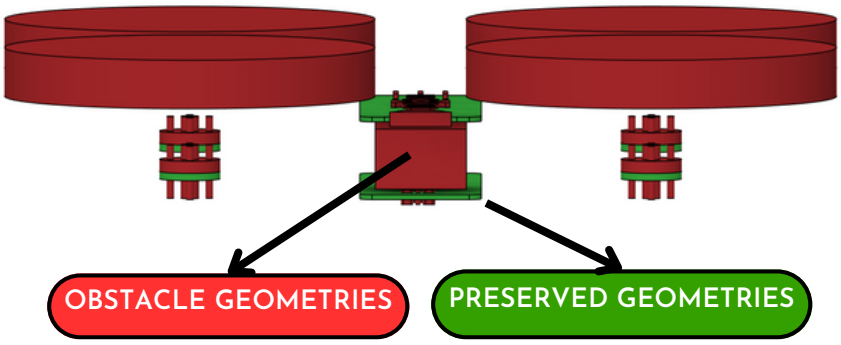
- Redesigned a quadcopter drone frame using **generative design**.
- Aimed to replace a **177g carbon fiber** assembly with a lightweight, additively manufactured single part.
- Aimed to **minimize mass** while maintaining a **safety factor of 2.**

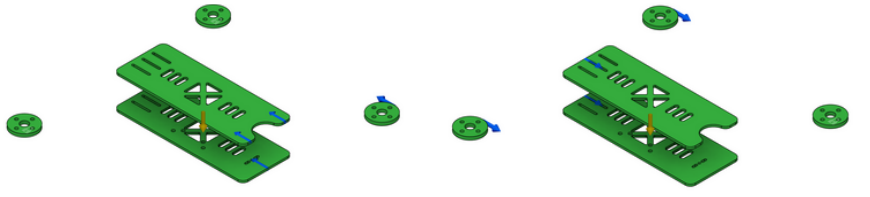
How?

- Utilized **Fusion 360** to define obstacles and preserve geometries.
- Calculated and applied complex loads including **thrust forces**, **torques**, and **impact forces**.
- **Simulated manufacturing** for an EOS P 396 machine using PA 12 Carbon Fiber.

Results

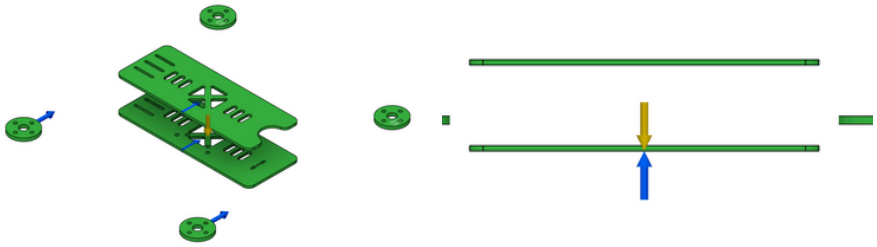
- Reduced frame mass from **177g to 86g (51% reduction).**
- Achieved a safety factor of **8.29**, exceeding requirements.
- Maintained structural rigidity with only **0.8 mm displacement.**





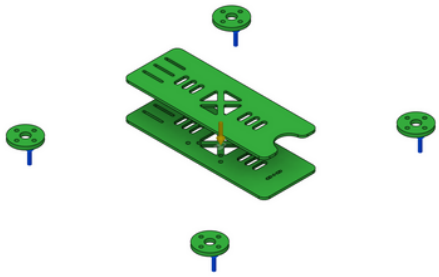
Front Impact

Back Impact

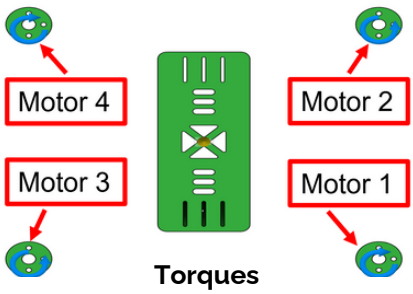


Side Impacts

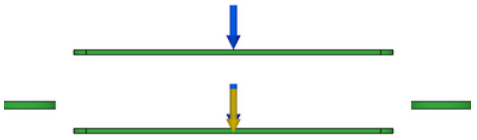
Botttom Impact - Hard Landing



Thrust Forces



Torques



Component Weight

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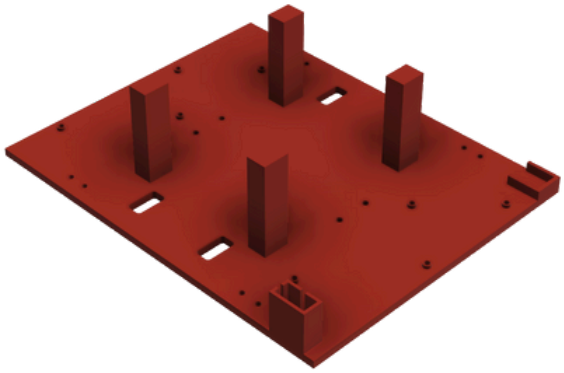
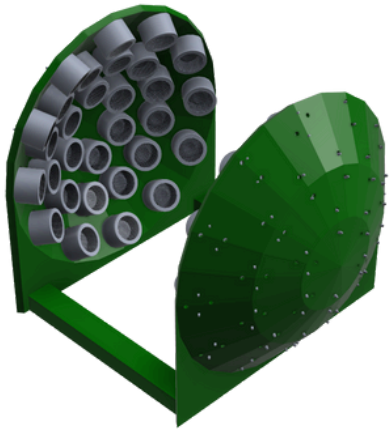
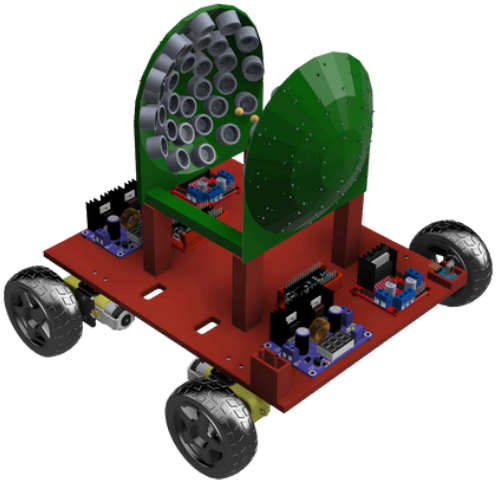
ULTRASONIC LEVITATION TRANSPORT - SPECIAL TOPICS IN ELECT- MECH CLASS







What?

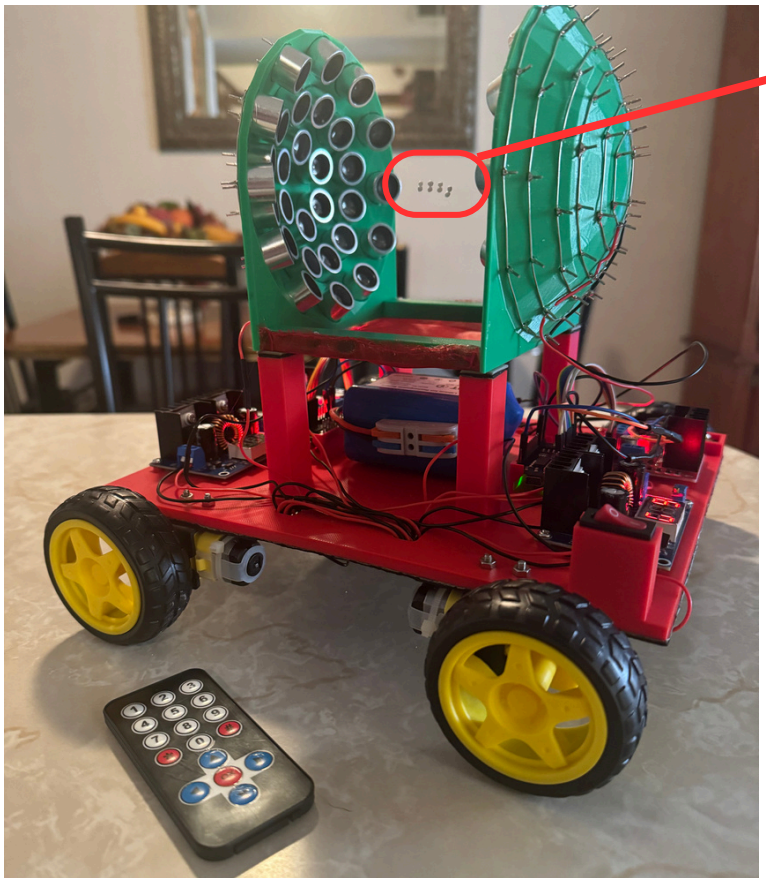
- Created a transport system using **ultrasonic levitation**.
- Aimed to **move small particles of styrofoam** without any physical contact.
- Focused on demonstrating non-contact object handling.

How?

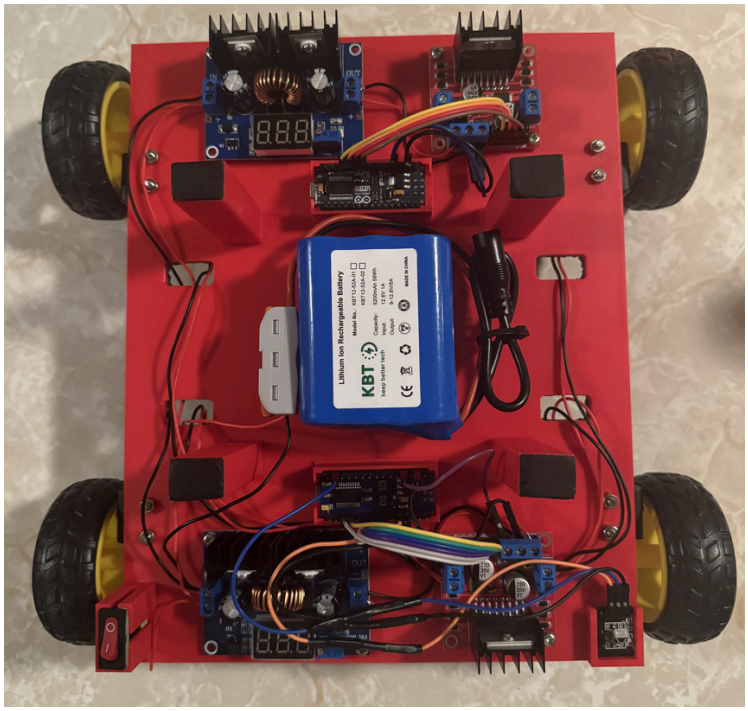
- Utilized Arduino Nanos to control the systems.
- Integrated transducers, buck converters, H-bridges, IR sensor, and motors for levitation and transportation.
- Used **Fusion 360** to design and **3D-print** a custom base for stability and transportation of the systems.

Results

- Achieved stable levitation of small particles of styrofoam using ultrasonic waves.
- Enabled precise remote control for object movement.
- Demonstrated effective non-contact transport capabilities.



Ultrasonic Levitation



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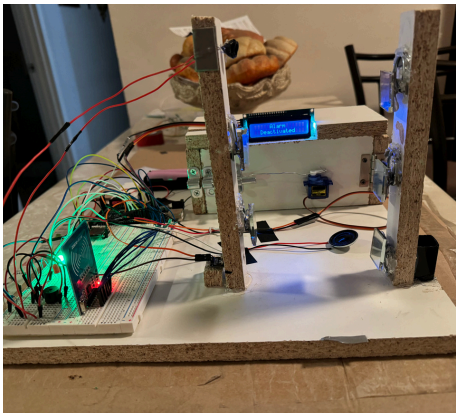
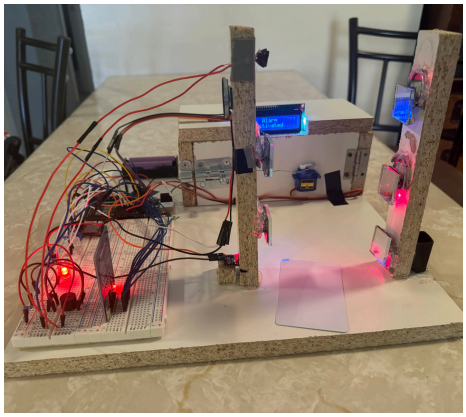
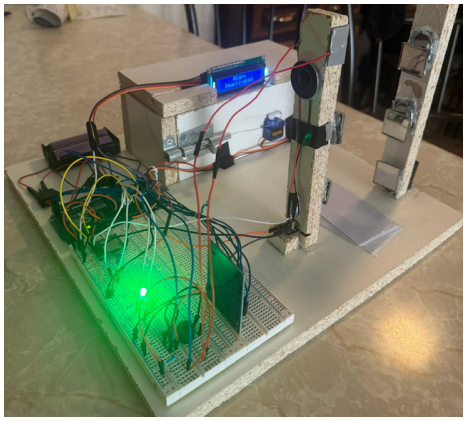
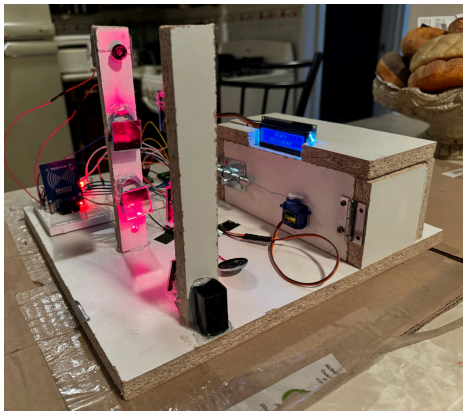
LASER ALARM SYSTEM - MECHATRONICS CLASS

What?

- Designed a **Laser Security Alarm System** for enhanced vault security.
- Aimed to detect unauthorized access and secure valuable assets.

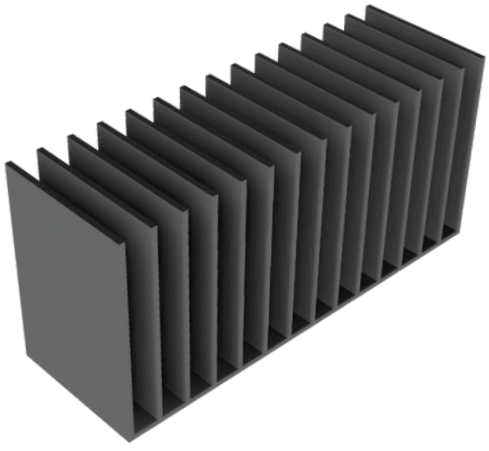
How?

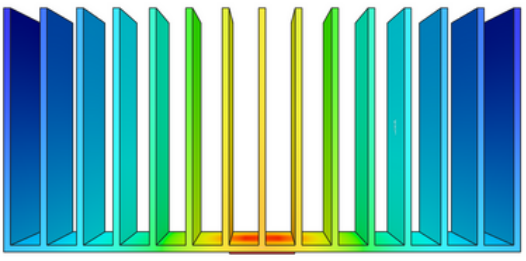
- Integrated a laser with **strategically placed mirrors** to form a detection grid.
- Utilized mirrors, alarms, laser, servo, photoresistor, LCD display, and **RFID and I2C technology**.
- Connected **audiovisual components** to trigger an alarm when the laser beam was interrupted.
- Implemented an **RFID sensor** for key card access for authorized entry.

Results

- Achieved accurate detection of obstacles breaking the laser grid.
- Successfully integrated RFID access control for user convenience.
- Delivered a reliable, effective security solution for sensitive areas.

HEAT SINK DESIGN - HEAT TRANSFER CLASS





What?

- Design a heat sink that lowers a simulating CPU surface by **22±1°C.**
- Performed a **natural convection-cooled thermal simulation**.

How?

- Used **Fusion 360** to design the heat sink and perform the thermal simulations.
- Used **heat transfer formulas** to determine characteristics.

Results

- The design fulfilled its purpose by reducing the temperature of the surface from **85°C to 64.3°C.**