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Portfolio
Winter 2025



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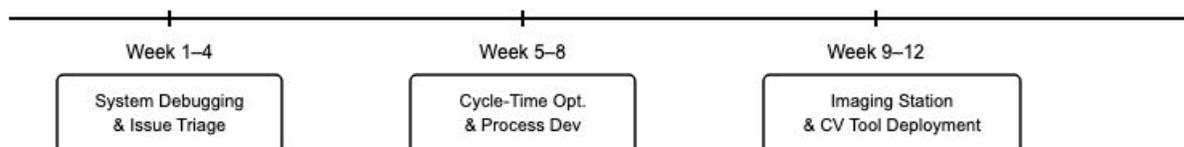
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SUMMER 2025 — HALO INDUSTRIES INTERNSHIP



Halo Industries develops next-generation technology for silicon carbide ingot wafering. As a summer mechanical engineering intern at Halo Industries, I worked to develop and fine-tune a silicon carbide wafer cleaning process.

My role focused on improving system reliability, debugging cross-disciplinary issues, and accelerating production throughput through enhanced motion planning, pneumatics sequencing, and automated inspection tools.

I evaluated end-to-end machine sequences—robotic motion, pneumatic actuation, and safety features—and redesigned the control logic to eliminate unnecessary delays, improve actuation timing, and enhance cleaning efficacy. After resolving major machine issues and implementing these optimization techniques, machine cycle time was reduced by ~60%, significantly improving operational throughput.

Over 80 issues were triaged and addressed throughout the internship, spanning robot kinematics and motion smoothing, sensor and HMI communication, and valve actuation reliability.

Wafer imaging also played a critical role in verifying cleanliness post-process. To support rapid iteration as the cleaning process evolved, I constructed a wafer imaging station featuring HEPA filtration to minimize airborne contamination, shadow-free lighting, compressed-air particulate removal, and a fixed camera support structure.

Finally, I developed simple computer vision software to analyze imaged wafers. This complemented manual inspection and provided a quantitative ground truth for wafer cleanliness. Core functionality included background subtraction, morphology analysis, and pixel-level cleanliness scoring.

/w The Terrain Table —self-leveling outdoor surface



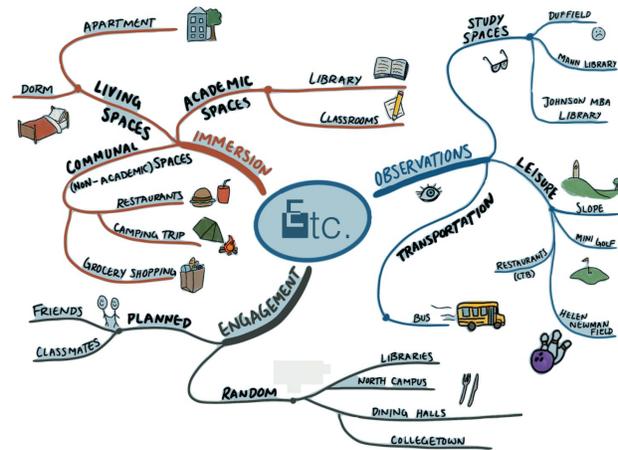
In a class project for Innovative Product Design via Digital Manufacturing, my team and I developed a product meant to improve the lives of university students. We were tasked with **redesigning the student experience** so that they may thrive on campus. This process was broken down into needfinding and empathy fieldwork, ideation, brand development, and fabrication/final design. This project melded design thinking methods, systems engineering techniques, and mechanical engineering to arrive at a final optimized product. The project was realized over the course of a semester and was completed in collaboration with Stephanie Young, Dani Weisenfeld, Gabriella Passarelli, Neil Ramasray, Chase Collins, Sabrina Morse, and Ashley Paton.



Final prototype in folded position

/w User research, needfinding, and brainstorming

The design process began with **empathy fieldwork**, as all 8 team members attempted to understand the needs and desires of students on the Cornell campus. Fieldwork involved student interviews, observations of common areas, and reflections on our own experiences.

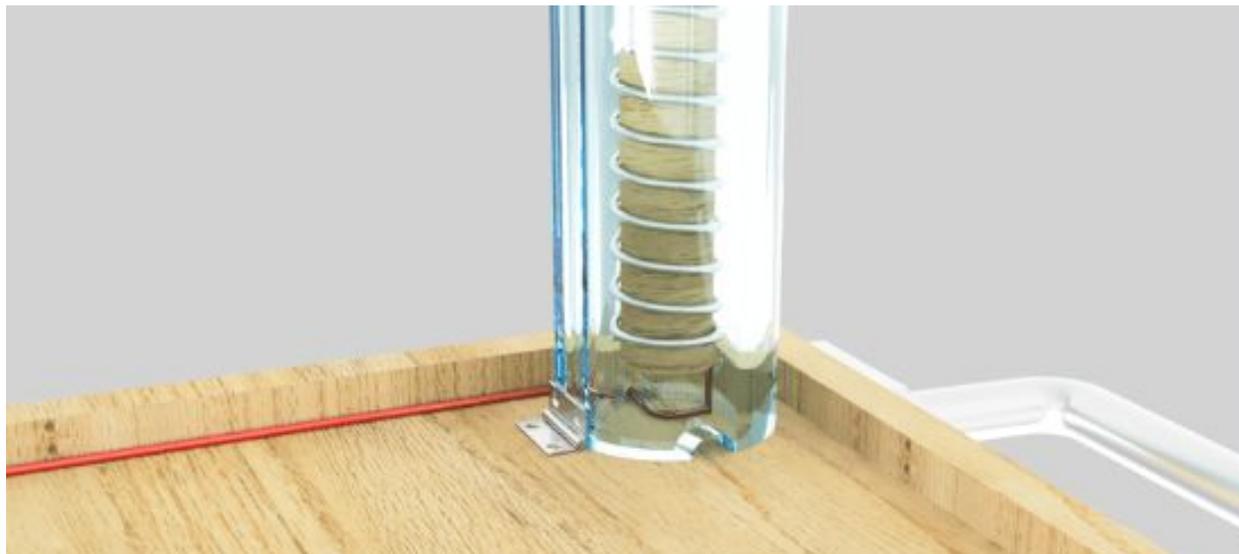


We recognized the value in designing a product which could facilitate a **healthy social life** and enable students to spend more **time outside**. We brainstormed ideas, and I proposed an adjustable table capable of maintaining a level surface on any slope. This table would allow students to meet with friends, complete assignments, or simply have lunch in any outdoor environment. We developed a rough paper prototype to explore the feasibility of the design and better understand the user experience.



Rough prototype (Design 0) in action on a sloped surface

/w Modeling and key mechanisms



Close up of the spring (silver)-string (red) interaction and the outer leg housing geometry



From a mechanical perspective, the final design would feature four auto-leveling legs. Inspired by the mechanisms commonly found in ladders, each leg included a spring-washer system which, when actuated by a string, allowed each leg to slide freely to the ground. The springs maintained an internal washer at a non-perpendicular angle with the axis of the inner leg. By designing for a small

clearance between the concentric washer and inner leg, the angled washer imposed a friction force on the leg and locked it in place. Pulling the string realigned the plane of the washer to be perpendicular with the leg, allowing free movement and removing the interference. My contributions to the 3D modeling were focused on the outer leg enclosure (pictured in grey) and the multi-degree of freedom feet.

/w Final prototype, design features, and branding



To contextualize our product development, our team chose the brand name *Et Cetera*, representing the intersection of our different skill sets. Together, we synthesized expertise in design, engineering, and more.



3D printed
lattice feet

Features

/a Compliant Lattice Feet

[3D printed, multi-degree of freedom feet enabled compliance with any surface geometry]

/b Folding features

[Concealed hinges at all four legs and along the middle of the table minimize the size and improve portability]

/c Integrated Table Level

[Table level enables visual confirmation of a level surface]

/d Self Leveling Mechanism

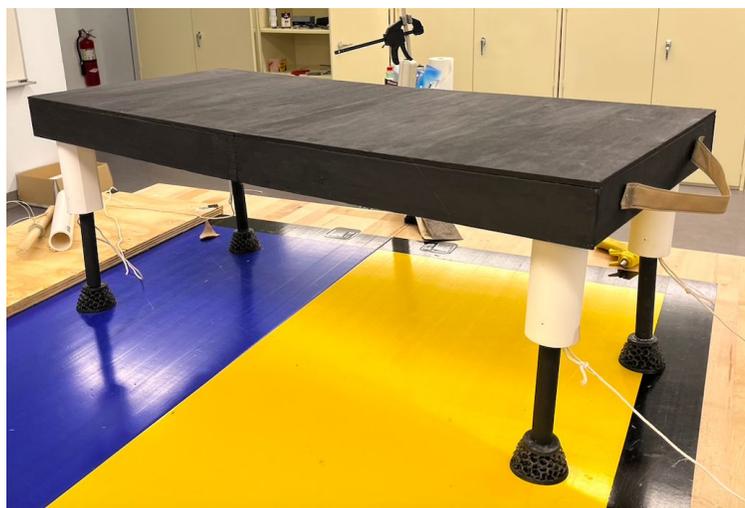
[Hidden spring-washer mechanism with tension release allows for automatic leveling at the pull of a string]



Folded view of
Terrain Table

The final design was optimized for a seamless user experience. Integrating key features established via a conjoint analysis survey, the product was finalized and presented to the class. While not mentioned for brevity, further work investigated the manufacturing process for such a product, a competitor analysis, and potential legal concerns for product development.

/w Final presentation and physical model



In an end of semester final symposium, *Et Cetera* presented the **Terrain Table** to the class and select industry professionals.

While not all features of the ideal design were included in the physical model, the design won third place in the competition.

/x Adaptive hair brush—Accessible personal care

Functional Prototype Features

/a Tapered Handle

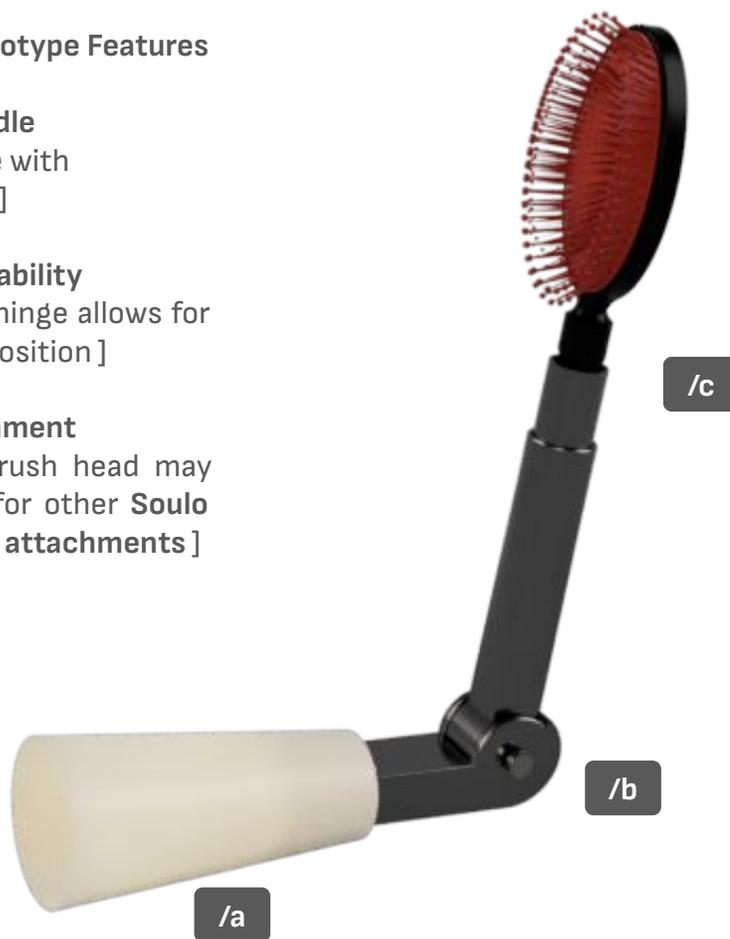
[Conical handle with ergonomic grip]

/b Angle Adjustability

[Twist locking hinge allows for variable angle position]

/c Brush Attachment

[Detachable brush head may be exchanged for other **Soulo** designed brush attachments]



As a mechanical engineering intern with the design and innovation startup **Soulo**, I led the early development of a new product. I spent months designing and fabricating prototypes of a hinged, adjustable hairbrush intended for users with limited mobility. In collaboration with Everhome, a company dedicated to elderly home care, we

developed this hairbrush to accommodate the needs of one of their clients who has severely limited hand and shoulder dexterity. Through extensive user research and ideation, we developed an early prototype that could help the client and other users suffering from similar ailments brush their hair independently.

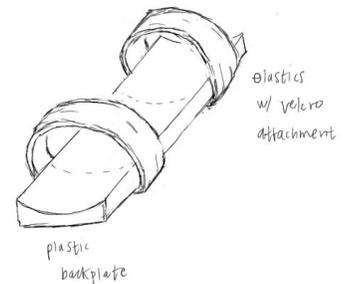
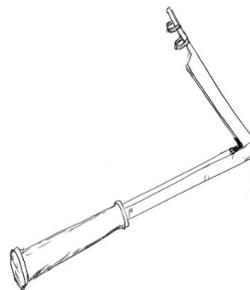
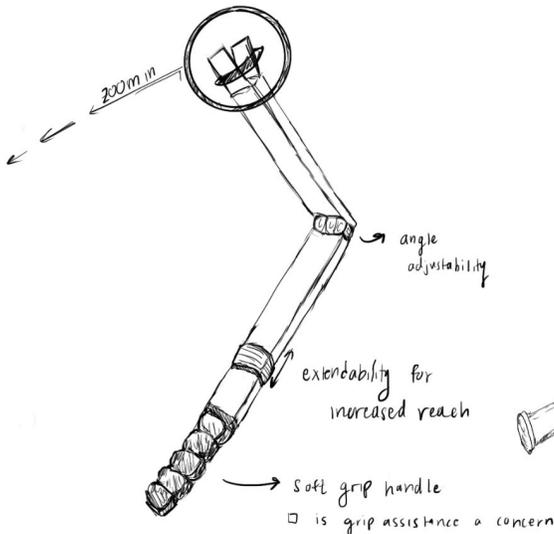
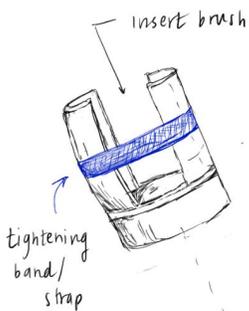
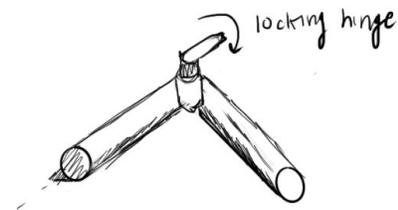
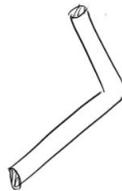
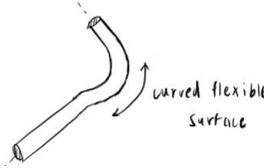
/x Early product development and ideation

Angular Adjustment

how is the angle of the hair brush managed?
 ↙ preset ↘ adjustable

→ "living hinge" → rigid bend

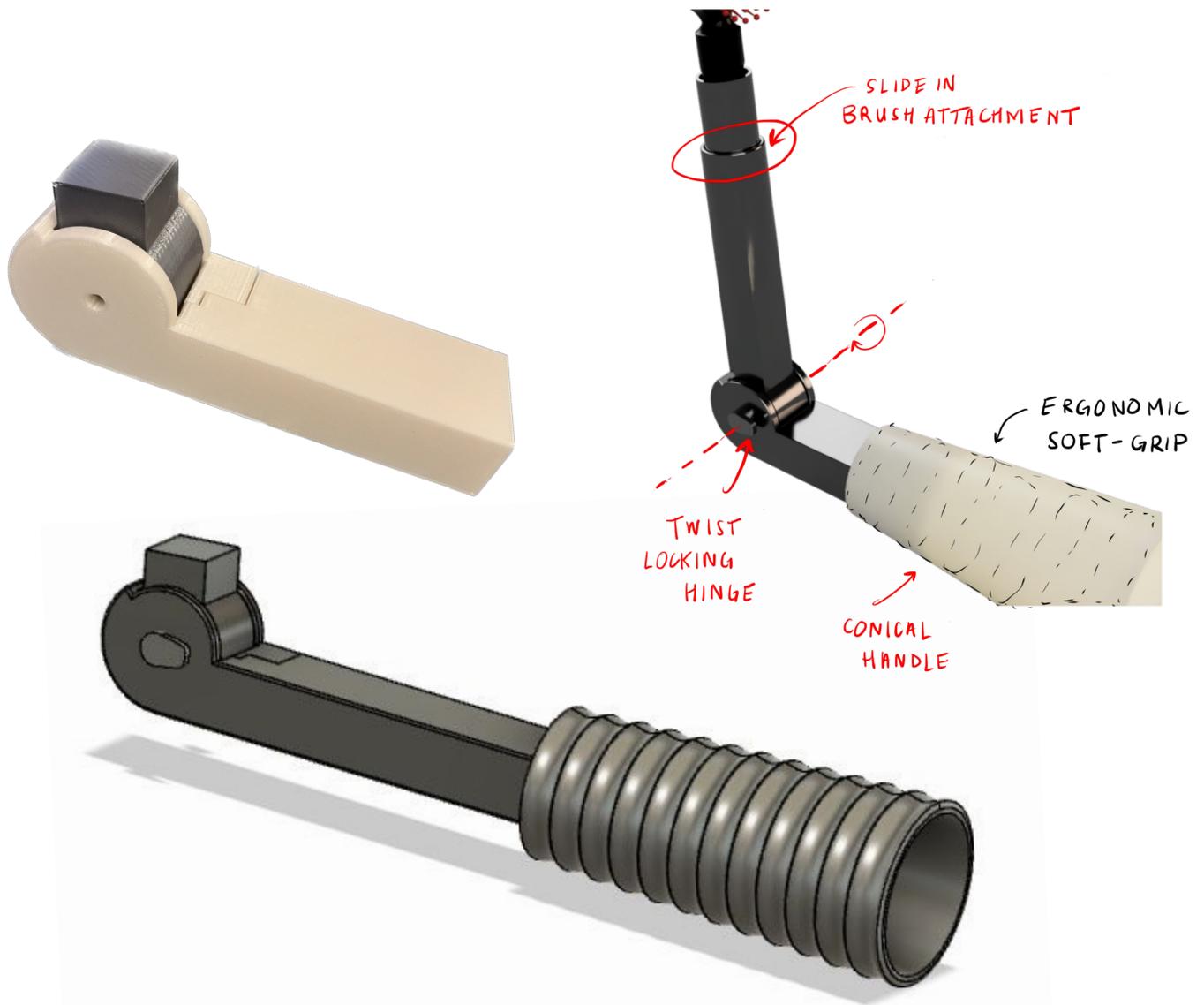
→ levers or latches



Development focused primarily on two key hairbrush features: angular adjustability and the brush attachment, with priority given to the angularity of the brush. The angularity of the hairbrush, as validated by our client, was essential to effectively brushing the back of the head without extensive arm or shoulder movement. Multiple designs were considered to address this user need, such as flexible 'living hinges', rigid structures,

and adjustable locking hinges. A locking hinge design inspired by disc brakes in bicycles was selected due to the simultaneous improved structural rigidity and variable angle adjustability. Collectively, we decided the brush attachment would require more long term development internally to manufacture a set of proprietary brush styling head inserts for different hair types and styling needs.

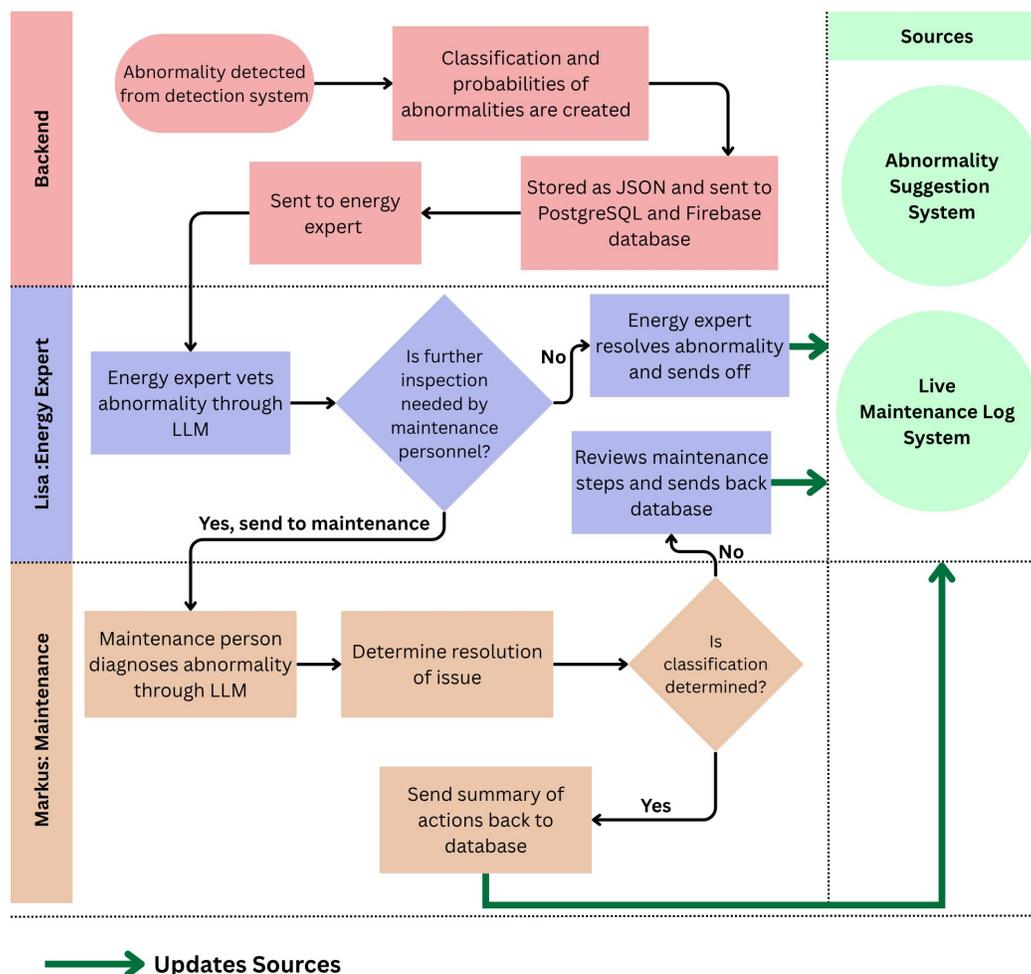
/x Presented prototype and future plans



By the end of my internship with **Soulo**, I had developed a variety of successful features to be implemented on the hairbrush. While the actual hair brush attachment and ultimate product styling would be addressed by a collaborating industrial designer (Ivan de Leon), the hinge locking mechanism proved to be a versatile and robust feature

which could ensure compatibility with a variety of users. Additionally, the conical, ergonomic grip design was successfully tested and developed using compliant TPU filament for a comfortable, easy-to-grip feel. We plan to submit a provisional patent for the presented design in 2024.

/y TuneUp—AI Building Maintenance Automation



Sustainable operations in modern real estate portfolios have become increasingly achievable with the rise of interconnected sensor systems. However, historical buildings often struggle to keep pace. Installing new sensors is costly, invasive, and can cause damage to heritage properties—making “smart building management” far more challenging. As part of Stanford’s ME310 global design innovation course, my team was tasked with a 9-month project in collaboration with a large Austrian real estate company. Our challenge: use only existing utilities data—already collected across the portfolio—to meaningfully improve building operations.

We developed TuneUp, an AI-based building fault detection and troubleshooting system. The platform uses machine learning to identify abnormal utility consumption patterns in real time (e.g. water leaks, equipment malfunctions) and automatically alerts facility managers when an anomaly is detected. Managers can then interact with an integrated AI assistant, trained on historical maintenance logs, to diagnose issues and determine likely root causes. Once the issue is confirmed, TuneUp helps to assign technicians, provide relevant troubleshooting context, and collect updates back into the platform—creating a continuous feedback loop that strengthens the model over time.

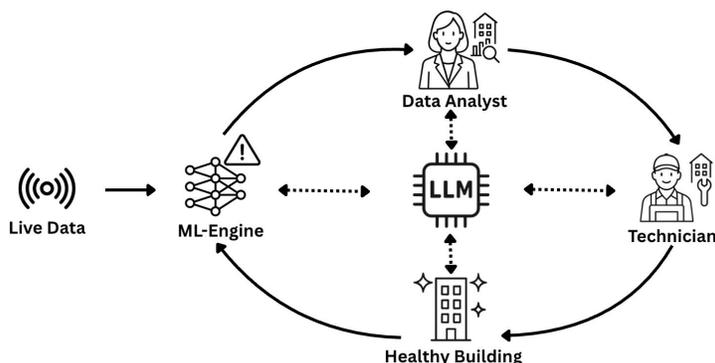
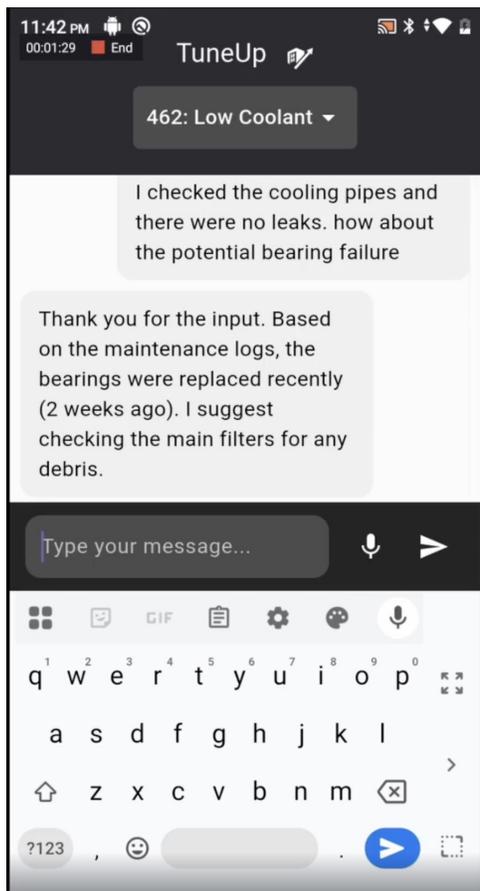
/y Design development and needfinding



To understand the landscape of sustainable building operations, our team conducted interviews with key stakeholders across the real estate and facilities management ecosystem. We spoke with experts from Stanford, Meta, Uber, and other organizations to learn how industry leaders approach energy efficiency and where the major pain points exist. From these conversations, we discovered a paradox: AI-assisted smart buildings are both widespread and widely frustrating. Many U.S. facilities rely on machine-learning fault detection systems, yet these platforms often generate unreliable insights when data quality is poor. Several experts expressed skepticism toward computationally heavy AI systems that promise marginal efficiency gains but risk false positives, unnecessary alarms, and high maintenance overhead.

Given the constraints of our challenge—limited sensors, historical buildings, and minimal new hardware—we needed a solution that could deliver trustworthy insights from sparse data. To fill the gaps, we immersed ourselves in the day-to-day experience of maintenance technicians within the Austrian real estate portfolio. Technicians carry deep, tacit knowledge about their buildings—much of which is never captured in traditional data systems. Their intuition about normal vs. abnormal behavior is invaluable. This insight reshaped our solution direction. Rather than building a purely automated AI platform, we envisioned a hybrid fault detection system that combines machine learning with the lived expertise of building technicians and managers. Our goal became clear: build a tool that augments human judgment rather than replaces it.

/y System overview and contributions



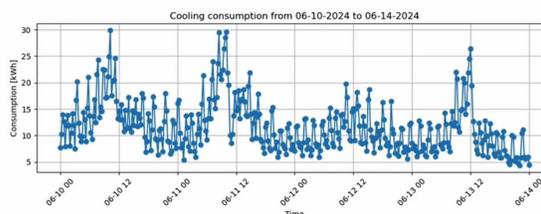
Low Coolant

Freihaus

Status: Action Required

Ticket #462

Select Date Range 06-10-2024 to 06-14-2024



Available Technicians

- M Markus
- R Rachel
- E Eric

Task Summary

Ticket summary will be generated at end of conversation.

To bring our AI maintenance assistant to life, I aided the design of the TuneUp platform's frontend experience and helped develop the IT architecture connecting the machine-learning engine, LLM, and user interfaces. On the front end, I built an interface that allows building managers and technicians to view anomalies, explore sensor data, and seamlessly launch an AI-assisted troubleshooting chat. When the ML engine detects abnormal utility usage, the interface displays a structured "anomaly card" with classifications, probabilities, and sensor locations—information that also initializes the AI assistant's context. Behind the scenes, our system ingests and vectorizes historical maintenance logs, building issues, and equipment documentation using embeddings.

This enables the LLM to retrieve relevant context and provide grounded, building-specific troubleshooting advice. I also contributed to the architecture for conversation memory, allowing technicians to pause and resume chats while keeping logs consistent and ready for documentation. At the end of each session, the system auto-summarizes the troubleshooting steps and writes them into the maintenance log—closing the loop by feeding structured updates back into the machine-learning engine for continuous improvement. Together, these UI and backend elements create a unified workflow: detect → vet → troubleshoot → document → improve. The result is a user-friendly platform that brings AI into the day-to-day experience of building operations without overwhelming the people who keep buildings running.

/z Bio-inspired drone attachment for dual gliding–flying flight behavior

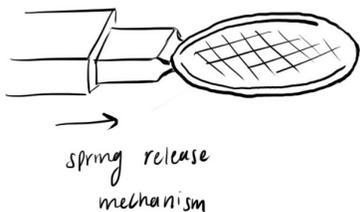


In a summer research experience at Imperial College London under Professor Mirko Kovac and Dr. Pham Huy Nguyen, I co-developed an attachment for a **flying-frog-inspired drone**. This drone was capable of bi-modal flight behavior, **both flying and gliding**. My task was to develop an attachment to deploy four frog-like glider arms from a contracted position. I spent weeks prototyping different mechanisms to deploy these arms, considering weight,

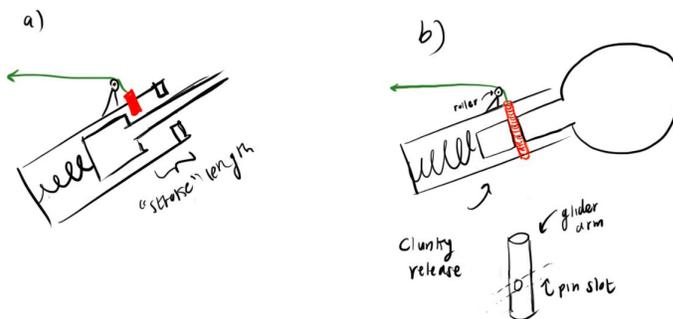
complexity, materials, and reliability as design constraints. The final design was further inspired by the tendons in a crab claw and relied on a string-actuated, elastic contraction mechanism. Shown above is the final design featuring the square retaining frame, one glider arm with three hinged sub-sections, and the attached glider pad sized via preceding computational work.

/z Early design process and ideation

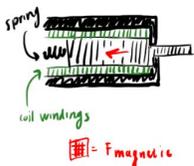
□ 'Telescopic' Design



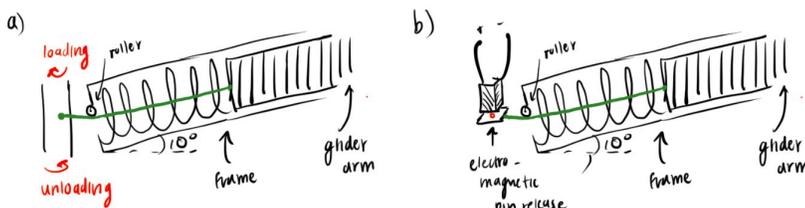
3) mechanical pin-release



- 1) electrical signal to mechanical motion w/o servo? linear solenoid?



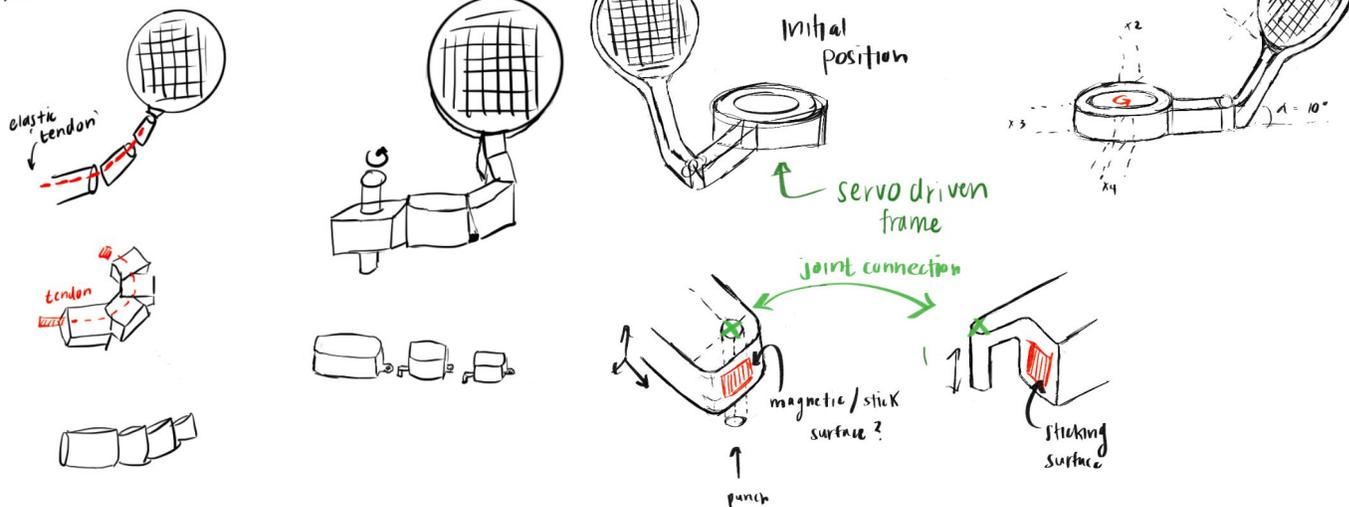
2) string-spring compression



* limit

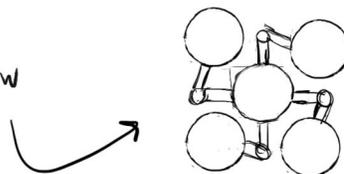
□ momentum based approach

□ "Crab Claw"



A variety of mechanisms were sketched and explored in the initial design process. The considered designs included a hinged crab claw mechanism, various telescopic arm deployment mechanisms, and hinged momentum-based mechanisms.

top view



/z Early prototyping via FDM 3D printing

/a



/b



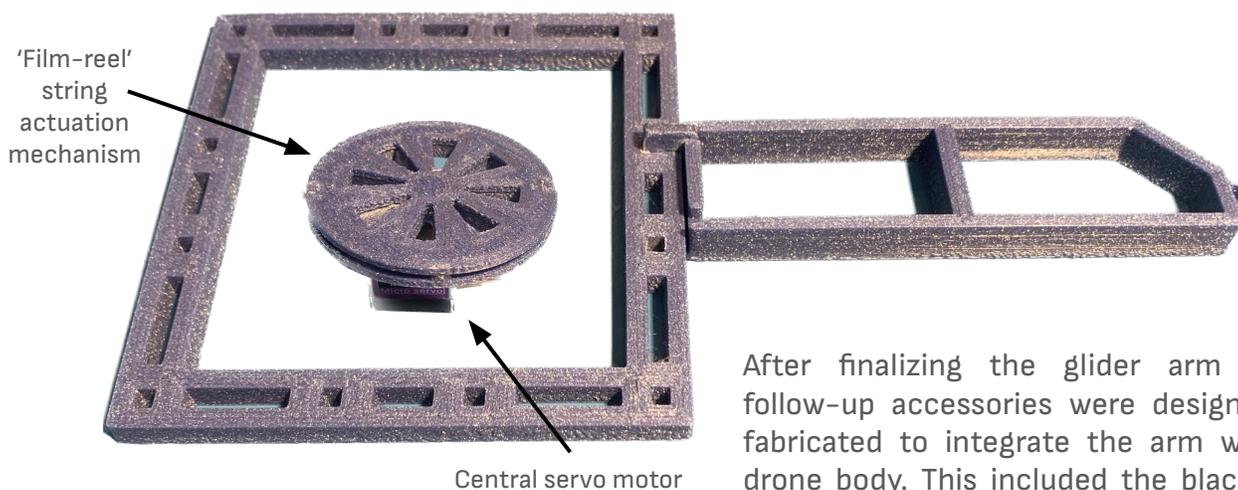
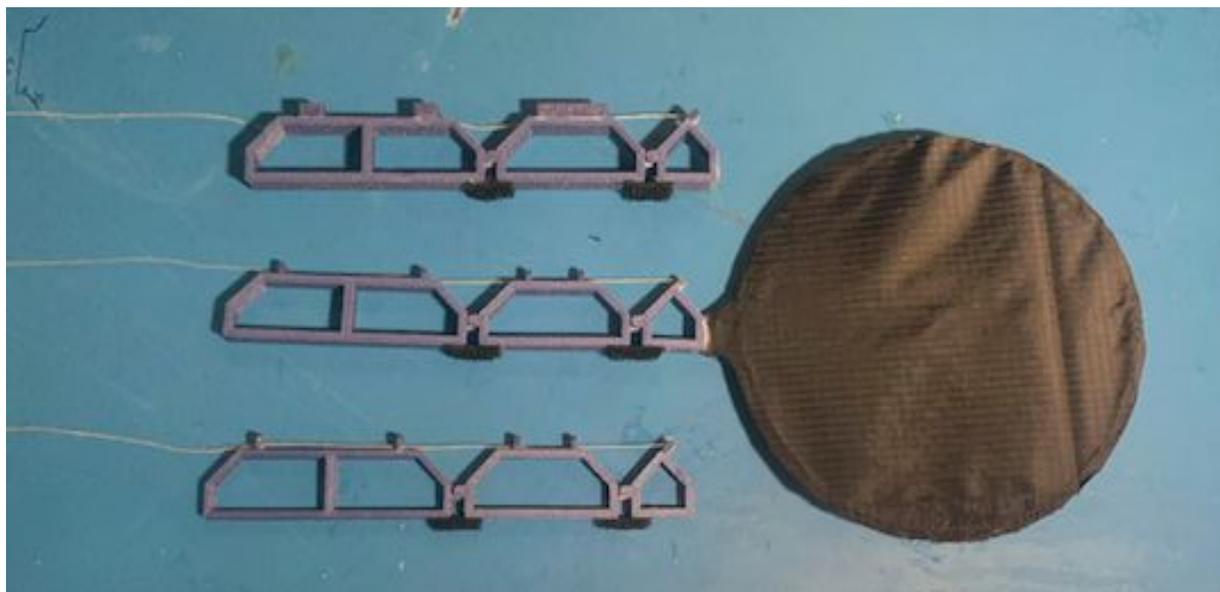
/c



Early prototypes explored the reliability of /a a telescopic extension mechanism and /b a crab claw inspired mechanism. We quickly determined that the telescopic mechanism introduced unnecessary complexity, as the tolerancing and tight clearances necessary for smooth operation were challenging to achieve with the

available equipment. The crab claw mechanism presented a simple, intuitive, lightweight alternative reliant only on string actuation. Some obstacles to this design's development involved proper tolerancing in the hinge joints between the three sub-arm sections. A poor joint fit is shown between the final two arm sections in /c.

/z Design refinement and accessory development



The development of the crab claw arm involved multiple iterations, varying tolerances between joints, wall thickness, elastic sizing, string pathways, and more. This is shown above with the three side-by-side glider arms. Key goals of the design process were to balance the competing influences of weight/beam bending effects and structural integrity.

After finalizing the glider arm design, follow-up accessories were designed and fabricated to integrate the arm with the drone body. This included the black glider pad shown at the top, the rectangular retaining frame to connect the four arms, and the 'film-reel' string actuator powered by a central servo motor. All accessories featured weight saving cutouts and involved multiple iterations to refine the functionality. Note that the glider pad sizing and preset dihedral angle (out of plane angle optimized for flight behavior) was determined by previous work in the lab.

/z Final prototype functionality



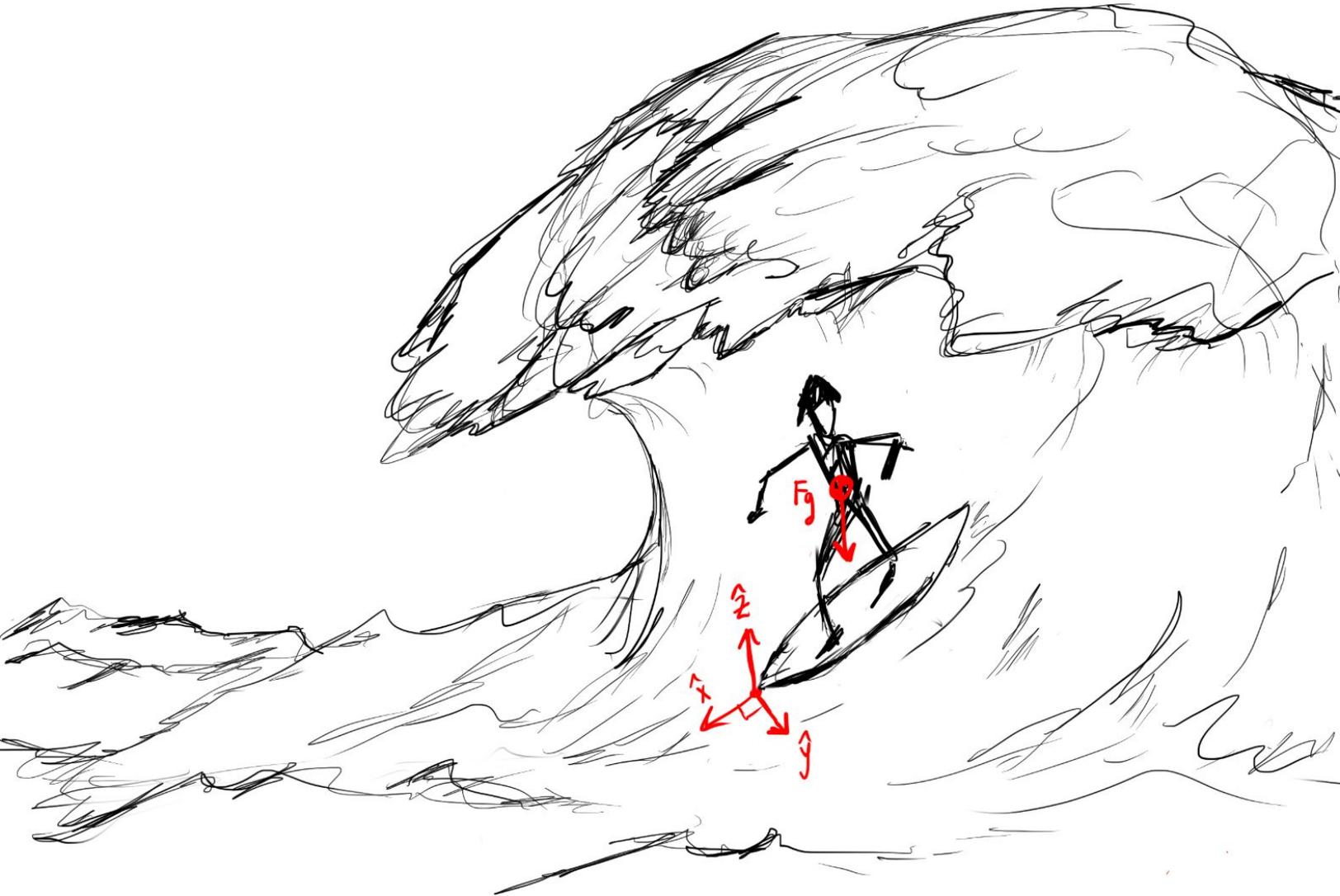
By the conclusion of the six week International Research Opportunities Program, I had successfully co-developed the presented design for a drone attachment enabling bi-modal flight behavior. The final prototype allowed for a 229 percent extension from the contracted position. While the final product was not

tested in flight with an actual drone, the design concept was validated through ground testing. All work was presented at the **Cornell Commitment Virtual Symposium**. I would like to thank Dr. Pham Huy Nguyen, Oscar Peng, and Professor Mirko Kovac for their contributions and support.

[Thank you]

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I like to go surfing.



better watch
your ΣM about
the g !

...nosedive

