PORTFOLIO

MATTHEW RABIN

Designer & Engineer

I design how people interact with physical and digital systems.

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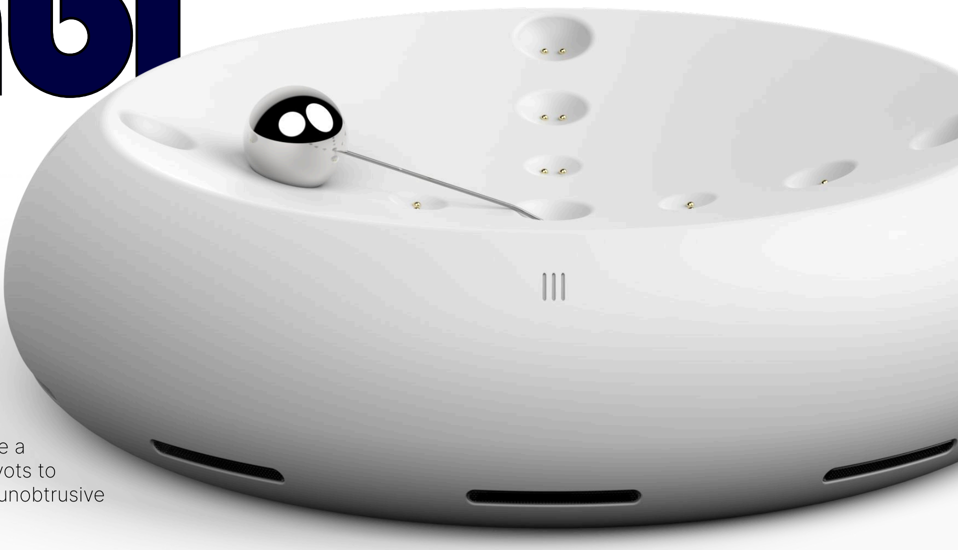
ambi



Nighttime Tactile Music Player

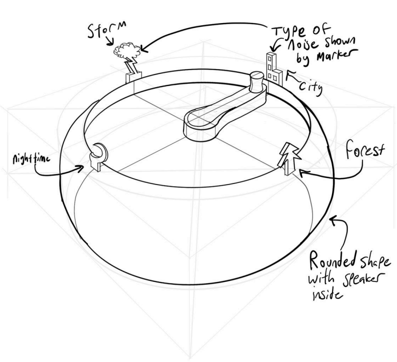
This project was for a design competition held by the Philadelphia Museum of Art. AMBI is a small, tactile music player that replaces phone-based sleep sounds. Users move a magnetic metal ball between divots to select soundscapes, creating a unobtrusive way to wind down before sleep.

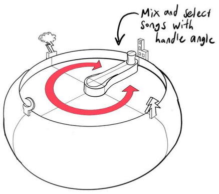
Fall 2024 • Individual Project • Design Processes

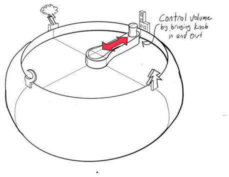
Concept

Early versions explored how users might "select" sound physically rather than through a screen.

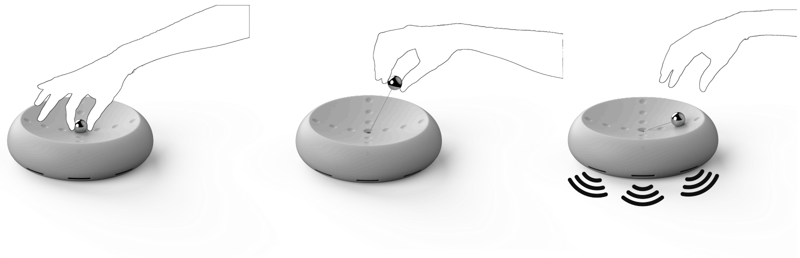
The first sketch model used discrete markers to represent different environments like city, forest, and storm.


Storm
Type of noise shown by marker
City
nighttime
Forest
Rounded shape with speaker inside


Mix and select songs with handle angle


Control volume by bringing knob in and out

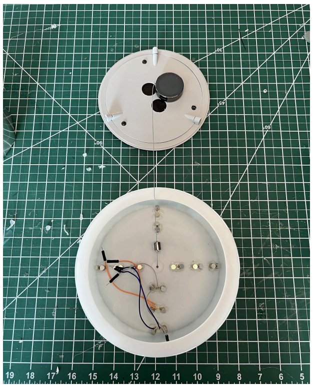
The concept later shifted to a smoother interaction; a single metal ball that snaps into magnetic divots, letting users choose and adjust sounds through that unique interface.



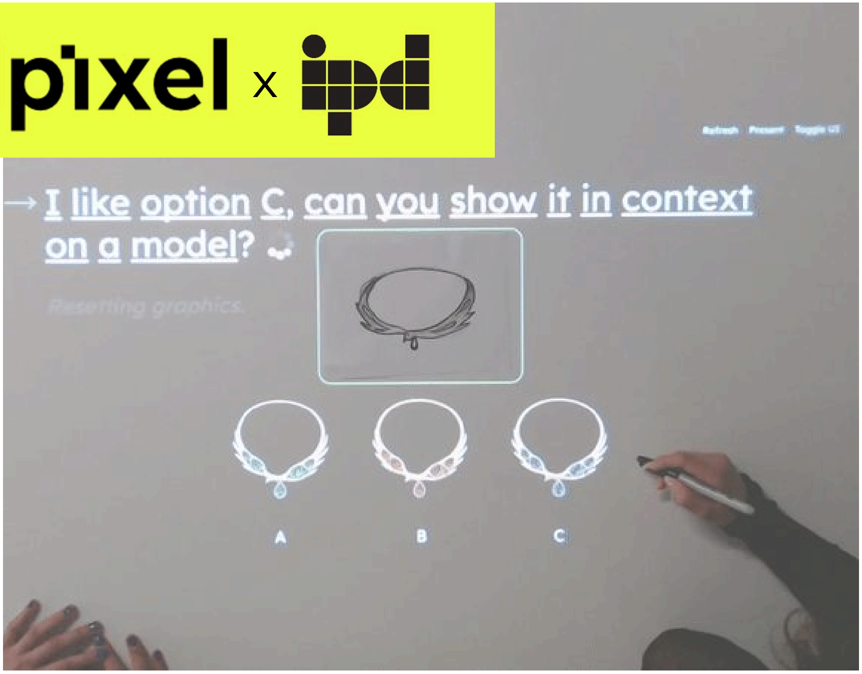
Result

The prototype was SLA-printed and wired so the ball completed a circuit by bridging two pins. Tests confirmed the interaction felt intuitive to users, but they wanted clearer cues for which sound was active. These insights led to plans to make larger divots, visible engraving, and a smaller overall form for the next iteration.

101 Things I Learned in Urban Design School
Matthew Frederick and Vikas Mehta



spatialpixel x ipd


Refresh
Present
Toggle UI
Resetting graphics.
A
B
C

→ I like option C, can you show it in context on a model?

AR/XR Design Client Project

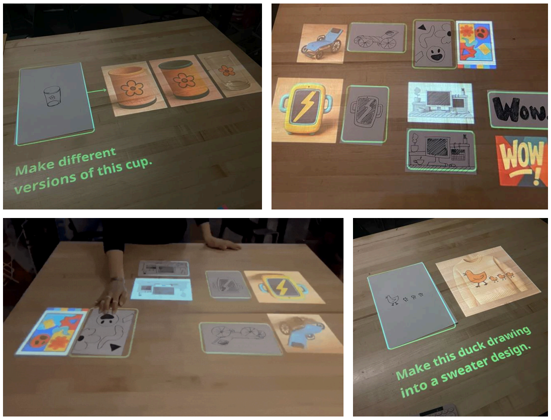
This project was a collaboration with Spatial Pixel, exploring how AI and spatial computing could be applied in creative workspaces. Our team was tasked with identifying the “killer use cases” for their prototype system, *Procession*; a projection-based interface that responds to voice, gesture, and real-world context. I focused on user testing, design visualization, and proposing technical improvements to the interface.

Spring 2025 • Group Project • Hsin Wang • Steyn Knollema • Sofia Elamrani

Concept

Our goal was to understand how people might use Procession in real work sessions. We expected users to struggle with *how* to engage with its functionality, but they actually struggled with *what* to prompt. Even informed participants used outside tools to decide what needed to be added to the canvas, rather than staying within the projected workspace.

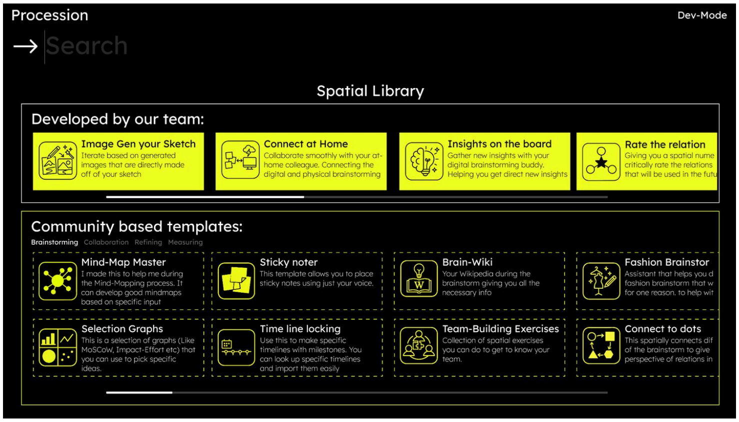
Because Procession already included a natural language interface, we focused on how AI could make that interaction more useful. We explored features that could visualize prompts, summarize content, and generate timelines directly on the table, helping users see and shape their ideas in real time.


Make different versions of this cup.
Wow
WOW!
Make this duck drawing into a sweater design.

Results

User testing and iteration led to a redesigned interface that made Procession feel more like a tool and less like a demo. We introduced a Spatial Library, a set of pre-built templates for brainstorming, mapping, and collaboration. The library let users share complete, ready-to-use modules, giving regular users a clear starting point and making the system easier to approach.

To help users decide *what* to create rather than *how* to prompt, we mocked up a visualization feature. These transformed sketches and text into visual scenes instantly, helping teams explore variations, summarize ideas, and make decisions faster together.


Procession
Dev-Mode
→ Search

Spatial Library

Developed by our team:

Image Gen your Sketch
Iterate based on generated images that are directly made off of your sketch

Connect at Home
Collaborate smoothly with your at-home colleague. Connecting the digital and physical brainstorming

Insights on the board
Gather new insights with your digital brainstorming buddy. Helping you get direct new insights

Rate the relation
Giving you a spatial nume critically rate the relations that will be used in the futu

Community based templates:

Brainstorming Collaboration Refining Measuring

Mind-Map Master
I made this to help me during the Mind-Mapping process. It can develop good mindmaps based on specific input

Sticky noter
This template allows you to place sticky notes using just your voice.

Brain-Wiki
Your Wikipedia during the brainstorm giving you all the necessary info

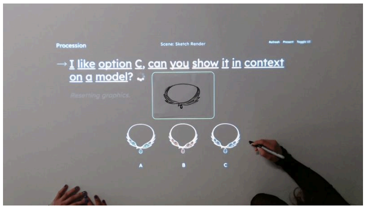
Fashion Brainstor
Assistant that helps you d fashion brainstorm that w for one reason. to help wit

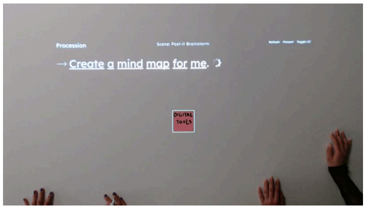
Selection Graphs
This is a selection of graphs (Like MoSCoW, Impact-Effort etc) that you can use to pick specific ideas.

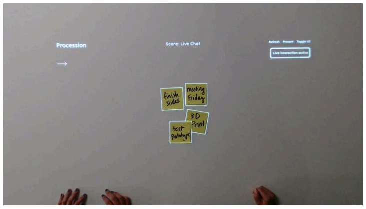
Time line locking
Use this to make specific timelines with milestones. You can look up specific timelines and import them easily

Team-Building Exercises
Collection of spatial exercises you can do to get to know your team.

Connect to dots
This spatially connects dif of the brainstorm to give perspective of relations in


Procession
Scene: Sketch Render
→ I like option C, can you show it in context on a model?
A
B
C


Procession
Scene: Post-it Brainstorm
→ Create a mind map for me.
DIGITAL TOOLS

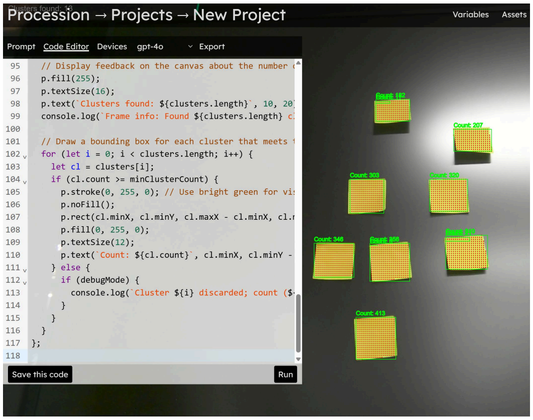

Procession
Scene: Live Chat
→
Live interaction active

Demo Video

Technical

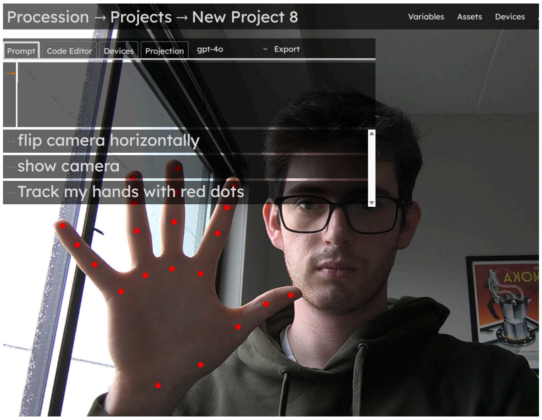
To support smarter interactions, I offered a number of technical improvements to Spatial Pixel:

- **Live OCR:** Used Tesseract plus a CLAHE + Otsu binarization pipeline to capture handwritten content from the workspace more reliably.
- **System Feedback:** Proposed a simple o3-style feedback panel so users could see what the system was doing without cluttering the canvas.
- **Dynamic Generation:** Used AI prompts to create timelines, maps, and summaries directly on the table so users could update content in real time.
- **Calibration:** Designed a startup calibration flow with fiducial tags to keep the projector and camera aligned.


Clusters found: 13
Procession → Projects → New Project
Variables
Assets
Prompt
Code Editor
Devices
gpt-4o
Export
Save this code
Run
Count: 192
Count: 207
Count: 303
Count: 346
Count: 413

```
  // Display feedback on the canvas about the number c
  p.fill(255);
  p.textSize(16);
  p.text(`Clusters found: ${clusters.length}`, 10, 20
  console.log(`Frame info: Found ${clusters.length} c

  // Draw a bounding box for each cluster that meets t
  for (let i = 0; i < clusters.length; i++) {
    let cl = clusters[i];
    if (cl.count >= minClusterCount) {
      p.stroke(0, 255, 0); // Use bright green for vi
      p.noFill();
      p.rect(cl.minX, cl.minY, cl.maxX - cl.minX, cl.r
      p.fill(0, 255, 0);
      p.textSize(12);
      p.text(`Count: ${cl.count}`, cl.minX, cl.minY -
    } else {
      if (debugMode) {
        console.log(`Cluster ${i} discarded; count ($
      }
    }
  }
};
```

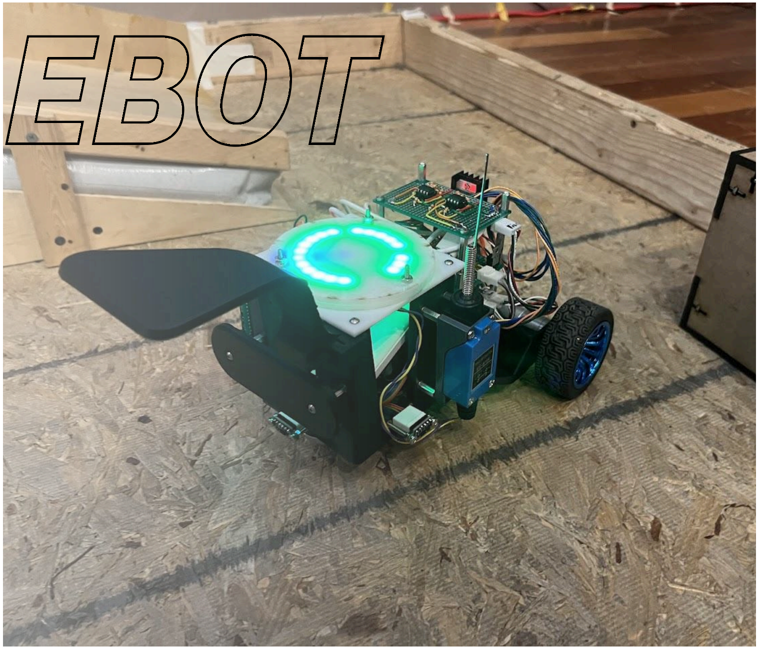

Procession → Projects → New Project 8
Variables
Assets
Devices
Prompt
Code Editor
Devices
Projection
gpt-4o
Export

flip camera horizontally

show camera

Track my hands with red dots

BATTLEBOT



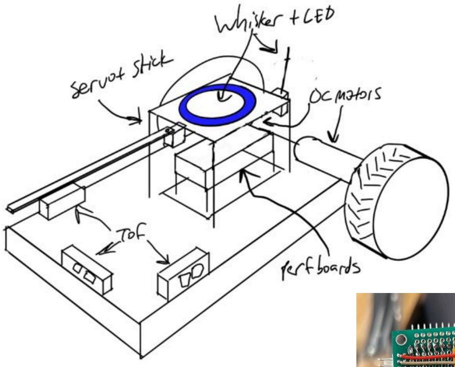
Custom Fighting Robot Final Project

Our final Mechatronics project focused on designing and building a compact fighting robot for a live multi-team competition. The goal was to create a fast, robust platform capable of autonomous wall-following, semi-autonomous navigation using an IR tower, manual control, and reliable physical interaction with game elements.

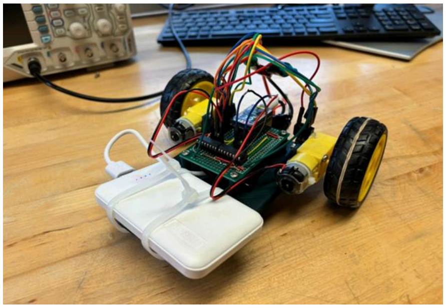
Fall 2024 • Group Project • Mechatronics • Stan Han • Steyn Knollema

Concept

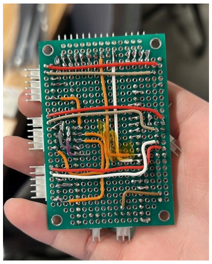
The project began with hand sketches exploring overall form, drive configuration, and attack strategies. We chose a low, forward-weighted chassis with a compact footprint and clear front interaction zone, establishing constraints around packaging and layout that guided subsequent prototypes.

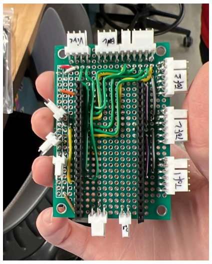

Whisker + LED
servo + stick
DC motors
ToF
perfboards

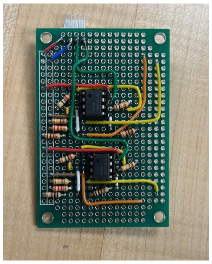
We used an early assembled platform to validate driving behavior, sensor placement, and control strategies before committing to the final enclosure.



I designed, soldered, and assembled all custom perfboard electronics for power distribution, motor control, sensing, and system interconnects. The boards worked as intended on first integration and supported a stable final system architecture.



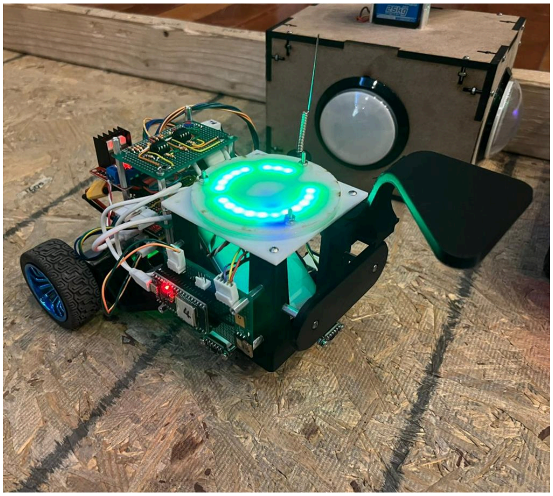


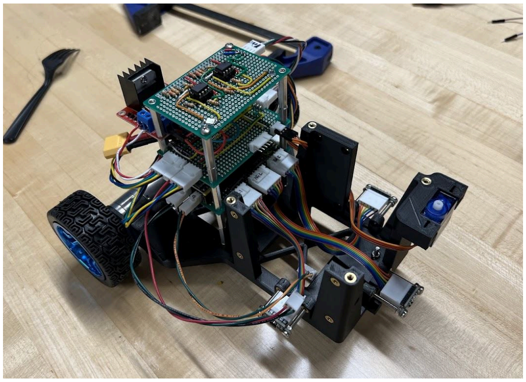


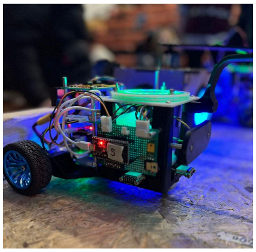
lts

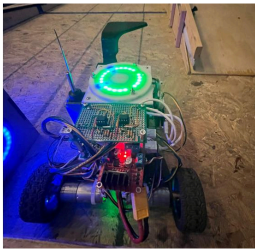
Resu

The robot demonstrated reliable wall-following and stable manual control during testing and competition, with robustness prioritized over more complex autonomous behaviors. Final deliverables included a fully functional robot, detailed CAD drawings, electrical schematics, and embedded software.

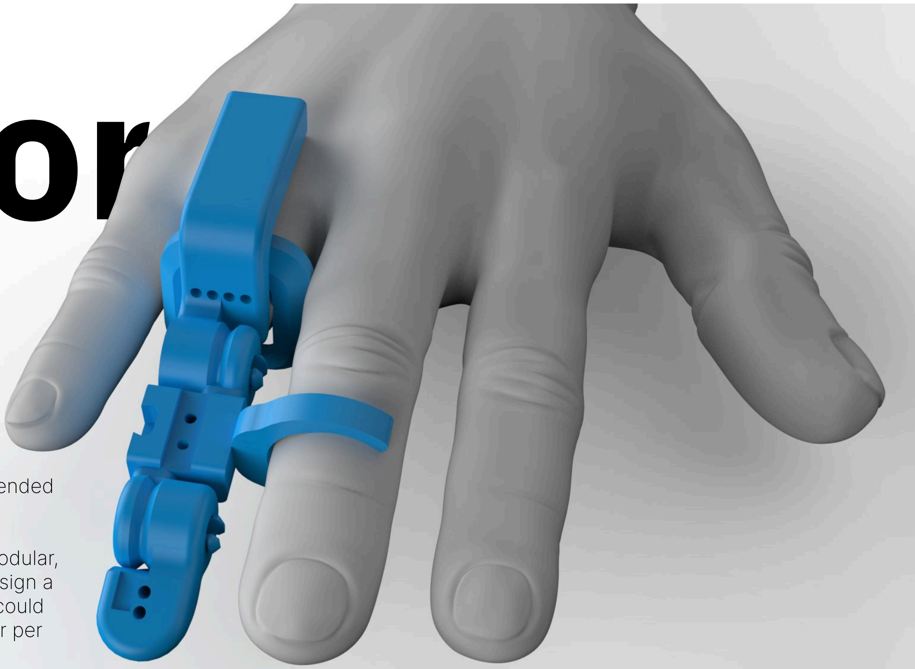








flexor



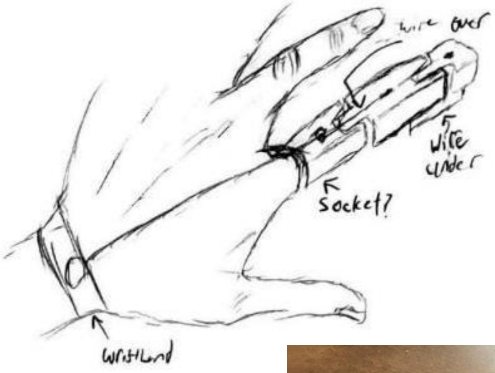
Low-Cost Modular Finger Prosthetic

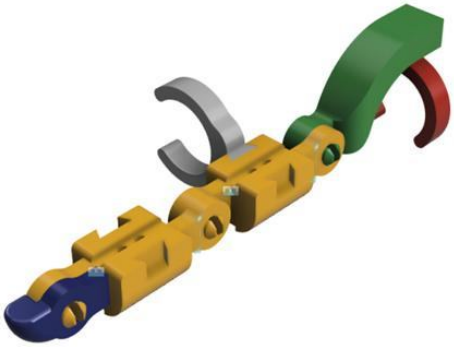
This project, completed for an open-ended biomechanics prompt, explored how prosthetic fingers could be made affordable and customizable using modular, 3D-printed parts. The goal was to design a cable-driven prosthetic that anyone could fabricate at home for under one dollar per finger. Inspired by tendon-driven mechanisms, I modeled, printed, and tested multiple iterations to improve cost, comfort, and range of motion.

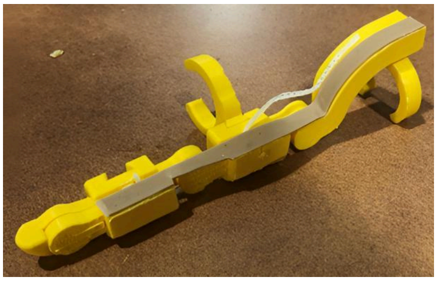
Spring 2022 • Individual Project • Biomechanics • Advisior: Dr. Akkus

Concept

The concept began with a tendon-driven finger inspired by biomechanical cable systems. I sketched, modeled, and printed early prototypes to test motion, tension routing, and ergonomics using off-the-shelf parts and basic 3D printing.

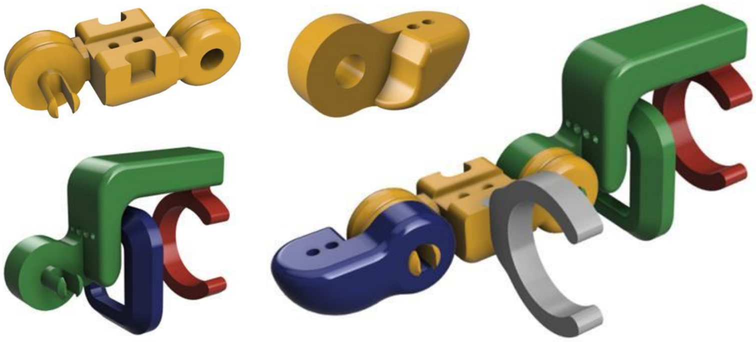

wire over
wire under
Socket?
Wristband

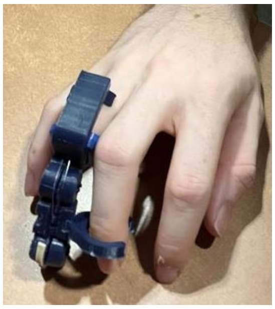




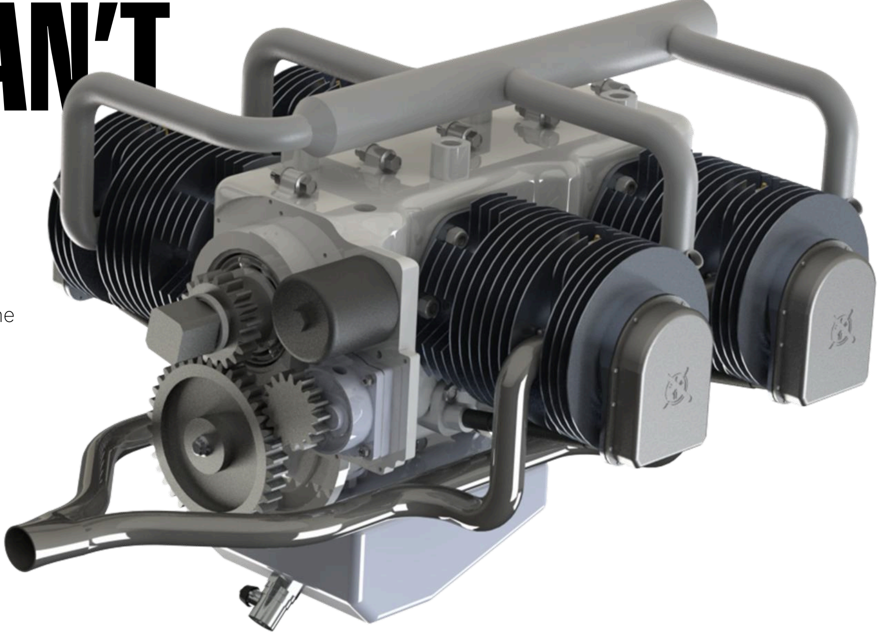
Result

The final prototype introduced improved joint geometry, stronger materials, and a simplified cable path. Using nylon string and rubber band tensioning, the prosthetic achieved a natural bending motion that closely mirrored a real finger. The full assembly cost under one dollar per unit to fabricate. Testing confirmed reliable actuation and easy repair, validating the modular approach for low-cost accessibility.





YAMAHAN'T



Motorcycle Engine Thesis Project

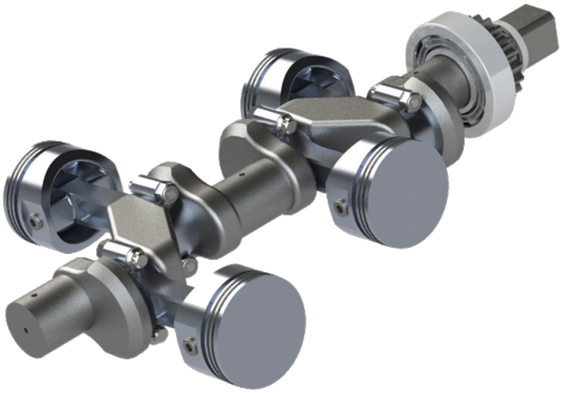
A semester-long team project to design a complete motorcycle engine from first principles. Our team developed a flat-four internal combustion engine focused on balance, efficiency, and rider comfort.The flat-four layout was chosen to reduce vibration and off-plane forces while maintaining mechanical simplicity. The final deliverable included a fully detailed CAD assembly, analysis, and technical documentation.

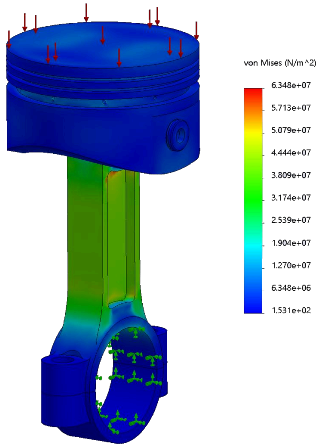
Spring 2022 • Group Project • Undergraduate Thesis • Team of 9

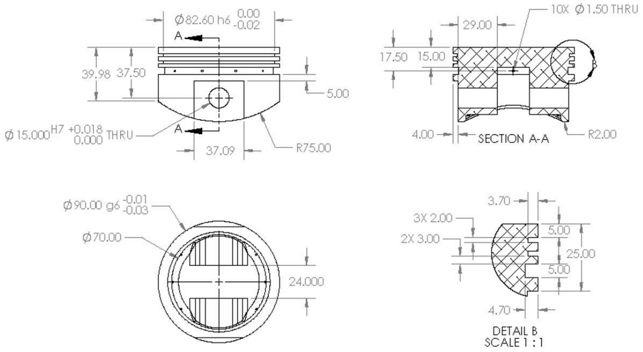
Mechanical Design

I served as the team's Design Specialist, focusing on the piston and crankshaft assemblies. I designed and detailed these components in CAD, resolving clearances, tolerances, and motion constraints across the full engine cycle.

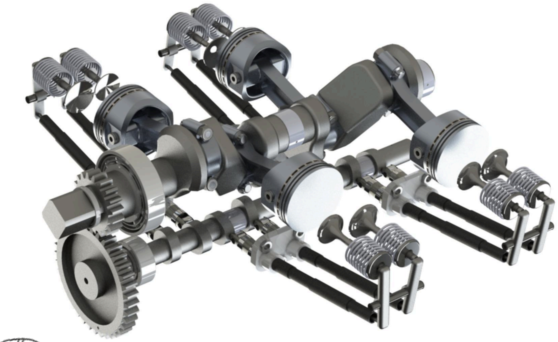
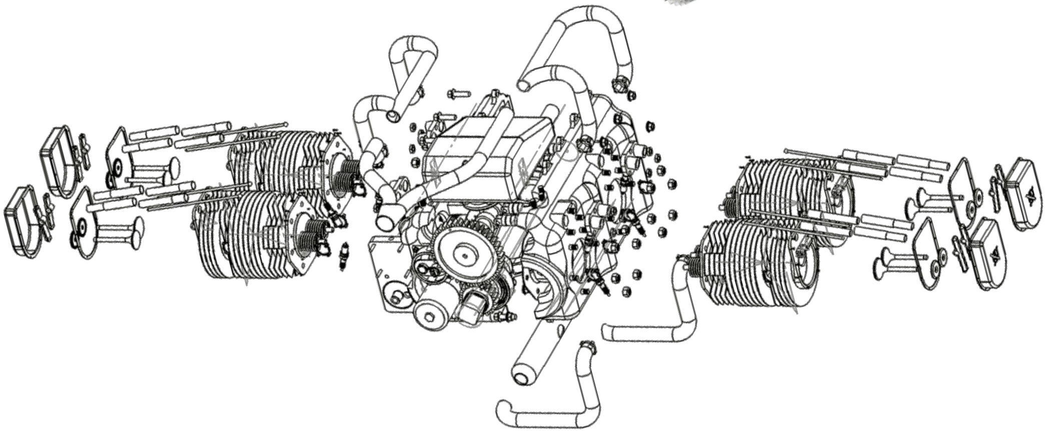
Critical parts were validated using finite element analysis. Early stress failures in the piston head led to a redesigned geometry that reduced weight and improved safety factors under load.






Ø82.60 h6 0.00 -0.02
A
39.98
37.50
5.00
Ø 15.000 H7 +0.018 0.000 THRU
A
37.09
R75.00
10X Ø1.50 THRU
29.00
17.50
15.00
4.00
SECTION A-A
R2.00
Ø90.00 g6 -0.01 -0.03
Ø70.00
24.000
3.70
3X 2.00
2X 3.00
5.00
25.00
5.00
4.70
DETAIL B
SCALE 1 : 1

Result

The final deliverable was a comprehensive technical report supported by a fully detailed CAD engine assembly with integrated analysis. While most of my work focused on the crankshaft, I also contributed significantly to the case and valvetrain. The project emphasized designing with analysis from the outset, using early FEA to guide tradeoffs between strength, weight, and manufacturability. Working within a large team highlighted how tightly coupled mechanical decisions are in complex systems, where changes to one component propagate throughout the design.