PROCESS BOOK

Project 3: Soft Goods with Integrated Technology

ALEX GILLINGHAM

Adaptive Air Ride Seat

Ducati Inspired Air Filled Moto Seat

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Project Brief: Tech-Integrated Soft Goods Design

Introduction: The textiles and apparel industry is at the forefront of a technological revolution, pushing the boundaries of what soft goods can do. This project aims to bridge the gap between traditional soft goods, such as apparel and accessories, and cutting-edge technology. Through functionality and user experience, the goal is to create a high-quality, innovative product that integrates technology in a thoughtful and aesthetically pleasing manner.

Goal: Bridge traditional soft goods (apparel, accessories) with cutting-edge technology to enhance functionality and user experience. Focus on innovative, user-centered designs that goes beyond your average person.

- **User-Centered Design:** Address specific user needs with practical, intuitive solutions.
- **Target Market Exploration:** Identify target users outside of college students.
- **Tech Integration:** Use tech to improve usability, comfort, and experience.
- **Creative Construction:** Develop a functional, stylish final model with strong construction skills.
- **Effective Communication:** Showcase the design process.

Process

Research & Insights: Understand tech trends, gather user needs, and explore diverse perspectives.

Concept Development: Brainstorm and create innovative designs with seamless tech integration.

Prototyping & Testing: Build samples, refine designs based on feedback, and ensure proper fit/function.

Final Model & Process Book: Present a polished product with a comprehensive design journey, tech packs, and visuals.

Conclusion: This project encourages innovative thinking and technical expertise, emphasizing the use of user-centered design to create soft goods that blend technology and tradition. By focusing on real-world applications, the final product will demonstrate how thoughtful design can enhance everyday life through functional, stylish, and tech-integrated clothing.

User Centered Design - This means the product will rely significantly on the quality of the user experience and a well-designed interface with seamless interaction. This is essential in ensuring that users feel comfortable, confident, and in control when using the product.

What is the role of industrial design in the soft goods industry?

- Human-Centered Approach
- Material Innovation
- Aesthetic Appeal and Brand Identity
- Functionality and Durability
- Sustainability and Eco-Friendly Practices
- Integration of Technology and Smart Textiles

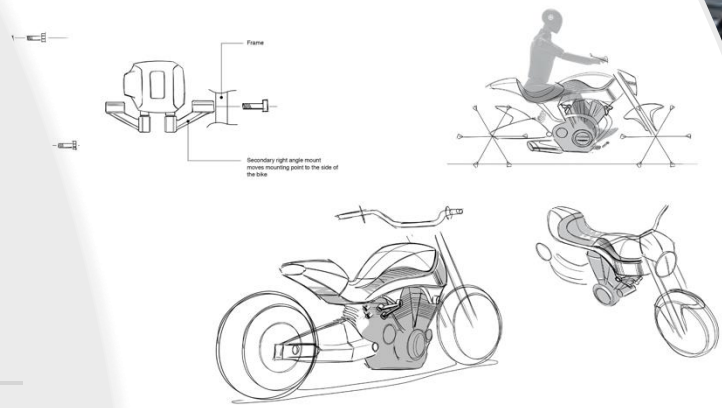
Research On User-Centered-Design And Materials

ARCH MOTORCYCLES

“Our goal has always been to create a riding and ownership experience unlike any other.” (Arch 2011)

“Each owner plays an integral part in co-designing the livery of their motorcycle by working closely with our in-house designers. During the design consultation, customers collaborate with our team to discuss their many options: custom colors, graphics, engraving, anodize and powder coat finishes, **seat materials**, detail accents, and more.”(Arch 2011)

- Arch Motorcycle embodies user-centered design, by allowing the customer to be apart of choosing different components of their bike. I personally admire not only the brand’s focus on the rider but also the passion of the people behind it dedicated to innovation and excellence. Their commitment to perfecting each detail inspires my own approach to design for this project.



https://jvleer.myportfolio.com/

Designer, New Product Development Designer
Arch Motorcycle Company
JAMES LEER

https://archmotorcycle.com/

Soft Good with Integrated Technology

PRELIMINARY INVESTIGATION ON THE DYNAMICS OF MOTORCYCLE FALL BEHAVIOR: INFLUENCE OF A SIMPLE AIRBAG JACKET SYSTEM ON RIDER SAFETY

Alessandro Bellati, Vittore Cossalter, Roberto Lot University of Padova, Italy
Andrea Ambrogi Dainese Spa, Italy

- I found the report on airbag jackets for motorcyclists highly engaging. This product exemplifies a user-centered approach in soft goods by integrating technology focused on keeping the rider safe. As the report states, "The airbag jacket system significantly reduces the risk of severe injuries in high-impact scenarios, providing a crucial layer of protection for motorcyclists" (IFZ Köln, 2006). This emphasis on rider safety highlights a user-centered design that results in life-saving products.

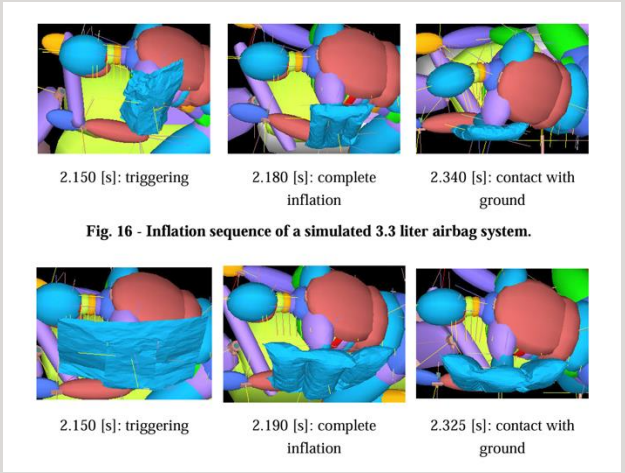
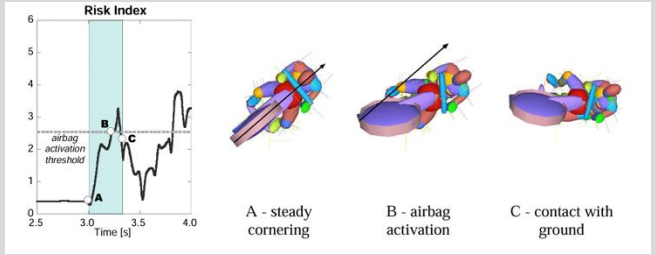
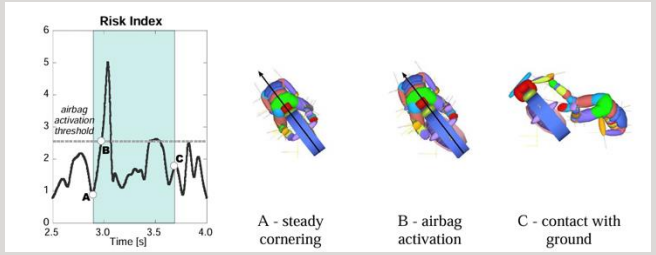


Fig. 16 - Inflation sequence of a simulated 3.3 liter airbag system.





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Extending skateboarding shoes' lifespan

Vans: The article on Vans' skateboarding shoe invention also exhibits a user-centered approach that focusing on the needs of skateboarders (traction, durability, and comfort). Vans achieved this by designing a rubber sole for better grip and reinforced canvas for durability, making the shoes curated for intense skating. This user-centered design addresses the demands of skaters and allowing the shoe to last longer. As stated in the article, it's "perfect for skateboarders," showing Vans' dedication to function and user comfort (Smithsonian, 2024).

https://invention.si.edu/invention-stories/invention-iconic-vans-skateboarding-shoe

Skate Shoes Design: The 2024 report emphasizes the use of LIBA's durable, abrasion-resistant PVA material, developed for mudguards in hiking boots and ideal for skateboarding gear. LIBA's PVA sheet, which is made from recycled plastic, is especially resistant to wear, which makes it well suited for high-impact activities like skateboarding, where it can withstand frequent friction and abrasion. As the report states, "The most important material is a sheet of PVA... tested against abrasion, so durable, and made from recycled plastic," (2024). The material is a perfect choice for both hiking and skateboarding applications

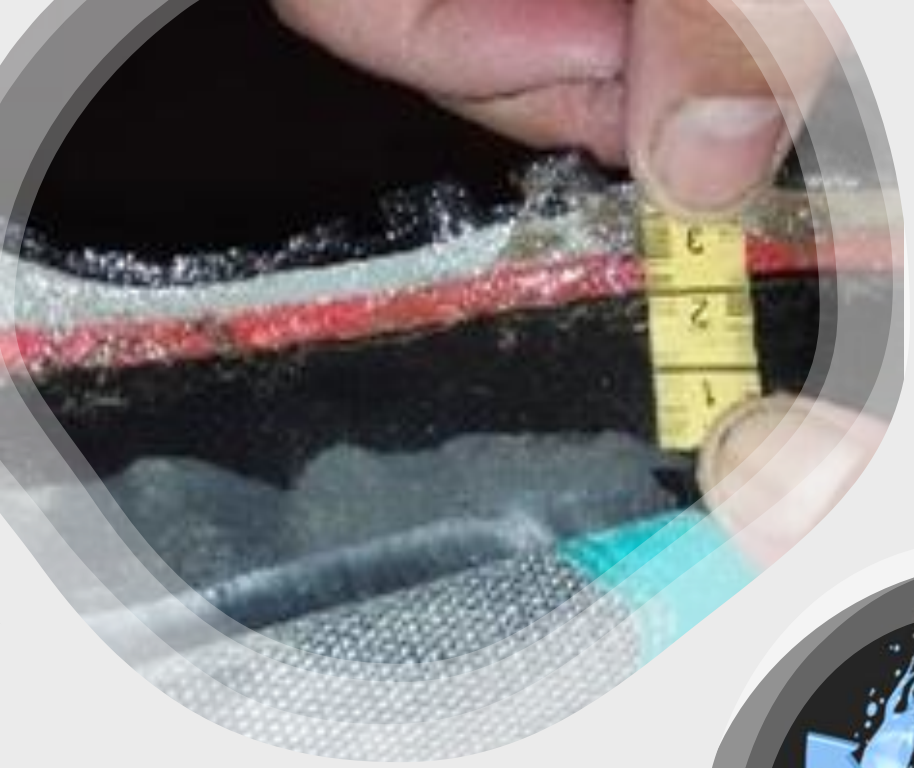
Also, this materteral is used is so many industries outside of just hiking and skateboarding.

chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.diva-portal.org/smash/get/diva2:1873452/FULLTEXT01.pdf

WATERPROOF PROCESS IN FOOTWEAR INDUSTRY

ADRIANA CHIRILĂ,ALINA IOVAN-DRAGOMIR "Gheorghe Asachi" Technical University of Iasi,

- The ICAMS 2018 report dives into waterproofing tech for footwear, focusing on materials like OutDry® and Gore-Tex® that block water while staying breathable. OutDry®, for example, bonds layers to keep water out without using DWR (durable water-repellent) coatings, which can harm the environment. The report states, "OutDry® fabrics…do not require DWR coatings, which are often not environmentally friendly" (Chirilă & Iovan-Dragomir, 2018, p. 314). This shows how smart materials can make waterproof footwear both effective and eco-friendly.



OutDry® Technology
- Heat-bonds layers to eliminate gaps and block water.
- Does not use DWR coatings, reducing environmental harm.

Gore-Tex® Technology
- Multi-layer with billions of micropores, promoting airflow while blocking water.
- Often uses DWR for extra water repellence.

User-Centered Design
- Prioritizes durability, comfort, and **breathability**.
- Designed to meet consumer needs for both waterproofing and **ventilation** in tough environments.

The Two Methods Being Evaluated

Designing a jacket for motorcycle drivers by combination of leather and denim

*Nilay Orka, Zumrut Bahadir Unalb, Behiye Elif Samlib, Hasan Ozgunaya**

The report discusses a design approach for a motorcycle jacket that combines leather and denim to meet the practical needs of riders. Leather is strategically placed on the front and shoulders for wind resistance, while denim is used on the back to improve breathability and reduce costs. The report states, “Mostly front side of the motorcycle jacket is in contact with the wind. That’s why; leather was chosen to be used on the front and shoulder parts of the jacket, and denim fabric was used on the other parts”—thus making a user-centered, wearable soft good.

- **Focus:** Design of a motorcycle jacket combining leather and denim.
- **Goal:** Enhance both protection and affordability for riders.
- **Leather:** Used on the front and shoulders for wind resistance and durability.
- **Denim:** Placed on the back for improved air permeability and reduced costs.
- **Result:** A cost-effective, **user-centered** soft good with comfort and protection.
- **Protection:** Leather offers wind resistance.
- **Comfort:** Denim enhances breathability.
- **Affordability:** Combining materials reduces production costs.
- **User-Centered Design:** Combines functionality, comfort, and affordability in a practical, stylish jacket.

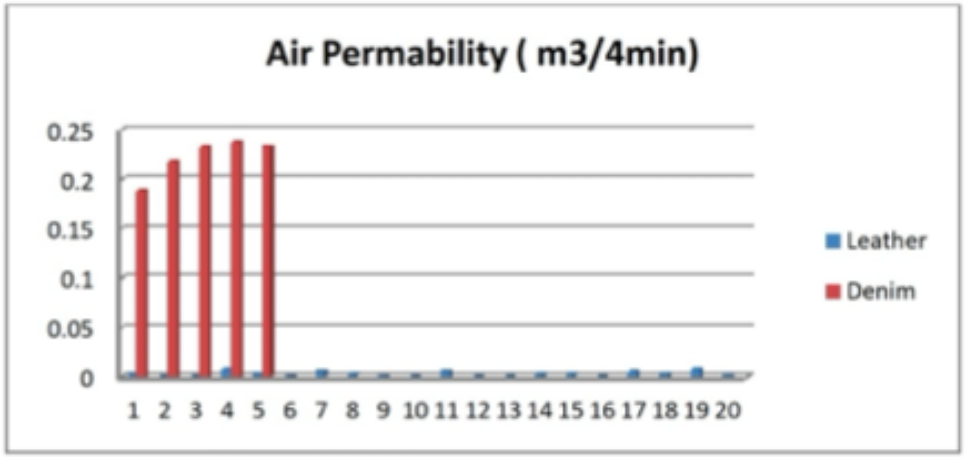


Fig. 1. Air permeability of the samples

Table 2. Air Permeability Test Results of Denims

Denim	Mean Thickness(mm)	Mean Air Permeability (m³/4 min)
1	0,80	0,1895
2	0,80	0,2182
3	0,80	0,2329
4	0,80	0,2373
5	0,80	0,2332
Mean	0,80	0,2222

https://www.aasrc.org/aasrj/index.php/aasrj/article/view/1868/989

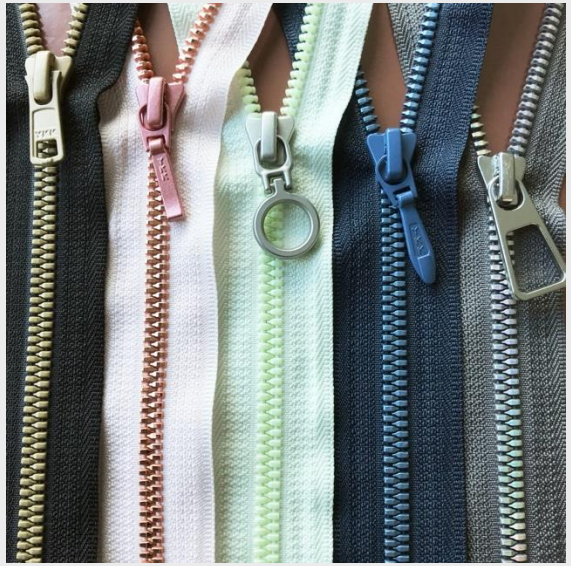
Zippers

Zippers are known for their strength and versatility, capable of supporting significant weight. Certain models can handle "weight capacities of up to 45 kg," (Saha & Gupta 2019) making them suitable for a range of applications including apparel and luggage mechanical design ensures a secure closure, enhancing durability and usability.

- Normal zipper

- Waterproof zipper

- Comes in many colors and different zipper pull tabs.



https://www.aasrc.org/aasrj/index.php/aasrj/article/view/1868/989

Buttons And Magnetic buttons

- Represents a cutting-edge fastening solution that combines functionality with user-friendliness. They can support comparable weight capacities to conventional buttons while providing a clean appearance. Research highlights that “magnets are much easier to work with for individuals with limited hand mobility, such as those with arthritis; however, ease of use is just the start of their advantages” (Maly, 2012).

- **Variety**: Available in numerous shapes, sizes, colors, and materials.
- **Customization**: Easily tailored to match garment design.
- **Garment Construction**: Essential in shirts, jackets, pants, and dresses.
- **Strength**: Provides a secure fastening that can withstand significant stress.
- **Magnetic Buttons**: Offer innovative solutions for ease and accessibility.
- **Traditional Buttons**: Remain a versatile and reliable choice in garment and fabric applications.

https://www.wired.com/2012/12/reinvent-clothing-with-magnets/

Velcro

- Velcro, a brand of hook-and-loop fasteners, is widely recognized for its versatility and ease of use in various applications, from clothing to industrial products. This fastening system consists of two components: the hook side, which contains small, stiff hooks, and the loop side, which has soft loops that engage with the hooks. Research has shown that Velcro can enhance the usability of garments, particularly for individuals with disabilities or limited dexterity. As noted in a study, “the use of Velcro fasteners can facilitate independent dressing for users with motor impairments, significantly **improving** their quality of life”

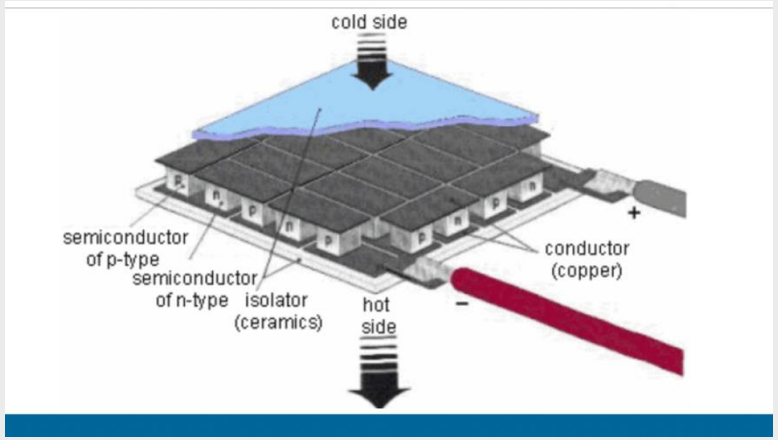
- **Ease of Use**: Simple to operate, making it suitable for all ages and abilities.
- **Adjustability**: Allows for variable tightness and fit.
- **Reusability**: Can be opened and closed multiple times without losing effectiveness.
- **Textiles**: Widely used in clothing, shoes, and accessories.
- **Consumer Products**: Found in bags, straps, and other items requiring secure fastening.

Peltier integrated heating & cooling jacket

Jeena Raju Poikayil, Jeffy Francis, Deepa Saju, Akhil Suresh, Jobin Varghese

Cool Technology ☺

- This paper goes over the development of a climate-controlled jacket designed to regulate body temperature in extreme weather conditions. This innovative suit addresses the health risks associated with temperature fluctuations, such as hypothermia and heat strokes, by allowing users to adjust their internal temperature with a **single button**. The jacket utilizes the Peltier effect for heating and cooling, providing a mobile solution for individuals working or engaging in outdoor activities in varying climates. "This jacket acts as a guard against the temperature variations and helps people to work comfortably irrespective of the weather conditions."(jacet)



- **Notes**
- **Purpose of the Jacket:**
  - To regulate body temperature in extreme weather conditions.
  - Prevents health issues related to temperature fluctuations (hypothermia, heat strokes).
- **Mechanism:**
  - Uses the Peltier effect for heating and cooling.
  - User can control internal temperature with a mobile interface.
  - Monitors temperature through built-in sensors.
- **Key Features:**
  - Provides comfort in both hot and cold conditions.
  - Eliminates the need for multiple layers of clothing.
  - Acts as a mobile solution for outdoor activities.
  - Offers different modes: summer and winter.
- **Applications:**
  - Suitable for outdoor workers, soldiers, and mountain climbers.
  - Enhances safety and performance in extreme weather.
- **Technological Components:**
  - Temperature Sensor: Measures internal suit temperature.
  - Microcontroller: Controls heating and cooling functions.
  - Bluetooth Module: Connects to mobile devices for temperature display and control.
  - Peltier Module: Provides heating and cooling.
- **Conclusion:**
  - The jacket is a practical solution to climate-related challenges, improving **user comfort and safety.**

https://ieeexplore.ieee.org/abstract/document/8212812?casa_token=4Cf3oSmXRPUAAAAA:f6pXui5xmdCdJZ8Q9f8zgVL329lEVnvXPca8Gt1HlIlOu04_DFBT3IFhvzC45HclUaY-JVnzQjw

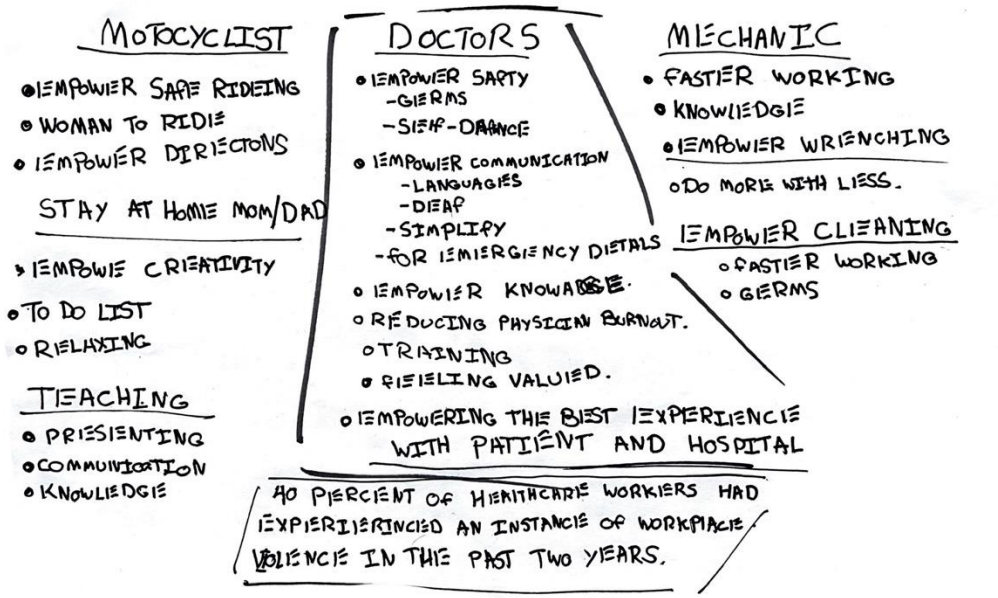
"WHO BENEFITS MOST FROM TECHNOLOGY-ENHANCED SOFT GOODS?"

TARGET USER

First Thoughts

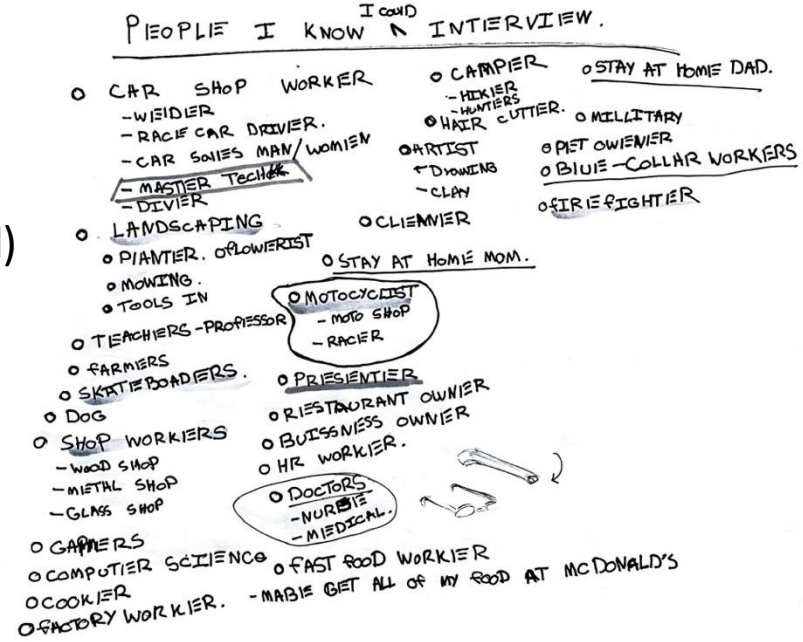
Initially, I wanted to focus on motorcyclists because this direction felt both engaging and personally motivating. As an everyday motorcyclist, I've come to appreciate many aspects of riding, while also noticing some areas that could be improved. I often find myself thinking about potential enhancements both on the bike side of things and gear. I thought this would be a great starting point for my brainstorming.

- In my previous "Wearables for Empowerment" project, I developed comprehensive lists of potential interviewees and key user groups that presented strong opportunities for impactful design interventions. This research ignited my initial explorations into identifying "Who Benefits Most from Technology-Enhanced Soft Goods?"



Main Ideas:

- Mechanic
- Shop workers (Metal & Wood)
- Stay at home Mom or Dad
- **Motorcyclist**
- Firefighter
- Doctors
- **Skateboarder**



POTENTIAL USER GROUPS

Technology-Enhanced Soft Goods List First Thoughts

- After selecting two user groups I know well through my own hobbies, I found it challenging to choose a clear direction for this project. To explore my options, I created a list of design ideas for each user group focused on technology-enhanced soft goods. Each user group presented a range of opportunities, but ultimately, motorcyclists stood out as the stronger choice, offering more impactful and relevant design possibilities. This initial brainstorming provided great insights into the types of technological enhancements that could best support motorcyclists' **safety and experience**, shaping the project's direction.

Motorcyclist

- Seat Cover (Heat,rain)
- **Tank Pad**
- Saddle Bags (to warble)
- Leather Helmets (the outside)
- **Wrist Bands** (Info) Watch, Tech Watch, Switchable
- **New Seat**
- **Bike Cover**
- Gear
- Smart Helmets:
- Protective Jackets With Tech:
- **Weather-Resistant**
- Wearable Safety Technology:

Skateboarding

- **Smart Skate Shoes**
- Protective Gear with Technology
- Tech-Enhanced Skateboards:
- Wearable Smart Tech
- Adaptive Backpacks

USER PERSONAS

Sarah

- **Age**: 35
- **Occupation**: Software Developer
- **Location**: Seattle, WA

Favorite Brands

POTTERY BARN

BANANA REPUBLIC

rizoma

Description

"The Daily Commuter"
Sarah is a wealthy software developer commuting through Seattle on her 2018 Ducati Monster. She needs luxurious stylish, high-tech products for her and her bike that easily allows her **to take calls on her bike.**

Their Bike

Naked Sport Bike
Ducati **Monster** 821

Modifications Done To The Bike

- DQS Ducati Quick Shifter
- Rizoma pegs and handlebars
- Termignoni exhaust and up map tune

Important Tools

- An Allen key to tighten bolts that come loose from her Ducati's rumble, and another to remove the rear piece for adding a passenger.

Day to Day JOURNEY On the Bike

Sarah starts her morning ride to work just before dawn, navigating through Seattle's rainy streets. Her commute is all about efficiency and safety—she relies on gear that keeps her **dry and visible** in low light, especially since her route includes dense traffic and narrow lanes.

GOALS

To one day find or build a bike that fits them perfectly.

NEEDS

Wishes there was sheltered parking for her bike everywhere she went.

CHALLENGES

Weatherproof gear, visibility for night riding, commuting gear with more tech options

Day To Day Off The Bike

Outside of work, she enjoys exploring Seattle's coffee shops, reading sci-fi novels, and meeting up with friends to unwind. She's also a fan of urban hikes and has an interest in minimalist design, which she incorporates into her daily life and the gear she chooses. For Sarah, her bike is a reflection of her love for adventure.

Leo

- **Age**: 45
- **Occupation**: High School Teacher
- **Location**: Denver, CO

Favorite Brands

Description

"The Adventure Rider"
Leo, a Denver Highschool teacher, that seeks adventure on his Husqvarna 701 Supermoto His style is rugged mixed with technology his gear is comfortable, protective, and adapts to changing weather and terrain conditions. He wishes for more **weatherproof gear.**

Their Bike

Off Road
Husqvarna 701 Supermoto

Modifications Done To The Bike

- Has two sets of tires (off road and pavement)
- Phone mount on handlebars

Important tools

"GPS is my top tool. Right now, I'm using my phone mounted on the handlebar."

GOALS

- Be able to ride anywhere

CHALLENGES

- Finding sheltered parking for bad weather while camping on my motorcycle is challenging. Many campsites lack cover, making it hard to protect my gear. This uncertainty adds stress and limits my ability to explore, reducing my enjoyment of the trip. Solving this issue is crucial for a better camping experience.

Day to Day JOURNEY

Leo, a high school teacher in Denver, starts his day with breakfast and a weather check before riding his Husqvarna 701 Supermoto to school. After teaching his classes, he enjoys an afternoon ride in the nearby foothills but gets caught in unexpected rain, highlighting his need for more weatherproof gear. In the evening Leo cooks dinner and begins planning for his next adventure.

Mike

- **Age:** 45
- **Occupation:** Sales Manager at Harley
- **Location:** Orlando, FL

Favorite Brands

Description

“The chill rider”
Mike values comfort and style, opting for relaxed pieces that reflect his artistic vibe. He wishes for a more **ergonomic seat design** that combines comfort and style

Their Bike

Cruiser
Harley Davidson

Modifications Done To The Bike

- **Seat** (but too high)
- Exhaust
- Tune
- S and S Package

GOALS

Ride from coast to coast with his club

Frustrations

- Gear that restricts movement or lacks comfort
- Difficulty finding personalized accessories

What's the most important thing you need for a ride?

I need music, whether it’s through headphones on my phone or the speakers on my bike.

Quote: “Riding is about freedom, and I want gear that enhances that experience.”

David

- **Age**: 29
- **Occupation**: Mechanical Engineer
- **Location**: Detroit Michigan

Favorite Brands

Description

“The Speed Racer”
David spends his weekends racing on the track. He craves stylish gear that maximizes his speed and safety. He wishes he could **change color** of his leathers.

Their Bike

Sport Bike
Ducati Panigale V4

Modifications Done To The Bike

No mods but have plans for mods in the Future.

Important Gear/tools

- AGV Pista helmet
- Full leather suit
- Boots
- Ratchet set

GOALS

Master the perfect wheelie and set a personal best at my home track.

HOBBIES AND INTERESTS

Watching Netflix and cleaning his bike.

PROBLEM STATEMENT AND OPPORTUNITY SPACE & IMPACT

Opportunity Space & Impact

User Problems:

After speaking with bikers and creating user personas, I compiled a list of **issues** within motorcycling that could be addressed with technology-enhanced soft goods. Here are some problems I identified that could benefit from innovative solutions:

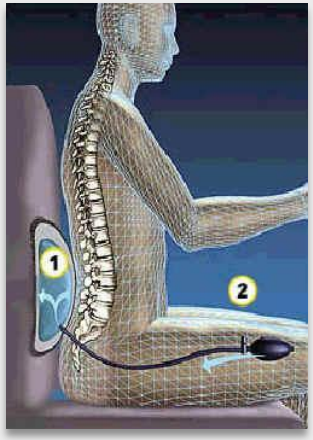
1.Visibility: Many riders struggle with being seen on the road, especially in low-light conditions.
2.Storage: Riders often lack adequate storage options in their gear for personal items and essential tools.
3.Comfort: Existing gear may not provide enough comfort for long rides, leading to fatigue and discomfort.
4.Safety: There’s a need for enhanced protective features that integrate seamlessly with the rider's gear.
5.Communication: Riders frequently face challenges in communicating with others while on the move.
6.Navigation: While GPS is essential, many find it difficult to access or view their navigation systems while riding.
7.Weather Resistance: Gear that doesn't offer sufficient protection against the elements can be a significant drawback.
8.Customization: Riders want gear that reflects their personal style but often find limited options.

Market Research

Companies like Rizoma and Thornton Hundred specialize in customizing stock motorcycles to make products, focusing on user feedback to enhance performance, style, and functionality. They modify and fine-tune existing bikes so that they are tailors to better meet riders' needs.

Thoughts:

- Making something for my bike



The aftermarket scene for motorcycles

rizoma

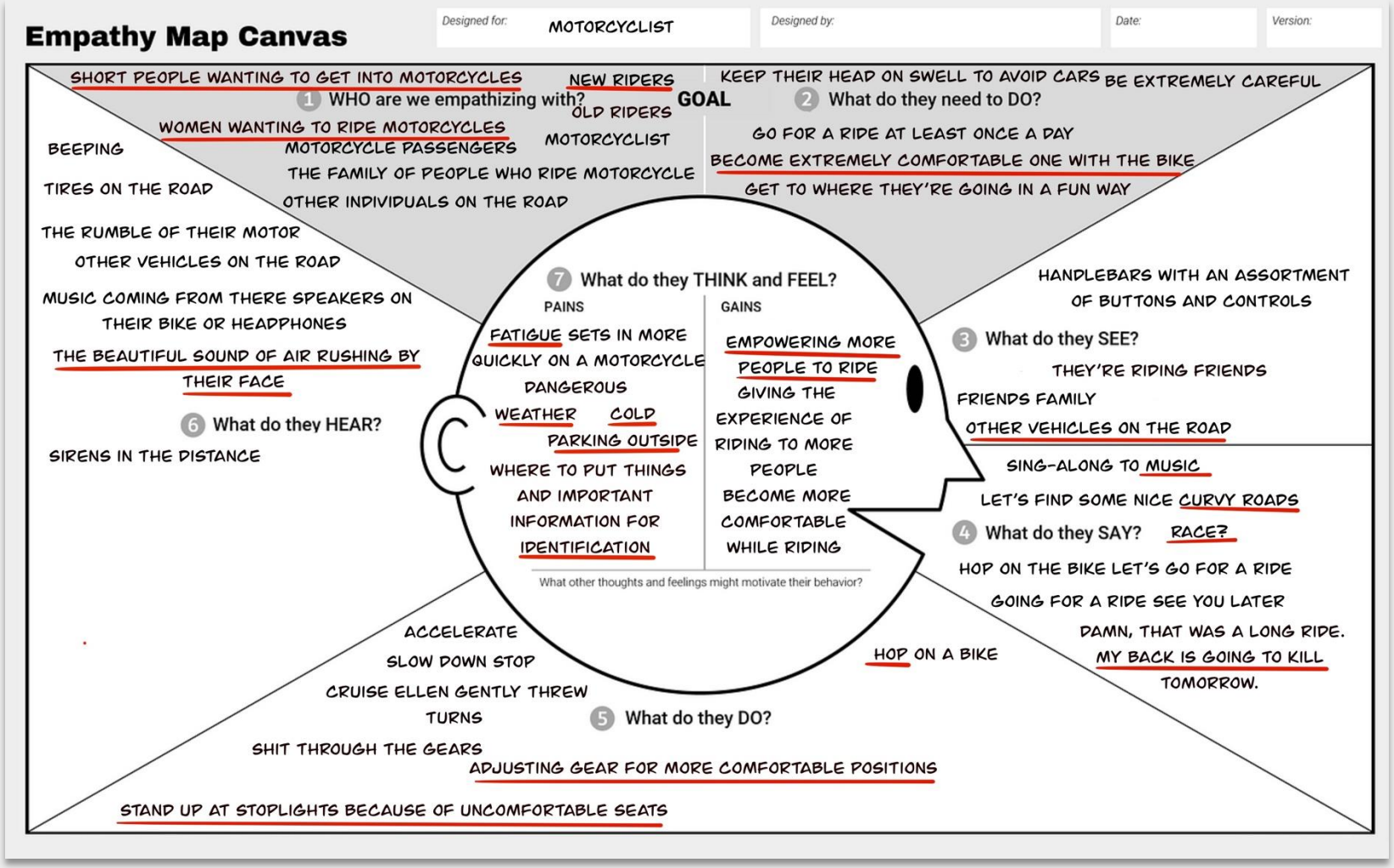
ÖHLINS

Empathy Map Insights

Creating this empathy map helped me understand the perspectives essential for designing my product for motorcyclists. By delving into the daily challenges riders face, I began to empathize with their unique experiences on the road. At the heart of every motorcyclist is a passion for freedom and adventure, but they also encounter serious obstacles, such as enduring long rides that lead to physical fatigue, navigating unpredictable weather, and staying vigilant about safety amidst traffic risks. This empathy map provided me with valuable insights into the realities of a motorcyclist's journey, highlighting areas where my product could enhance their comfort, safety, and overall riding experience.

Potential areas for consideration:

- **Storage** (Bags)
- Fatigue
- **Seat Height**
- Information (ID storage)
- Bike parking
- Short rides and long rides
- New riders (**Women**)
- To help **become one with the bike**



How Might We...

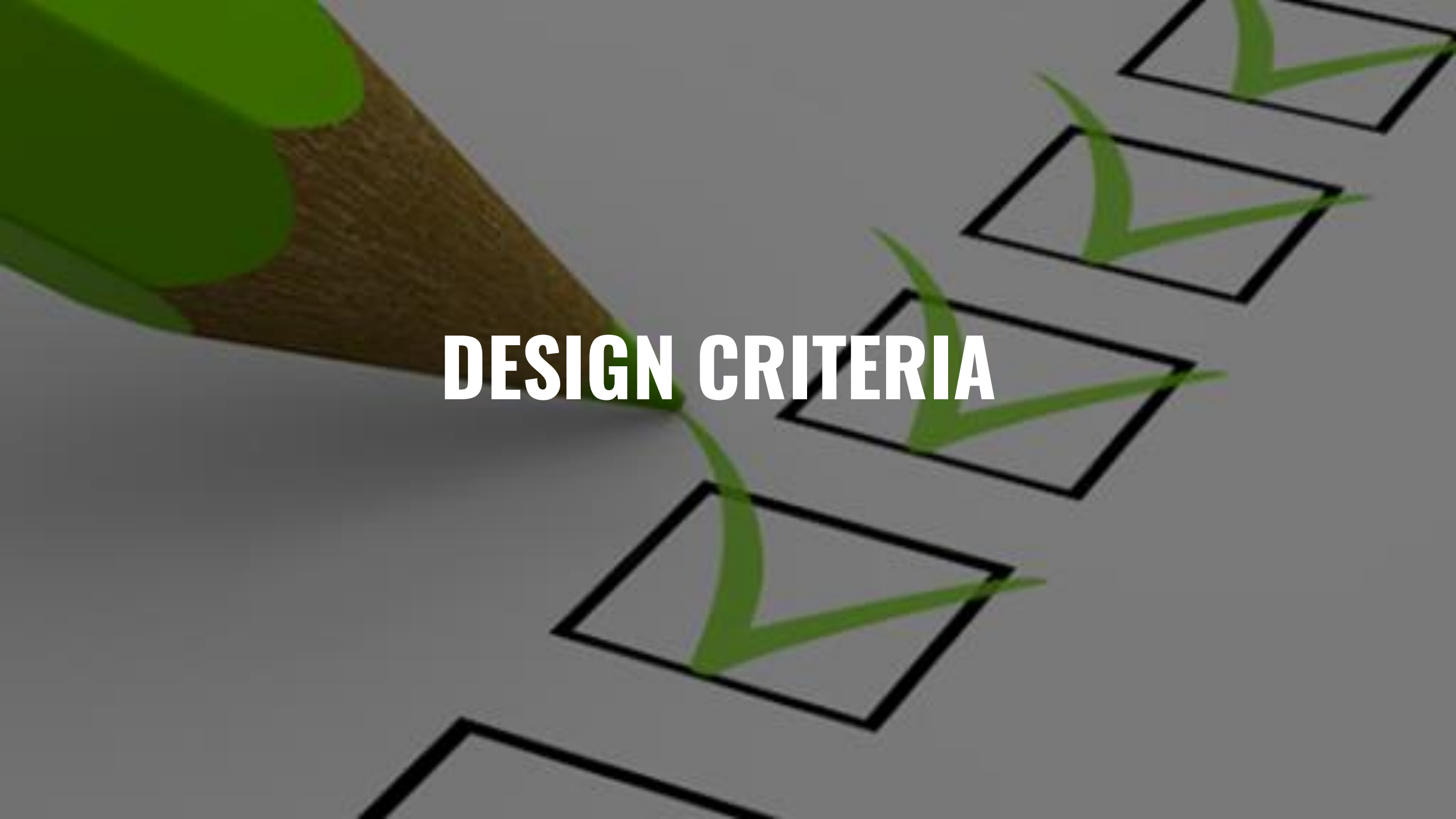
"How might we design a technology-enhanced soft good that not only improves safety and comfort for motorcyclists but also enriches their overall riding experience?"

Mood Board For The Design

Colors associated with motorcycles are typically red, yellow, and other bold colors that add energy and a sense of speed. They evoke feelings of intensity and secondary colors such as black/dark colors can show strength/support for the overall design.

Design elements such as textured surfaces, reflective finishes, and metallic tones suggest robustness and high-performance on a motorcycle. Shapes and modern lines convey precision and implement design elements associated with the motorcycle culture; specifically Italian high-performance bikes use triangles in their stitching.

It is important that my design implement an array of colors to signify strength and keep in mind the high-performance aesthetic of motorcycles.


DESIGN CRITERIA

Primary Goals

Here are some primary goals for designing technology-enhanced soft goods, with a focus on improving motorcycling comfort

- **Vibrations in seat** to alert rider when to turn
- **Safer overall riding experience** *Smartphone integration* Alerts rider when getting phone call can tap into headset etc.
- Visible **turn signals** and taillight integrated into the seat
- **Gel leather seat** that forms to the rider's shape for a more comfortable and ergonomic riding experience
- **Breathable and moisture-wicking materials**→ Making sure that they are suited for the elements/weather/varying temp.
- **Adjustable height** by filling bags under the seat with air.
- **Empowering** riders to want to ride more.

Ultimately, the seat will provide a non-slick and one of one formed seat centered around the rider for the optimal riding experience where they can corner better and feel more in control of the bike.

Some of the Secondary Goals

Here are some secondary goals that the technology-enhanced soft goods could address, but are not limited to

- **Holds Stuff** (personal Information for cops).
- **The feeling of luxury** (aesthetic appeal).
- **Protects** the bike **from** the **elements**.
- **Bags** (holds big stuff too).
- **Rist band** (personal information on band).
- Keeps the bike and rider **warm**.
- **Convenient Access**: Easy-to-reach compartments for commonly used items (e.g., wallet, phone, or keys).
- **Anti-Theft Features**: Incorporate GPS tracking or anti-theft locks to protect the bike.
- **Modular Attachments**: Include customizable storage solutions (e.g., detachable bags or expandable cargo).
- **Emergency Tools**: Include compartments for essential tools or first-aid kits.
- **Personalized Fit**: Adjustable straps or padding to cater to different body types for an optimal fit.

More Research

Research Insights on Designing for Motorcyclists

"Profiling motorbike owners on the basis of their perception"
Ashwini Pradhan, Dr. U. Suma Rao

- Motorcyclists often hold deep emotional connections to their bikes, making them "more than just a vehicle" and part of their identity. Many riders feel their bike brings a "unique relationship," adds "fun," reduces anxiety, and represents something essential in life (Pradhan & Rao, 2018, p. 54). These **emotional insights** reveal that users are not merely seeking functionality but an experience that aligns with their self-expression. Designers can thus "venture into this area of understanding," tailoring features that resonate with these emotional needs (Pradhan & Rao, 2018, p. 58).It is important for my design to incorporate this emotional need by designing something they can be satisfied with on their bike.

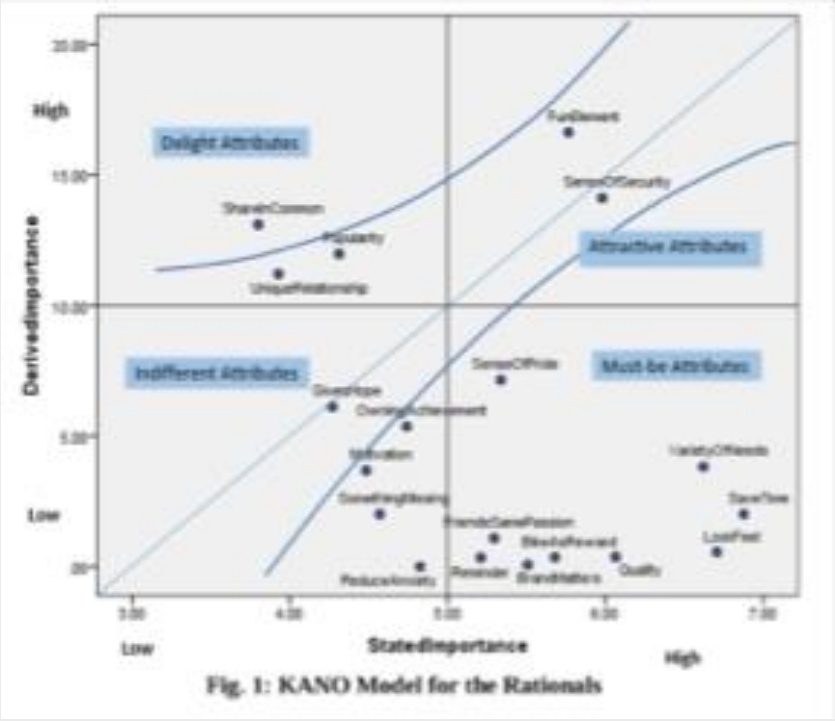


Fig. 1: KANO Model for the Rationals

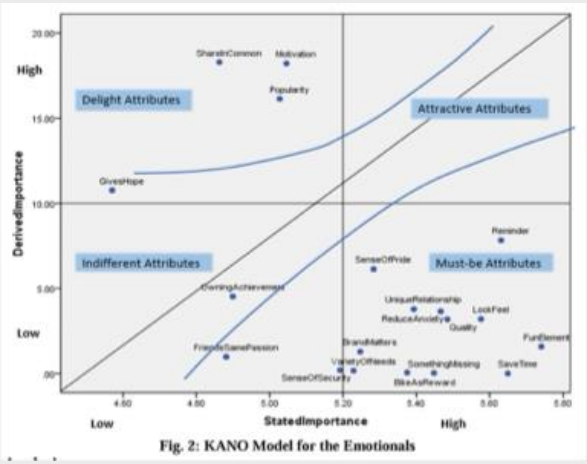


Fig. 2: KANO Model for the Emotionals

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Ergonomic Motorcycle Seat Design

Design and development of motorcycle seat from ergonomics point of view with vibration and discomfort analysis

Dr. M. M. Patil, Dr. Lokesh Bajpai, Dr. P. L. Verma

- Designing motorcycle seats with ergonomic principles can significantly improve rider comfort by reducing vibrations and discomfort. A key consideration in seat design is rider posture and weight distribution, as seats should evenly support the rider's "ischial tuberosities," or sitting bones, to minimize pressure and vibration impact (Patil et al., 2014, p. 11). Adjusting parameters like cushion density and shape allow designers the ability to improve body support and reduce the vibration transmitted to the rider's spine and buttocks. The modified seat design in this study reduced vibration amplitude by 47.83% to 89.29%, enhancing **comfort during long rides** (Patil et al., 2014, p. 14).

Fig. 2: Fabrication Process for Modified Seat of Motorcycle

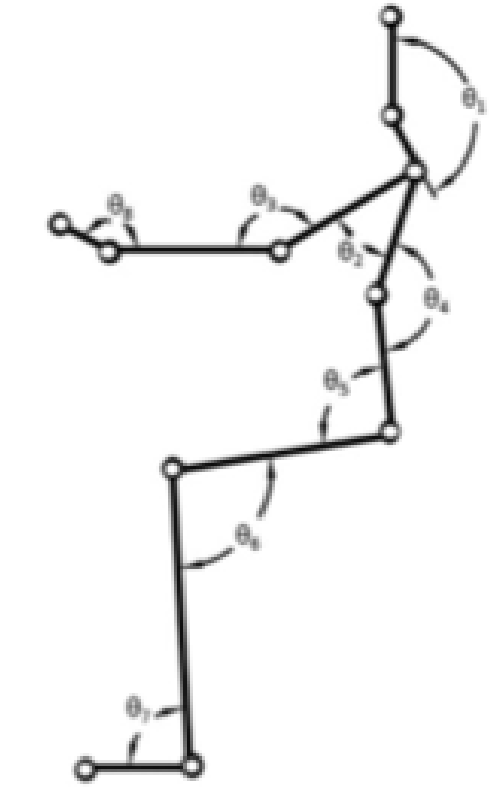
Table-1: Percentage Reduction in Discomfort (RAMSIS)

Sr. No	Parameters /Body Parts	Original Motorcycle Value	Modified Motorcycle Value	% value of Discomfort
1	Fatigue	3.6	2.9	19.44
2	Discomfort Feeling	4.6	3.8	17.39
3	Neck	3.5	2.6	25.71
4	Shoulders	3.5	2.5	28.57
5	Back	2.1	2.1	---
6	Buttocks	1.9	1.6	15.79
7	Left Leg	3.5	1.6	54.29
8	Right Leg	3.2	2.1	34.38
9	Left Arm	2.1	2.8	---
10	Right Arm	2.4	2.4	---
11	Spinal Column	4.2	4.2	---

Motorcycle riding posture: A review

Muthiah Arunachalam, Chirapriya Mondal, Gurdeep Singh, Sougata Karmakar

S. N o.	Joints/Body segments	Common Possible DOF in sitting	Possible DOF in motorcycling	USA military 1956 (Age: 18–40)	USA Students (Age: 20–28)	India mixed occupation (Age: 20–40)
1	Neck	Flexion	Flexion	45	70	45
		Extension	Extension	45	95	30
		Rotation	Rotation	60	72	55
		Lateral Bending	Lateral Bending	45	55	40
2	Lower back/Trunk (Lumber + Thoracic)	FlexionExtension	FlexionExtension	80 20–30	94-	40 10
		Rotation	Rotation	45	69	-
		Lateral Bending	Lateral bending	35	34	40



- Designing motorcycle gear requires an understanding of rider characteristics, which in turn influence the overall design of a product when adhering to their posture. According to Arunachalam et al. (2023), "Rider's physical characteristics (anthropometrics, age, gender, etc.)... are important determinants of adopted posture during riding. Among these, anthropometrics... is one of the crucial factors while designing a motorcycle with the intention of providing comfortable riding posture."

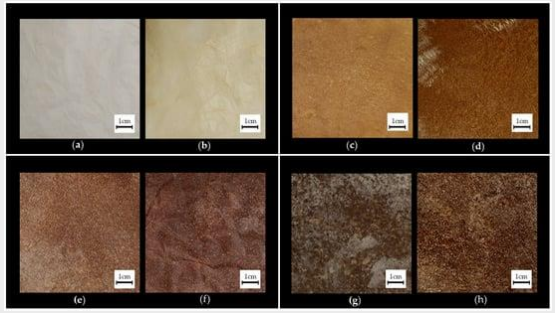
- The six key anthropometric dimensions to consider are stature, inner leg height, knee height, buttock-knee length, acromion to grip length, and hip breadth. Additional factors like trunk height and thigh circumference can also inform design (Arunachalam et al., 2023).

- By integrating these insights, I plan to create motorcycle designs that enhance rider **comfort and safety.**

https://www.sciencedirect.com/science/article/pii/S0263224118309448?via%3Dihub

Utilizing Biotechnological Leather in Motorcycle Gear

Design of a Naturally Dyed and Waterproof Biotechnological Leather from Reconstituted Cellulose
by Claudio José Galdino da Silva Junior, Julia Didier Pedrosa de Amorim, Alexandre D'Lamare Maia de Medeiros, et al.



- The study by da Silva Junior et al. (2024) explores a biotechnological leather made from reconstituted cellulose. It is naturally dyed and waterproof allowing git to be effectively used in various motorcycle gear applications, such as seat coverings, jackets, and accessories. According to the authors, this leather offers "a promising alternative for sustainable products due to its functional properties" (da Silva Junior et al., 2024). Its **durability** and **water resistance** make it an excellent choice for enhancing the comfort and longevity of motorcycle products. This is important research to consider when determining the kind of material for my designs.

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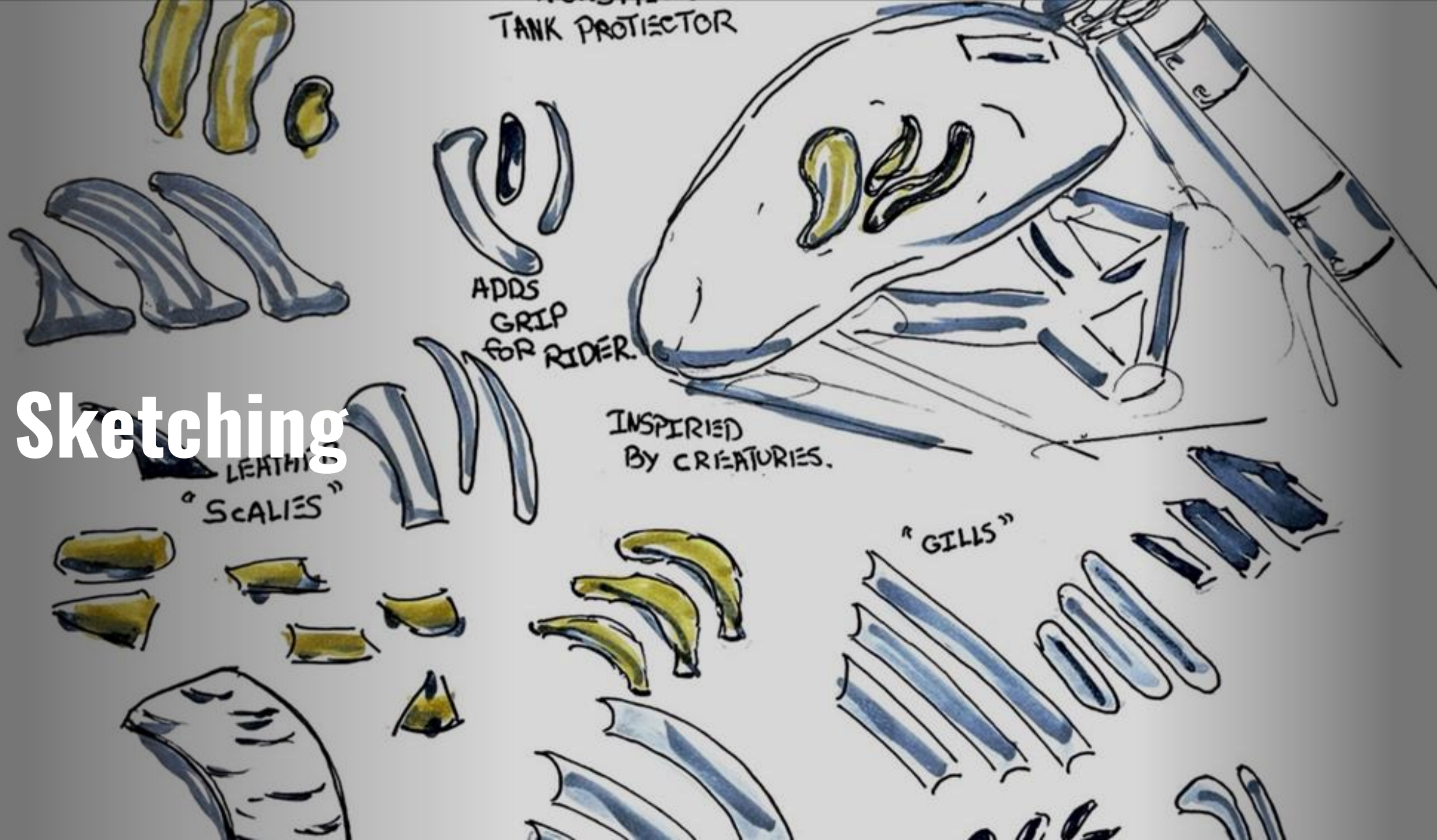
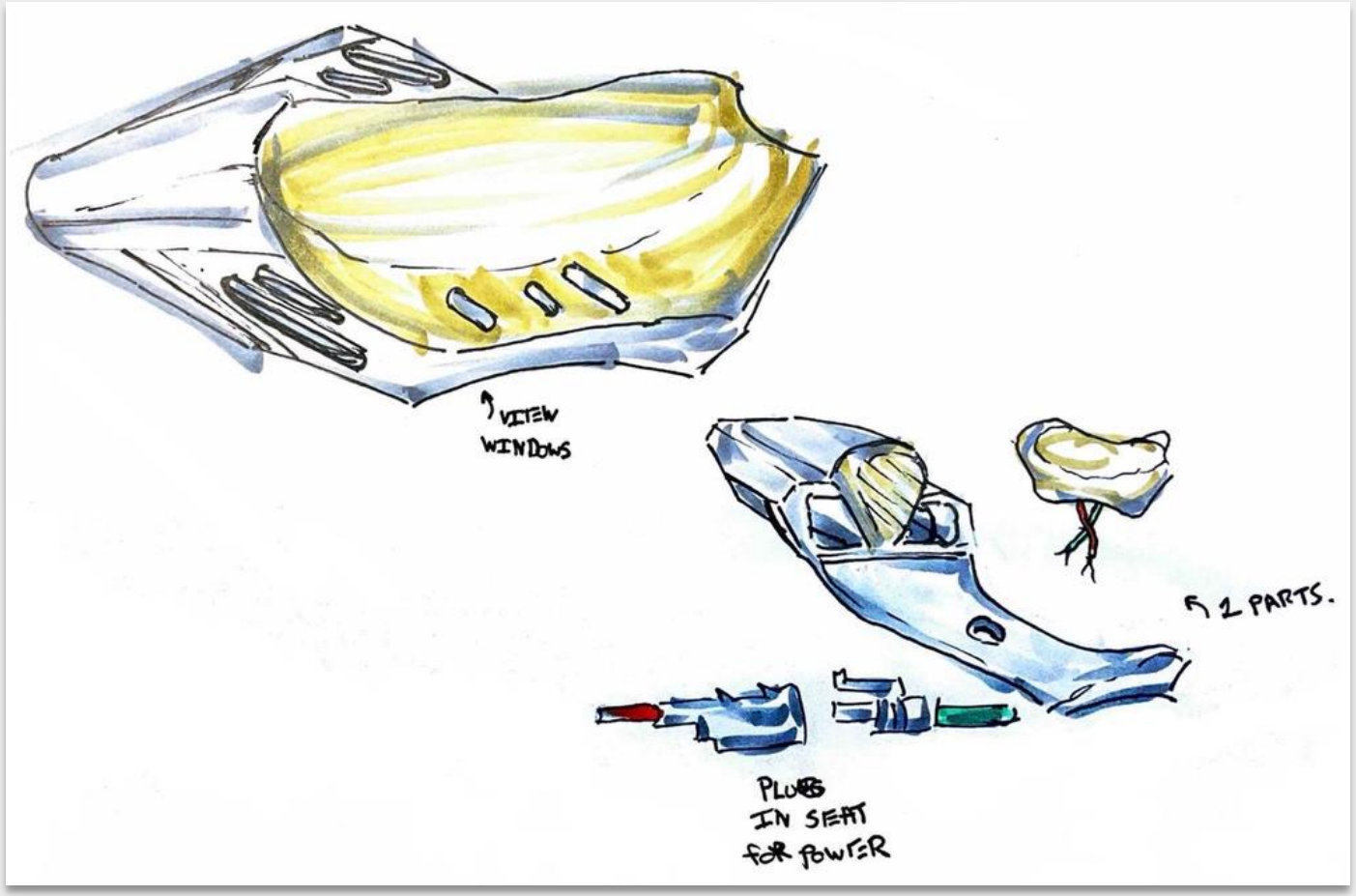
Sketching


TANK PROTECTOR
ADDS GRIP FOR RIDER.
INSPIRIED BY CREATURES.
"SCALES"
"GILLS"

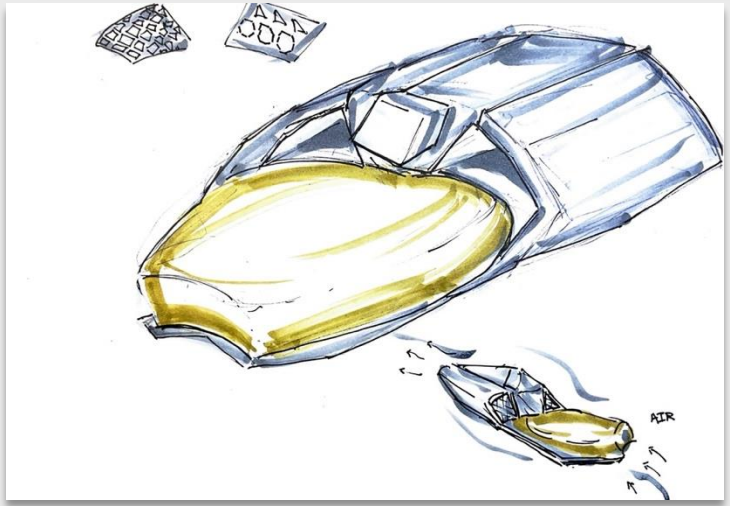
First Ideation

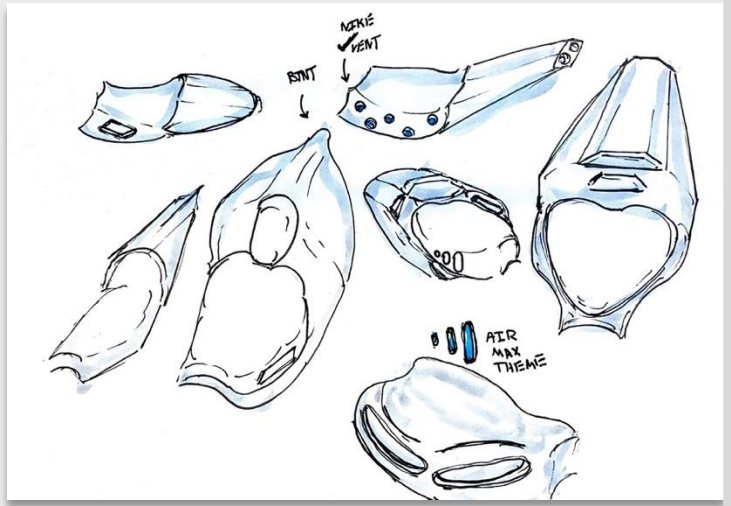
These sketches represent the initial concepts for a sportier, ergonomic seat design, focusing on sleek, dynamic forms. The objective was to create an all-in-one seat that integrates electrical connections while drawing inspiration from the **"Nike Air Max"** for enhanced comfort. The goal was to craft a seat that not only meets the practical needs of sport bike riders but also offers a balance of aerodynamics, aesthetics, and functionality, while supporting everyday electronics.



User Feed Back:

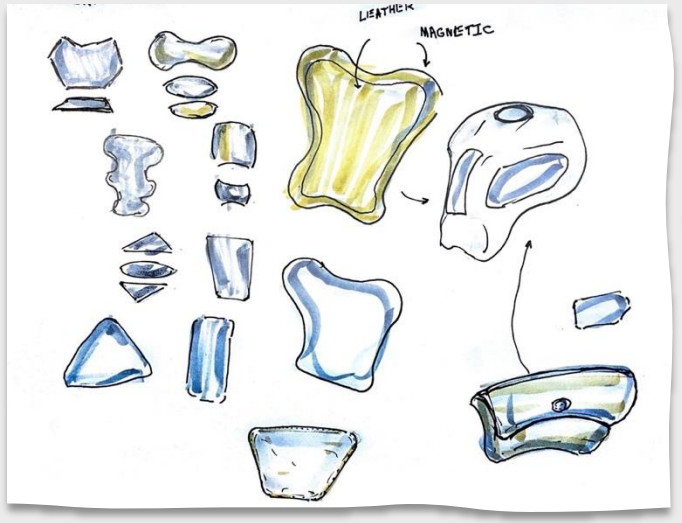
- Not too Aggressive of a look.
- I like the one-seater would like to. see more with a back seat too.
- Where would the air-filled bag go.

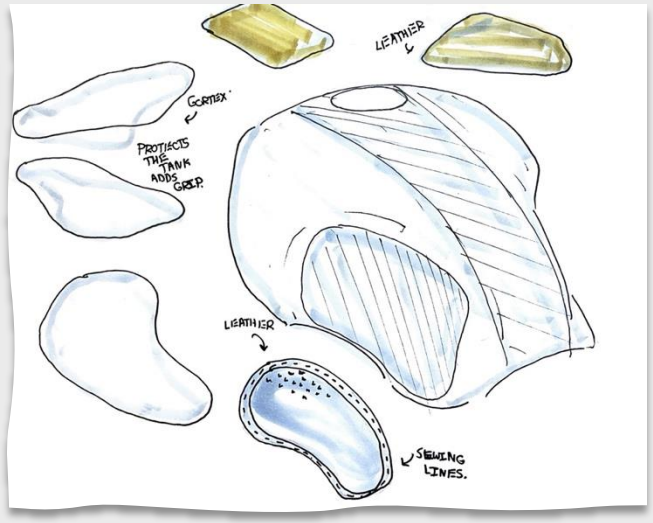


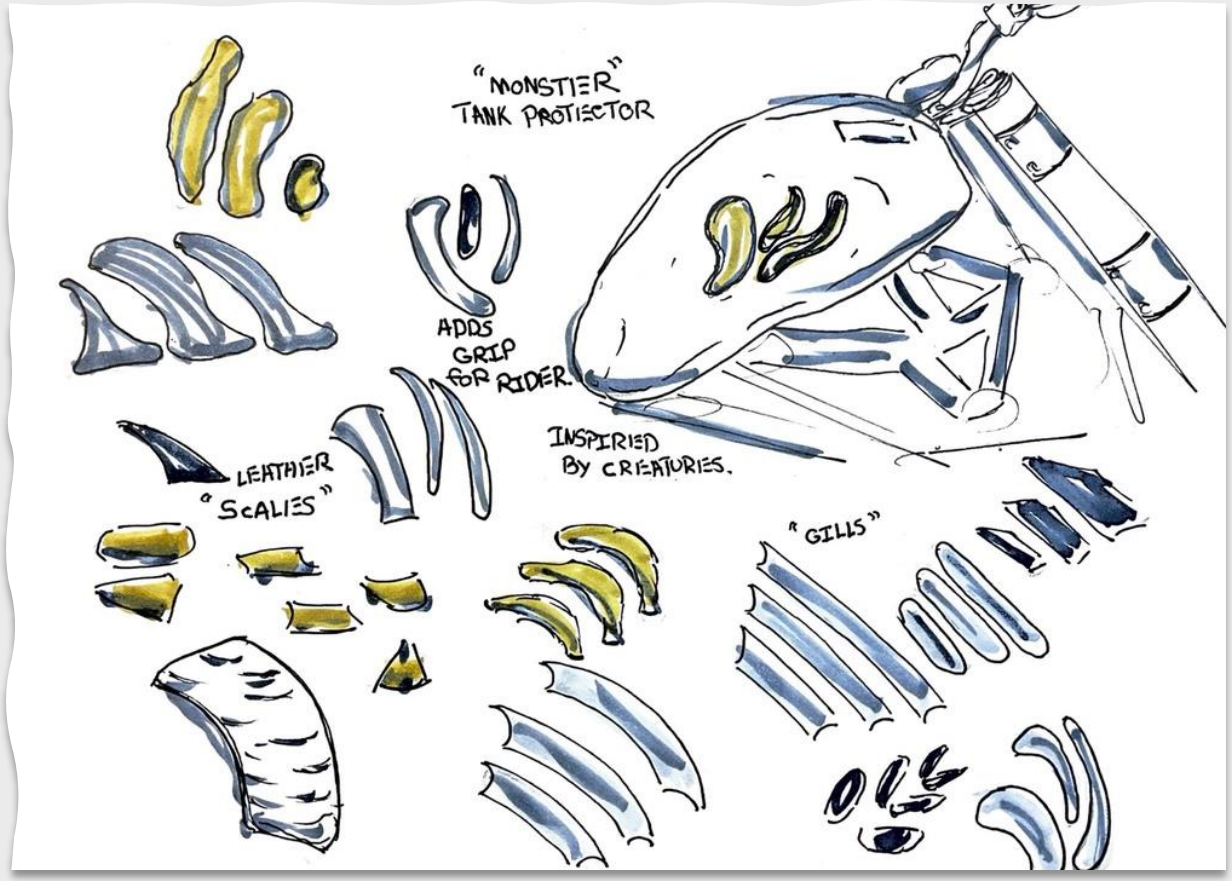


More Ideation

This design is inspired by the Ducati Monster's tank and is leather tank protectors that combine protection with style. The shapes are tailored to the tank's contours, providing paint protection while complementing the bike's look. Made from leather, the design creates a rustic feel, with textures that resemble leather scales. Ultimately, they aim to add both **grip** for the rider and **enhance the longevity** of the bikes paint.

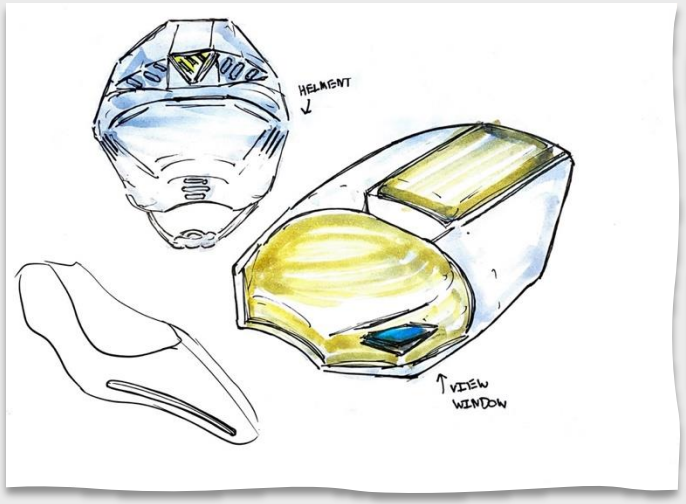


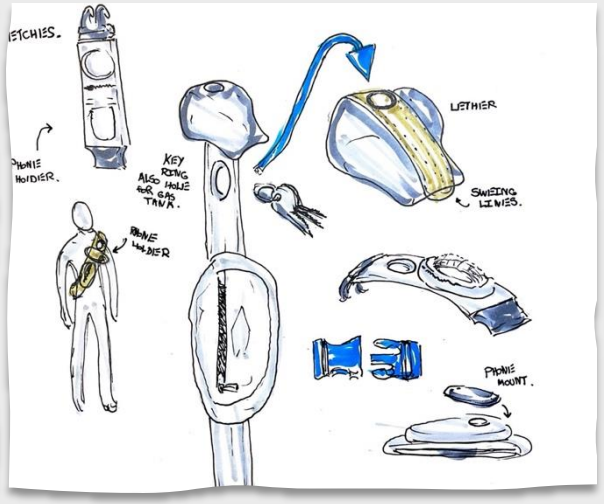


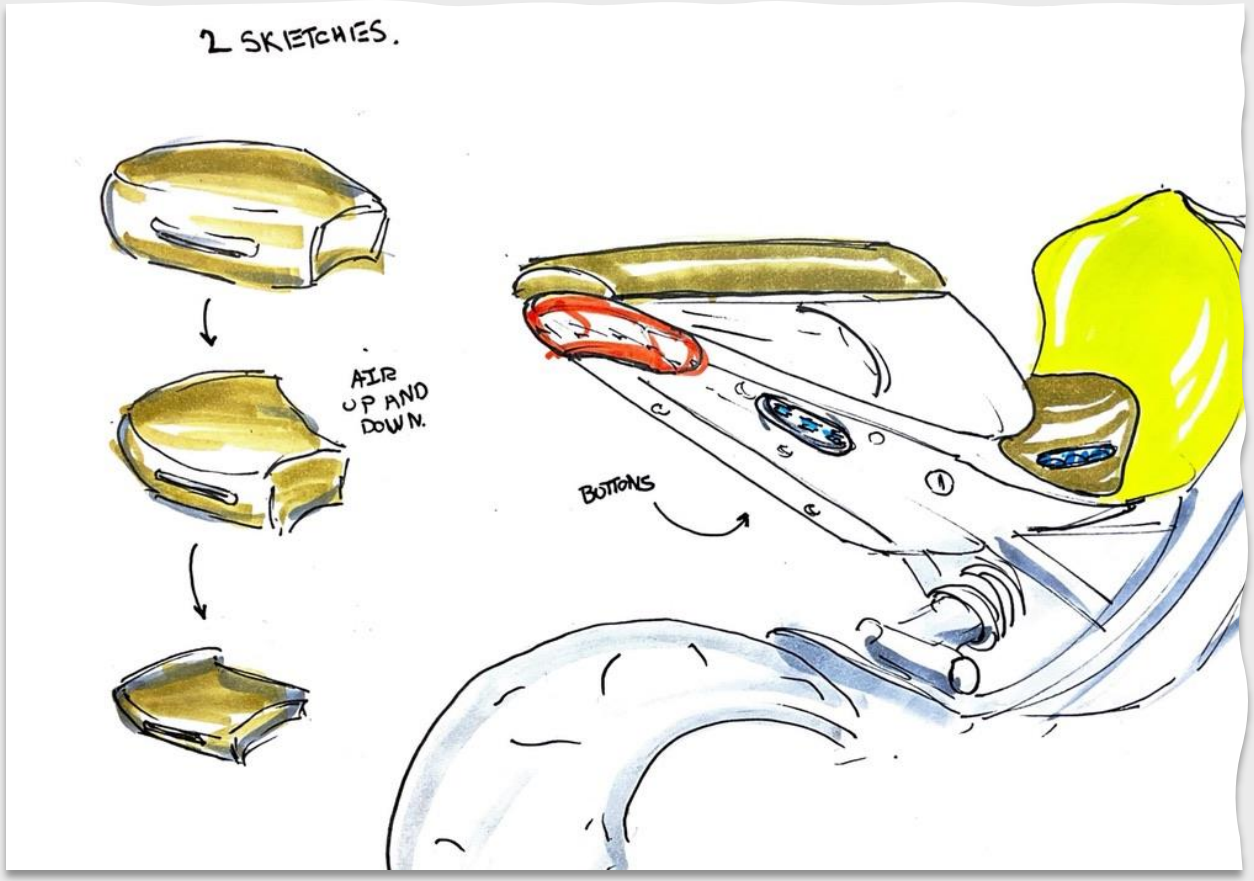


User Feed Back:

- Thought the Monster tank protectors were funny.
- You would need to protect the side and lower top of the tank from being scratched.
- Look at other materials.







More Ideation

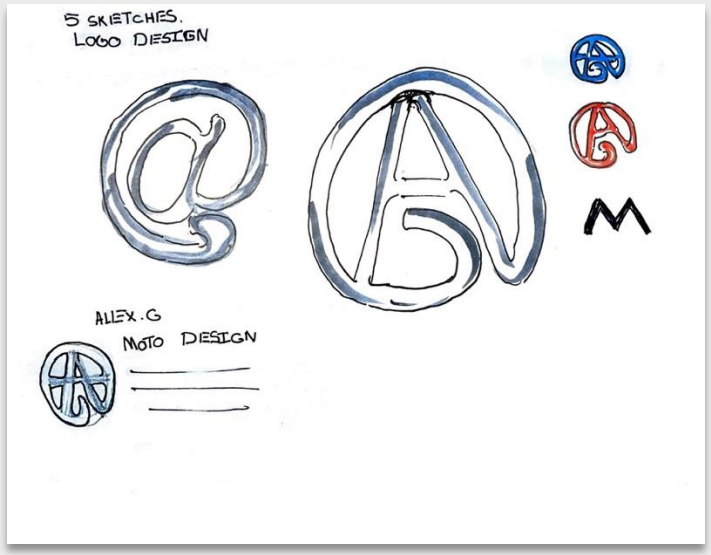
This ideation features a dual-purpose tank fanny pack that straps to the bike's gas tank when not in use. It serves two key functions: protecting the tank and providing convenient storage. Designed to complement the bike's aesthetics, the fanny pack allows riders to express their style off the bike, while offering easy, accessible **storage** for everyday items while riding.

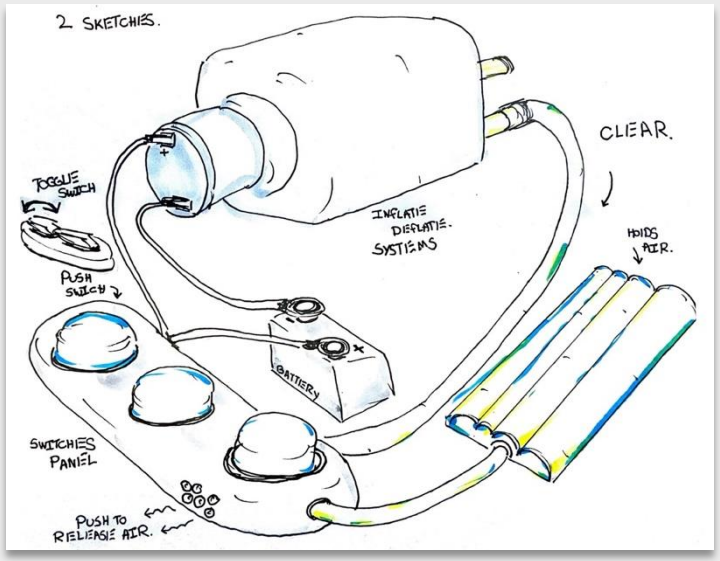
These ideations explore a seat that can raise and lower using compressed air. The design conceals this functionality to maintain a seamless appearance. Buttons located on the underside of the bike allow riders to adjust seat height for optimal **comfort and control.** Additionally, the seat features an ergonomic shape and incorporates moisture-wicking materials to protect the internal electronics.

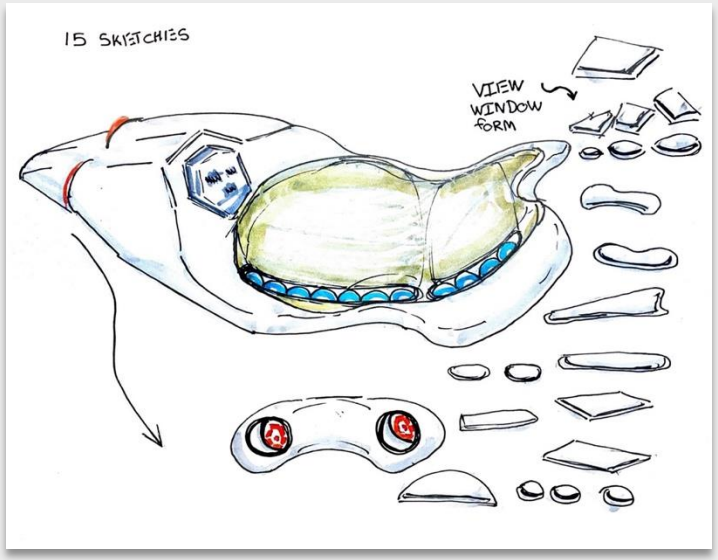
First Refinement Of Ideas

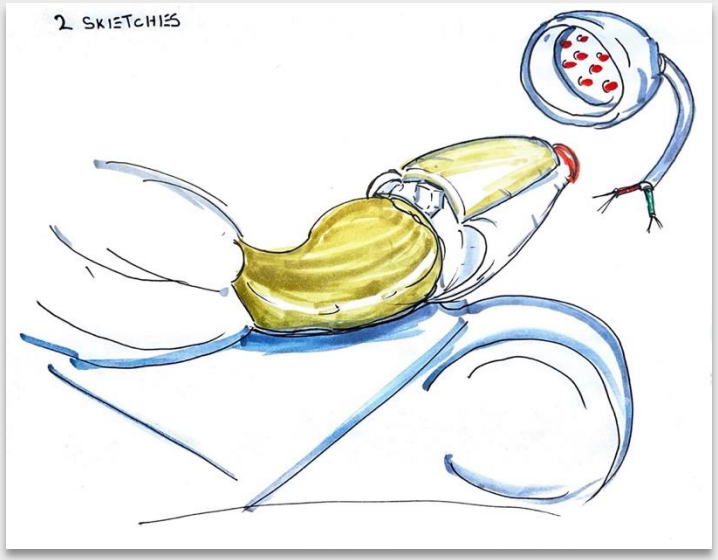
Here, I explore the functionality, form, and overall design of an **"any-level" adjustable seat.** The concept includes a compact compressor and integrated switches, seamlessly incorporated into the bike's undercarriage for a clean and efficient solution.

I refined my initial concept of integrating turn signals into the seat design, drawing inspiration from the "Nike Air Max" aesthetic. This iteration incorporates sleek, functional elements while ensuring the electronics are **weatherproofed** for durability.



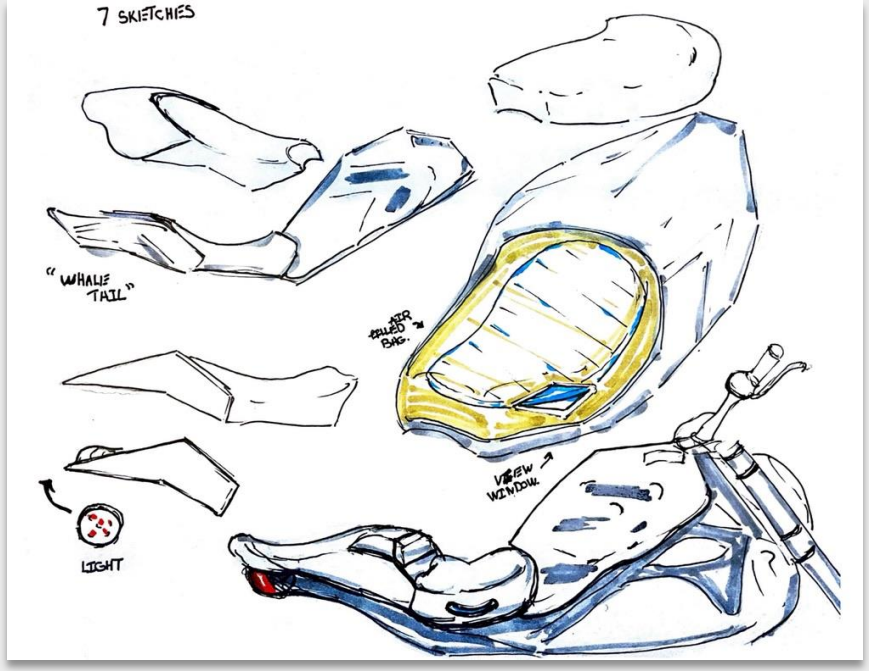


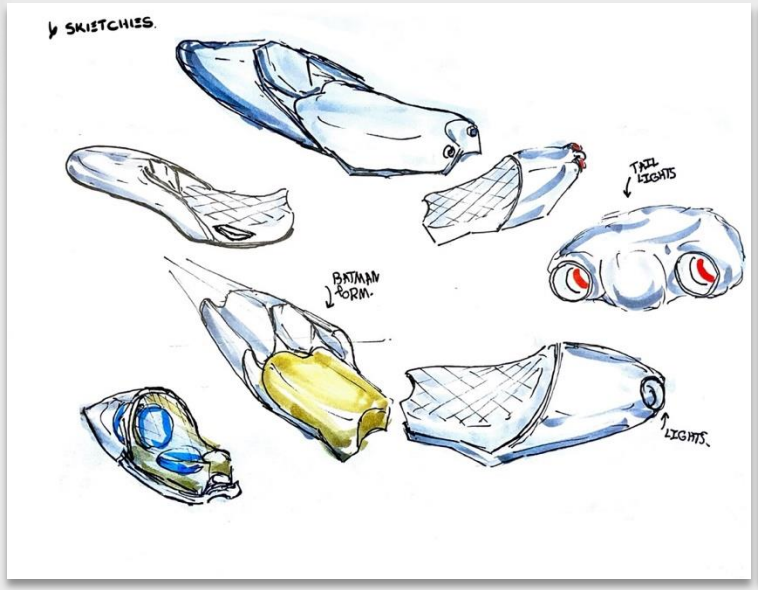


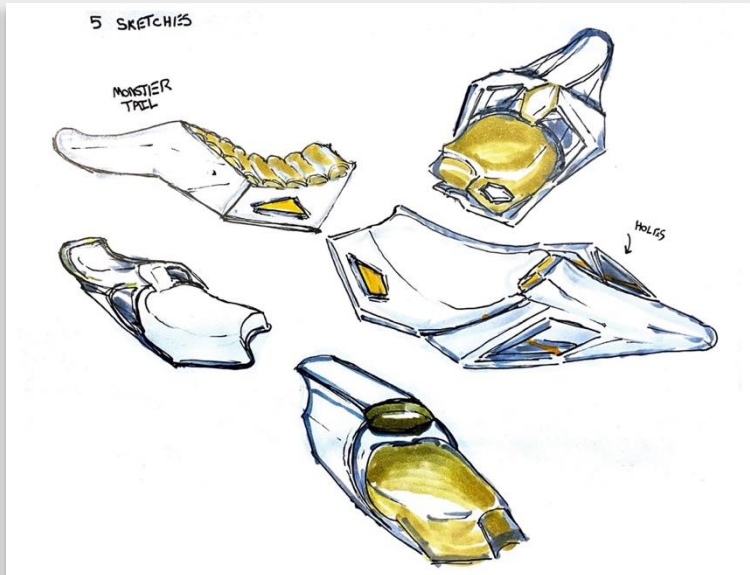


Refinement Of Form

These sketches refine my concept of combining traditional soft goods (like apparel and accessories) with modern technology to improve **both function and user experience.** The whale tail design brings a soft goods aesthetic, complemented by leather elements. Integrating electronics into the seat enhances functionality and safety while riding. The different tail designs give riders a way to express their style, while also offering comfort for long rides, with Nike Air Max-inspired features to boost ergonomics.

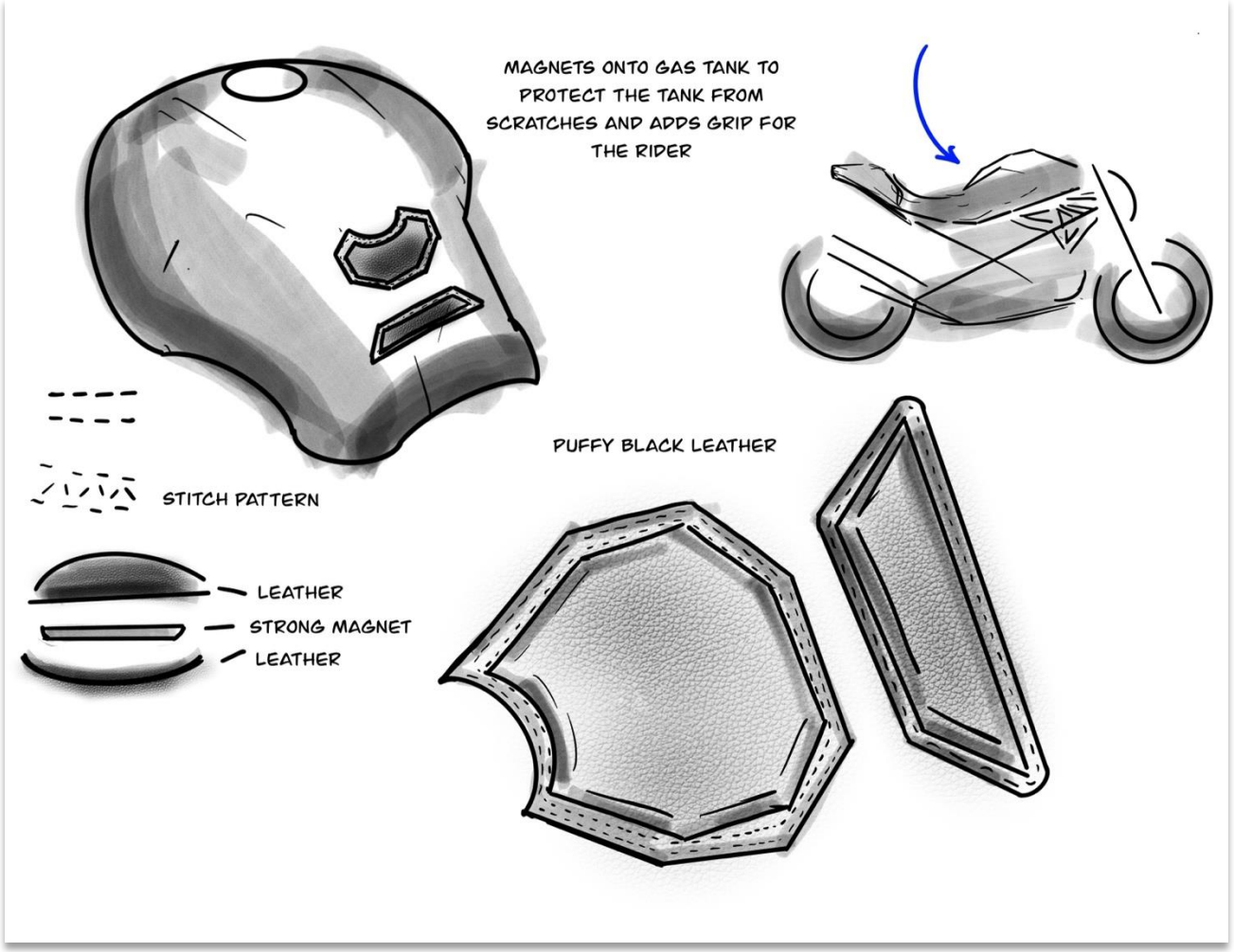




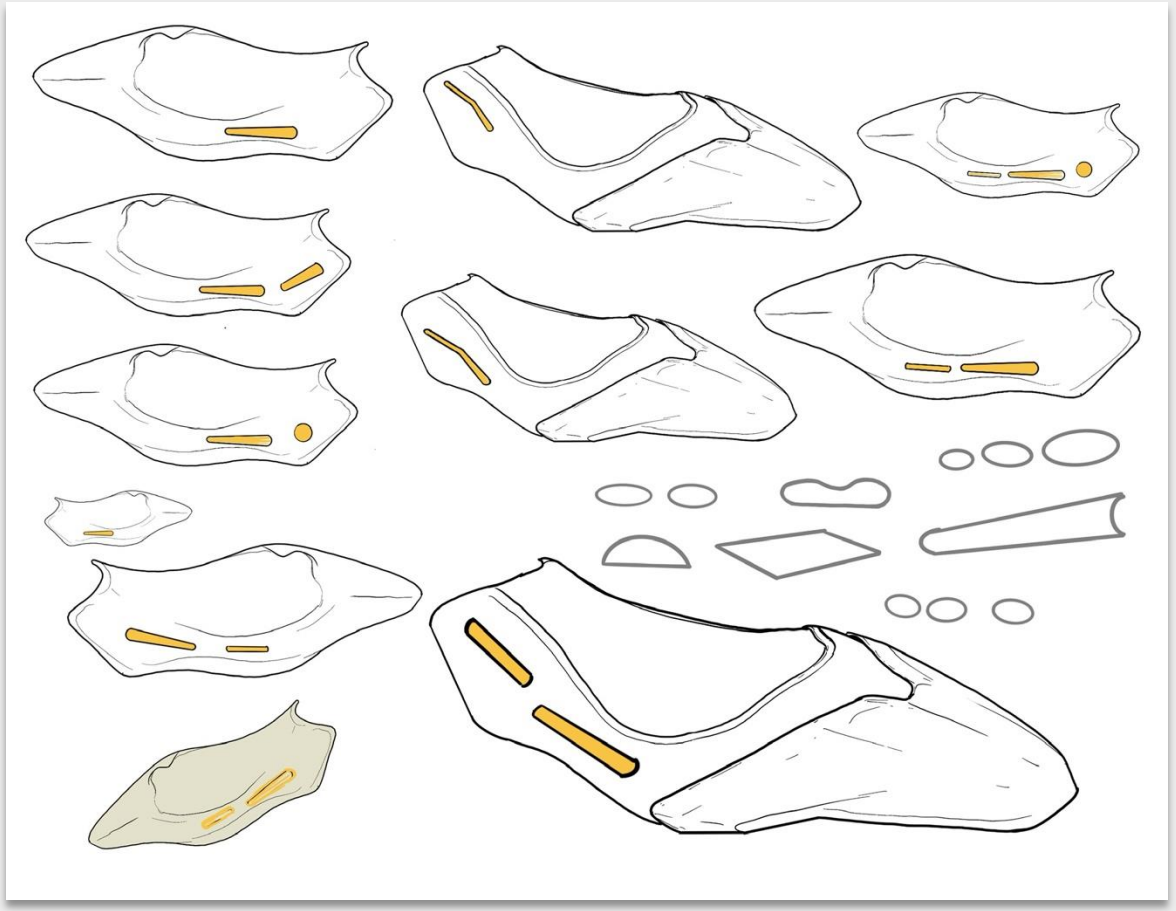


Final Ideas

This design showcases a tank cover enhanced with a puffy leather detail and precise stitching. It is secured with magnets to the tank for effortless attachment and removal. It offers riders full customization and allows them to easily swap out different color leathers to express their unique style.



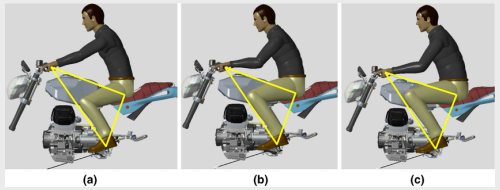
Final Ideas

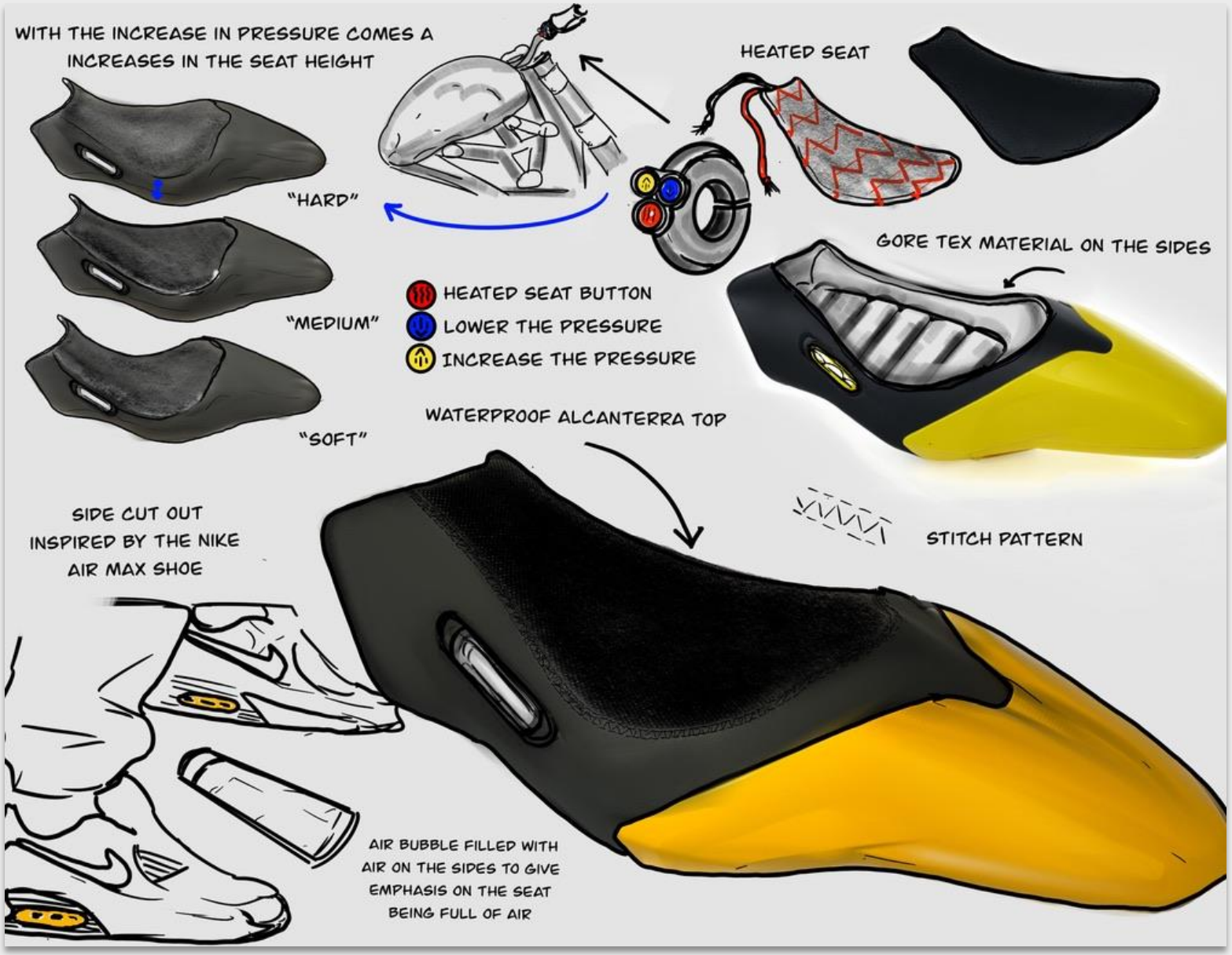


Going off the “Nike Air Max” bubble design, I wanted to play with the different potential avenues I could go with including this feature. Above are renders/sketches that incorporate the features in different ways so that they are on the seat in a stylish and inventive way. The bubble had to be featured in a way that went with the flow of the seat while also still offering the cushion for comfortability within the seat.

Final Ideas

This design uses Alcantara for its **luxurious texture** and **weather-proof** technology, combined with an integrated air compressor system. The system allows the rider to adjust the seat's firmness, switching between a firmer, sportier feel and a softer, more comfortable setting. This **flexibility** lets riders adapt to different riding conditions, providing better support for performance or a more relaxed, cushioned experience on longer rides. The system also includes a heated seat and built in electronics for other accessories to be incorporated. This design also boasts colored stitching to compliment the riders bike depending on what color they have.





Prototyping

Prototyping

All models and the final product will focus on developing an aftermarket seat for the Ducati Monster 821. However, the design concept will be versatile enough to apply to motorcycles across the market.

Background on the Ducati monster 821

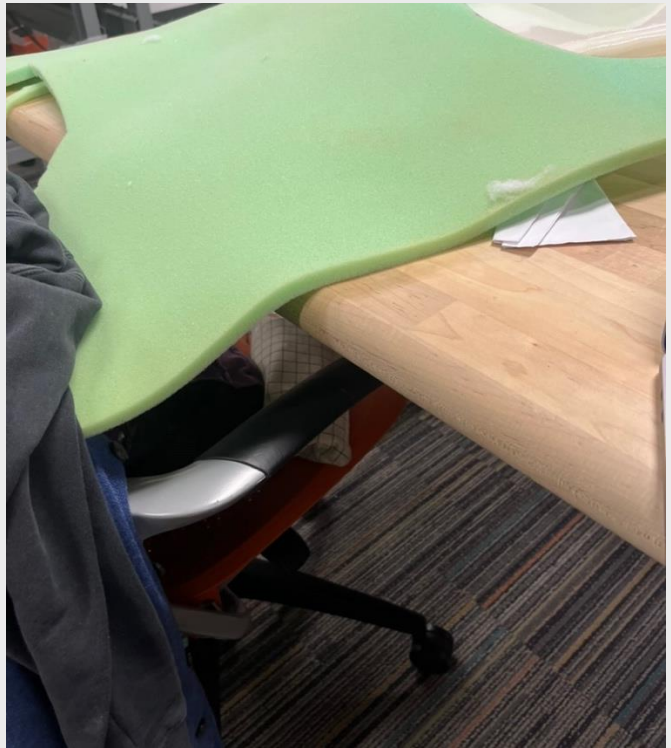
Famous for its iconic naked-bike style, the **Monster 821** is designed to deliver agility and power, making it a top choice for riders craving a thrilling ride. The bike features an exposed frame, and muscular build hints the **Monster** name. The bike was launched in the early '90s and set a new standard for urban street bikes.

Since I'll be designing an aftermarket part for the Ducati Monster, I wanted to capture the overall theme of the bike. Here's a mood board I created that best represents the Monster's style.

First prototype

- Verifying the concept

Here is my first prototype where I messed around with my initial concept. The prototype aimed to answer the question of what was possible and explore the implementation of two air filled bladders into a motorcycle seat.

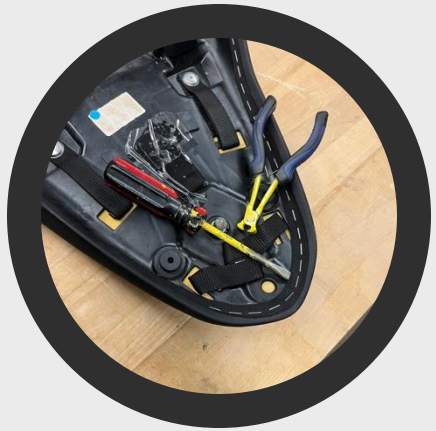


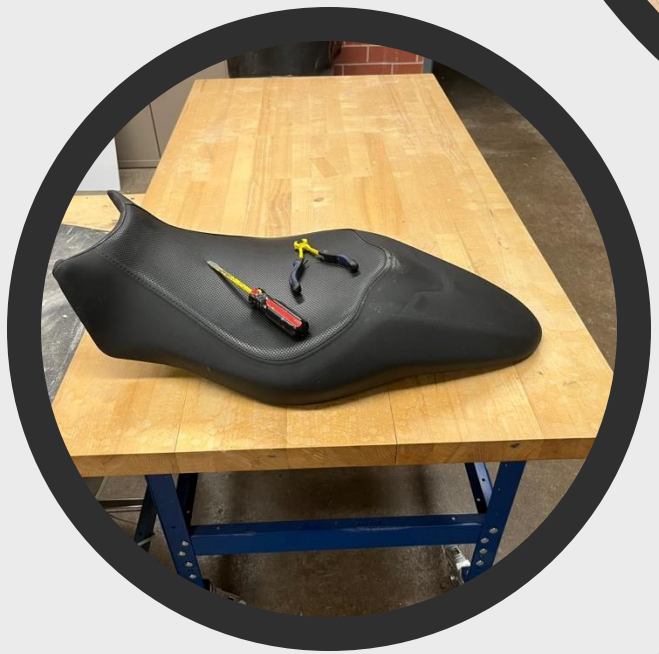
First prototype user feed back

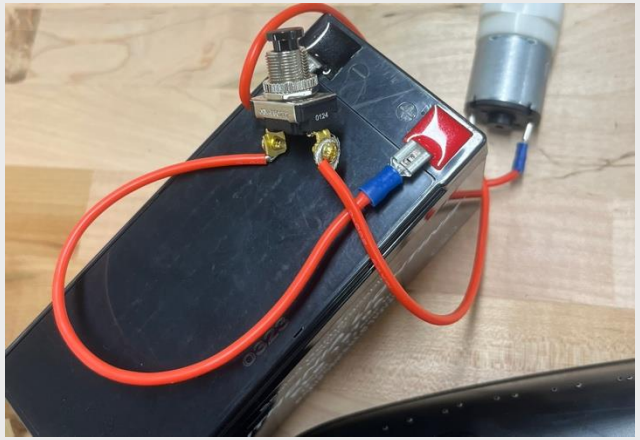
After creating the model and testing it myself. I wanted to gain feedback from my classmates. They enjoyed the functionality and how the seat could raise and lower.

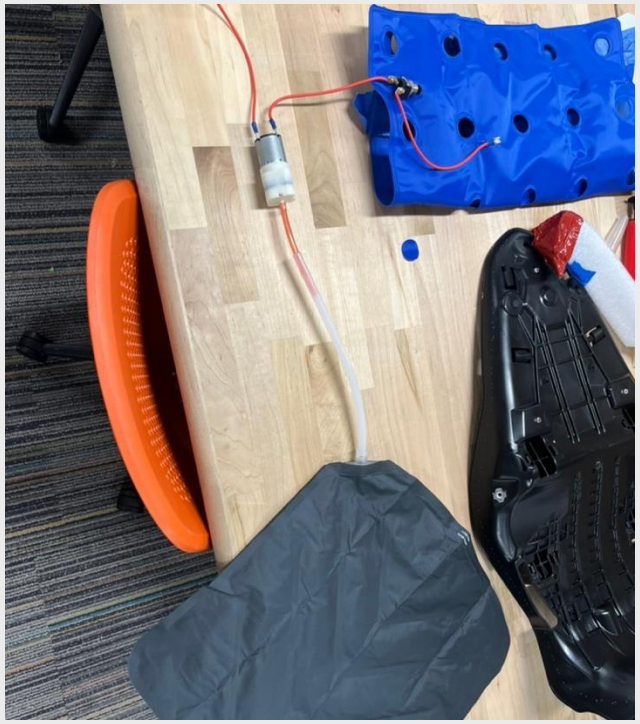
Deconstruct and redesign

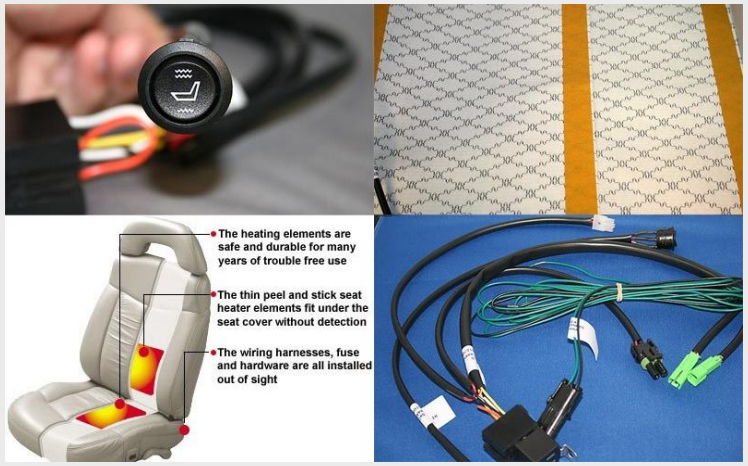
I purchased an OEM seat for the Monster from Ducati so that I could deconstruct it and find areas of improvement. The deconstructed seat offered a base for my design and how I could implement a redesigned soft-good material.







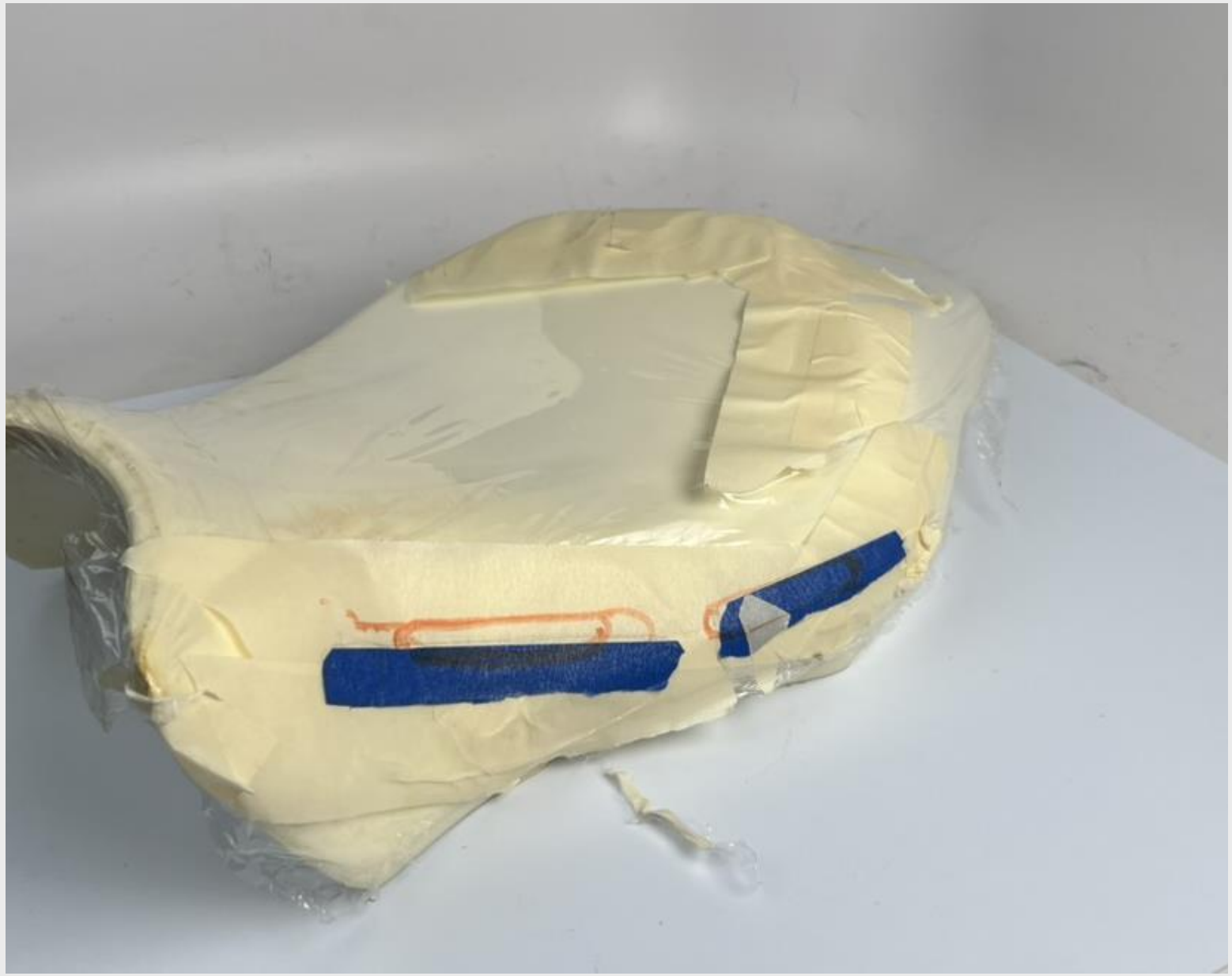


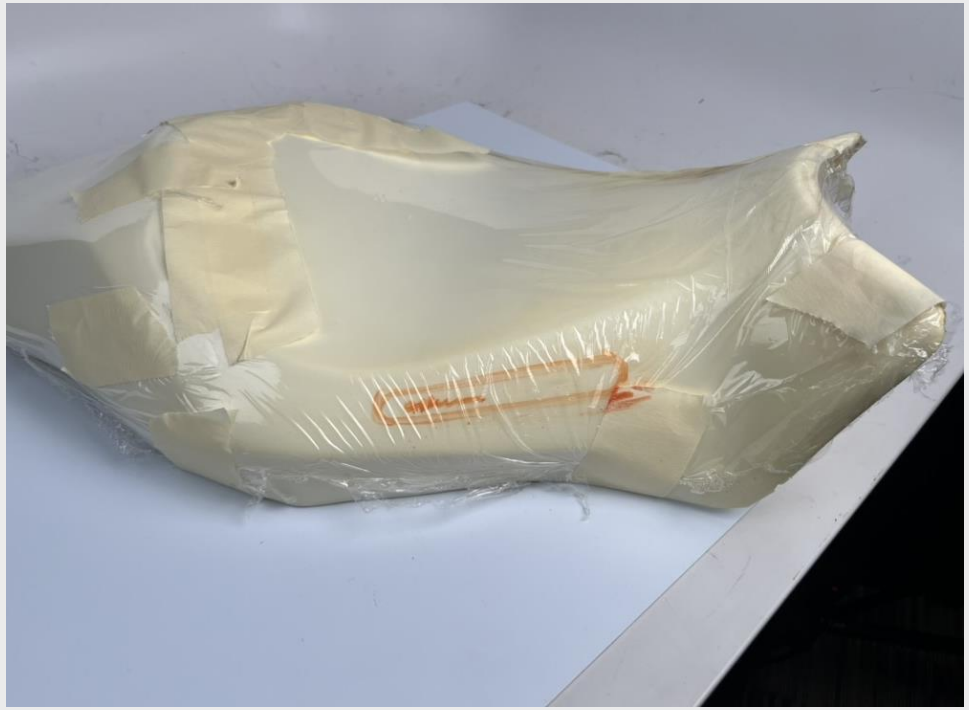


Incorporated technology

The final integrated technology will include an air-filled bladder that inflates and deflates using a small DC pump powered by the bike's battery. Additionally, the seat will feature built-in heating coils to provide warmth during cold rides.

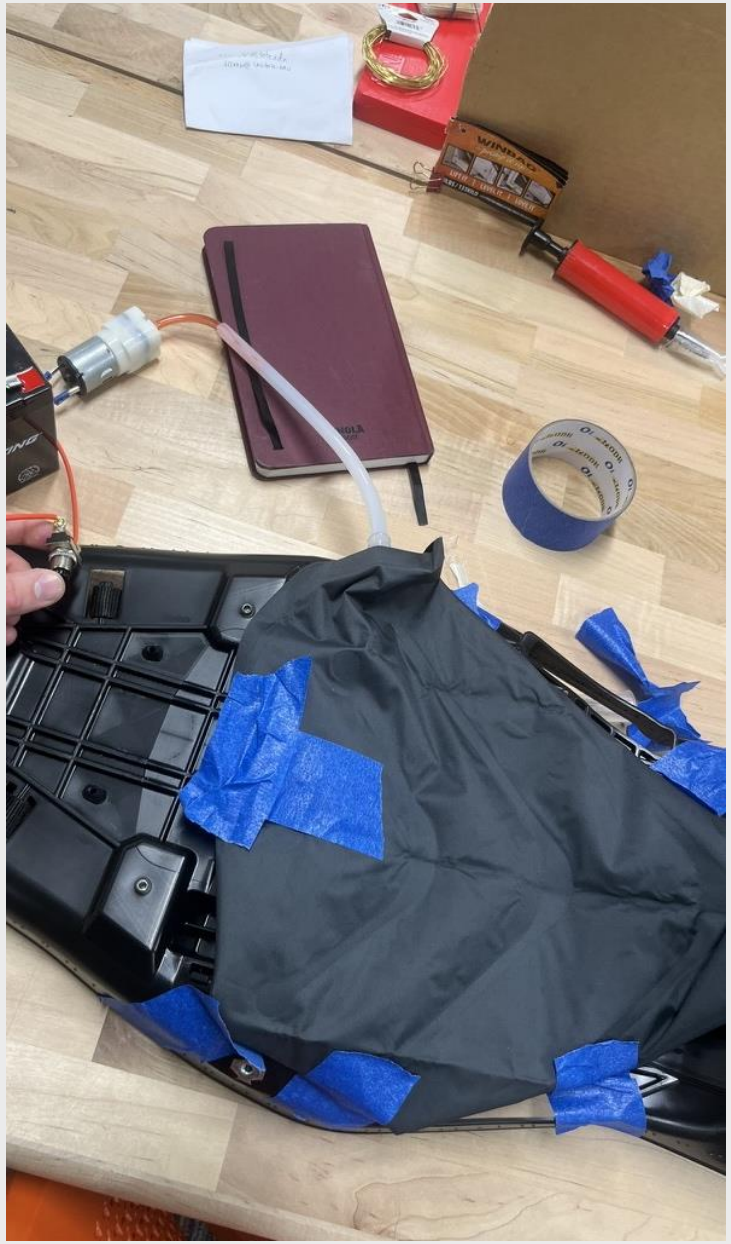
Prototyping Side Bubble

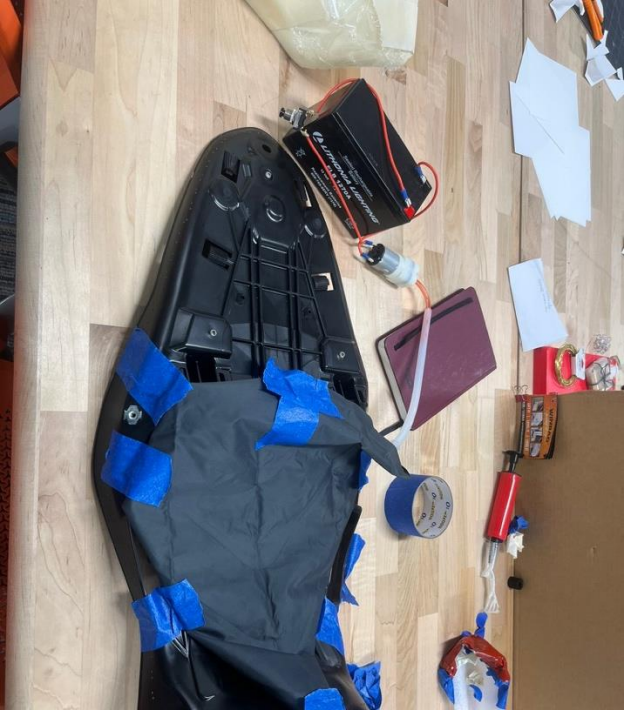




Prototyping Side Bubble

Prototyping form





Prototyping form

Here I played around with making the air bladder fit so that it was seamless and non-cumbersome

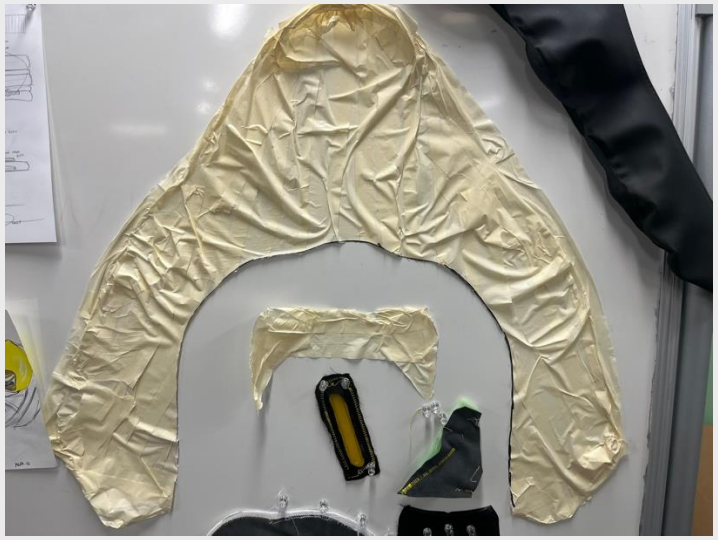
Expert insights

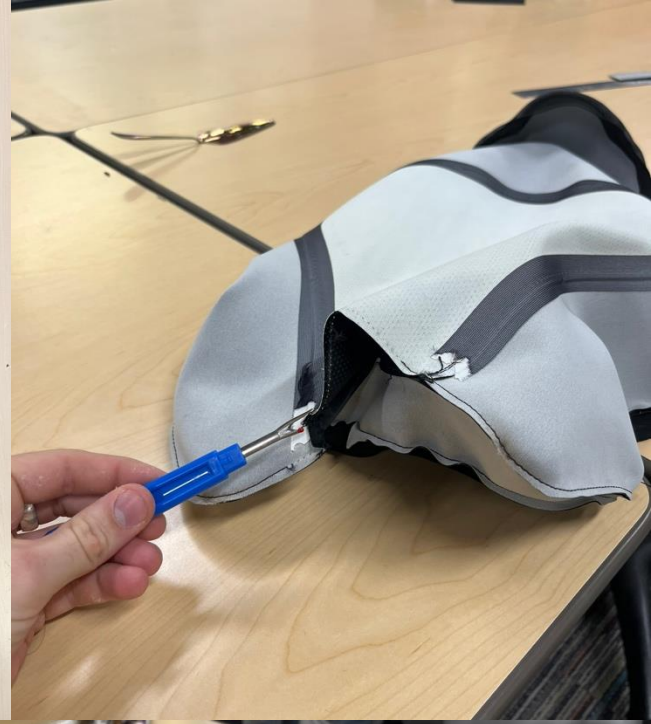
At this point in the project, I had no idea how to design a seat that looked factory-made, as this was my first time tackling such a task. To get some guidance, I searched for local upholstery shops and connected with the owner of *A Stitch In Time Upholstery,* who was incredibly helpful. He generously shared advice on creating a seat that would be both professional in appearance and highly functional.

- The most helpful advice he gave me was to use chalk and tape for everything during the drafting process.

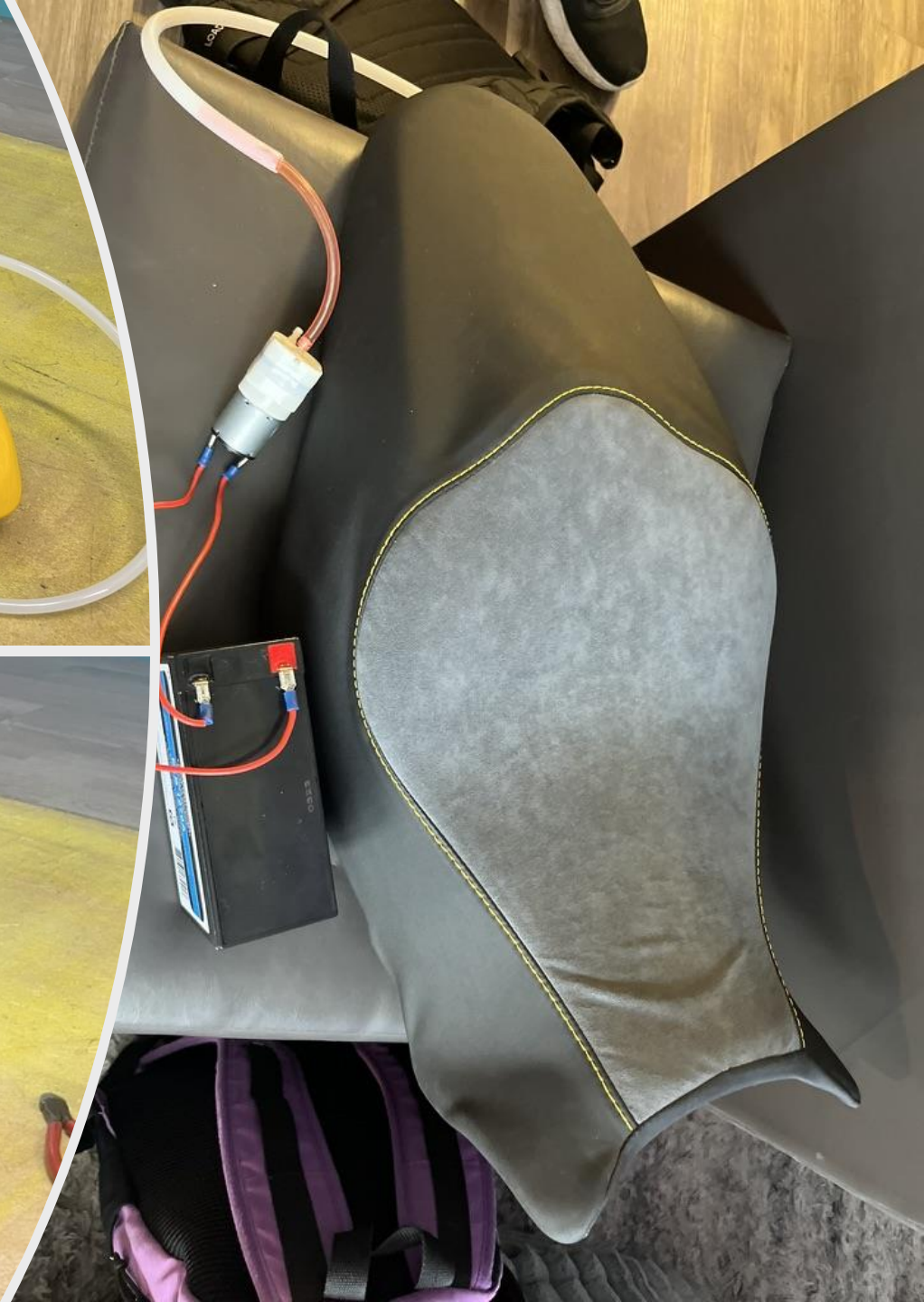
Pattern development

After creating the tape pattern, I transferred it to fabric to check if all the dimensions were correct and ensure the design fit properly. This step allowed me to identify any adjustments needed before moving on to the final materials, helping to refine the overall fit and functionality of the seat.

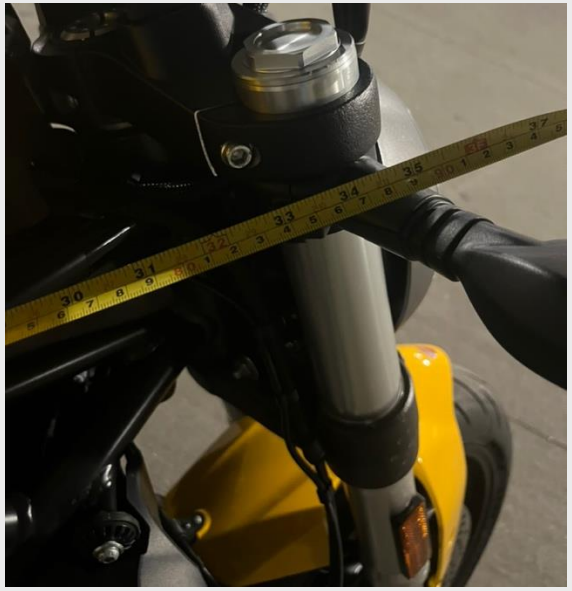




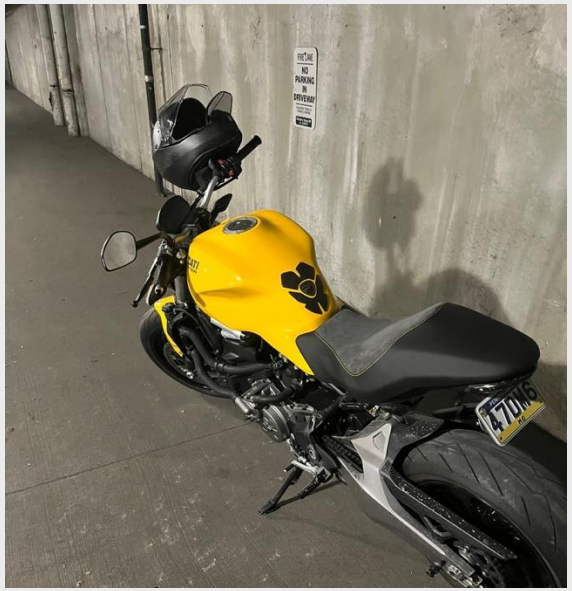
Putting The Seat Together

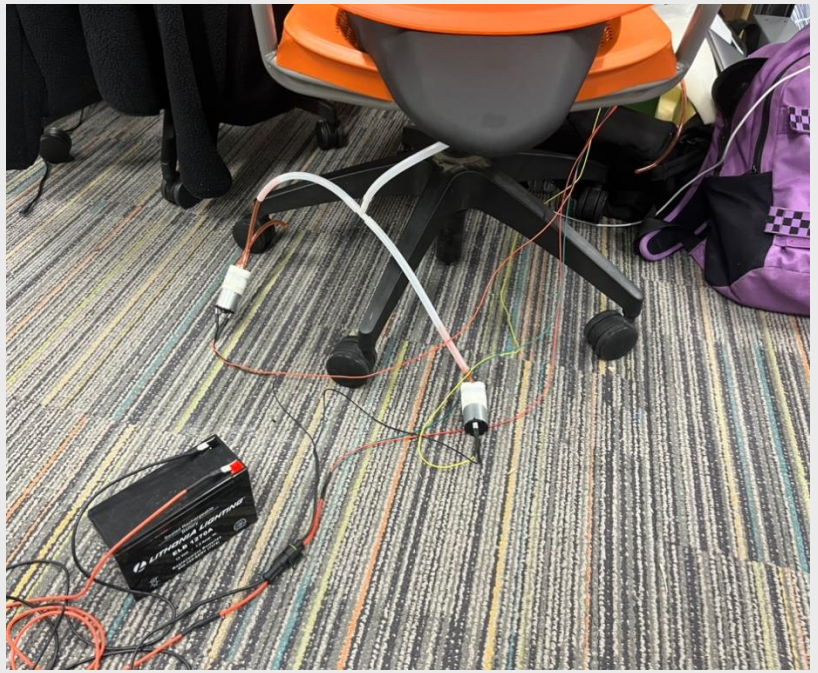


The space I have to work with for fitting the technology



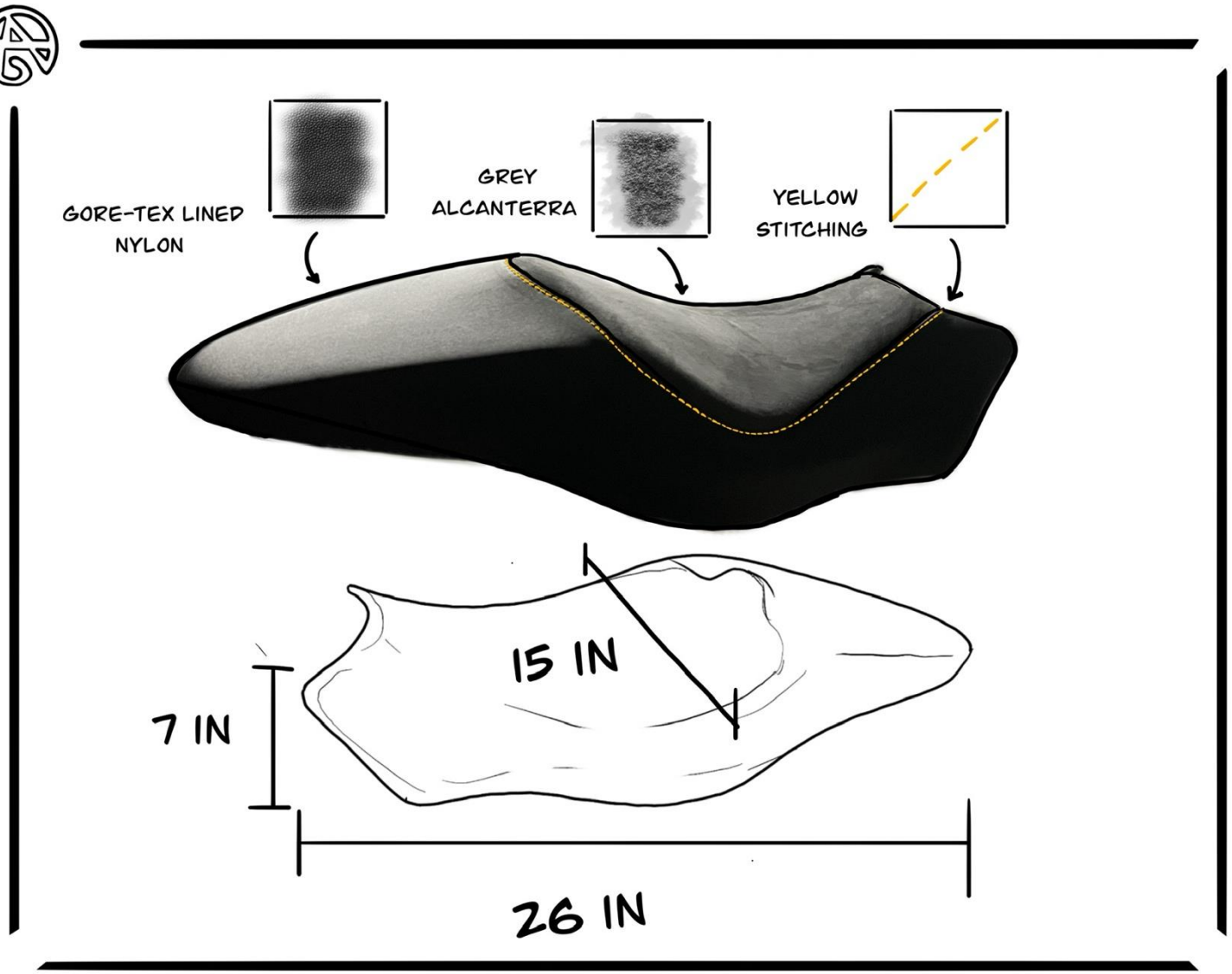
The First Real Test Fit

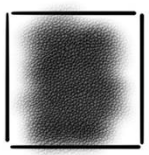




Tech pack

Throughout the project, I narrowed down the scope of what material would compliment the seat best. In the end I decided to go with Alcantara for the top piece and Gore-Tex lined fabric for the side pieces. Additionally, the stitching will be color-matched yellow to the bike. And the seat will also feature hydrophobic technology for wet conditions.


GORE-TEX LINED
NYLON
GREY
ALCANTERRA
YELLOW
STITCHING
15 IN
7 IN
26 IN

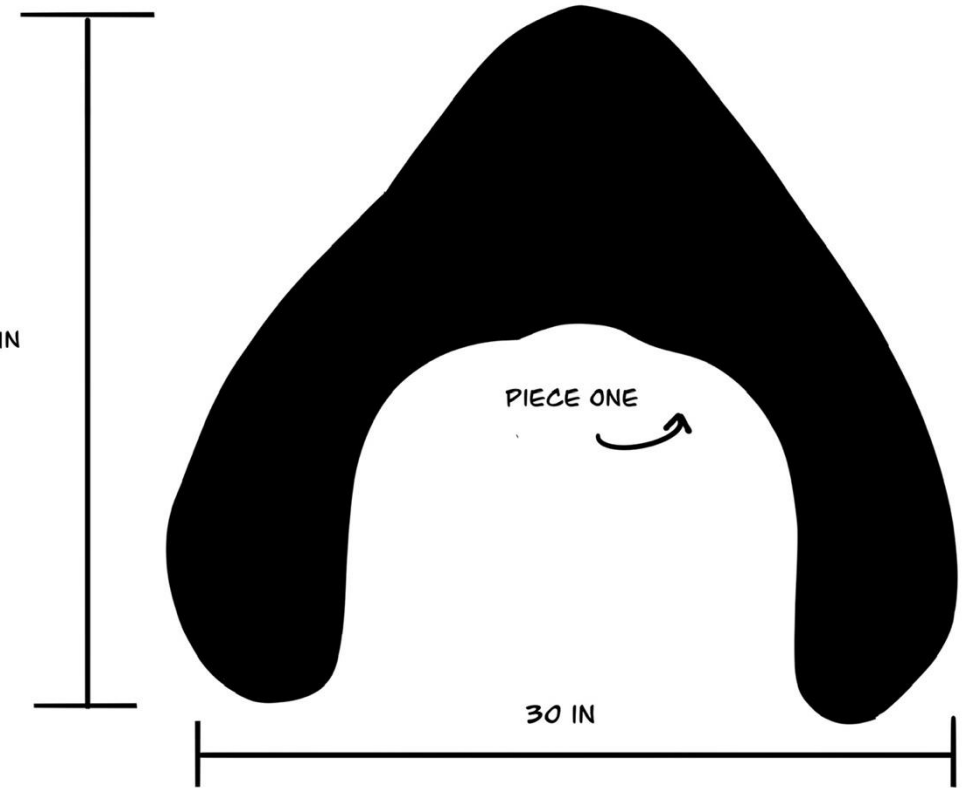


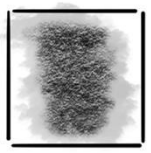
MATERIAL

GORE-TEX LINED NYLON

TASKS

1. CUT OUT ONE OF EACH PIECE



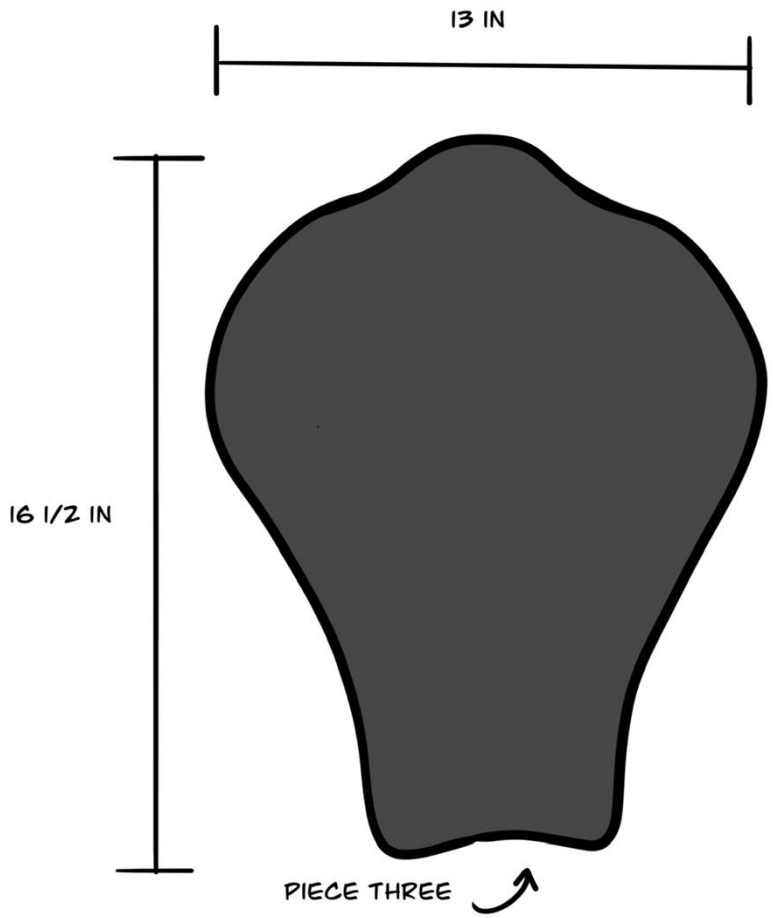


MATERIAL

GREY ALCANTERRA

TASKS

1. CUT OUT ONE OF THESE PIECES

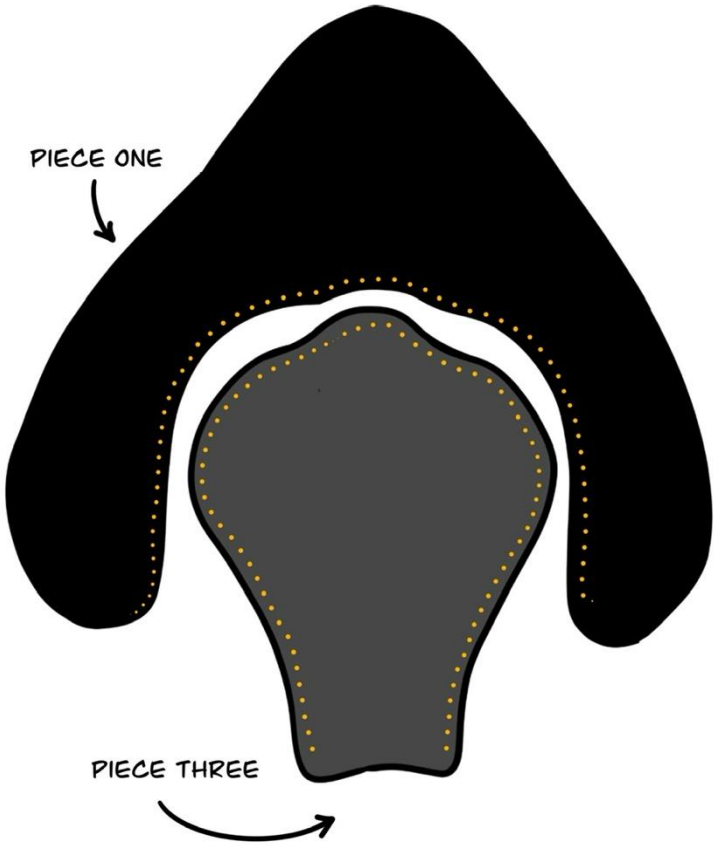


MATERIAL

YELLOW TREAD

TASKS

1. USE THE YELLOW THREAD TO SEW PIECES ONE AND THREE TOGETHER

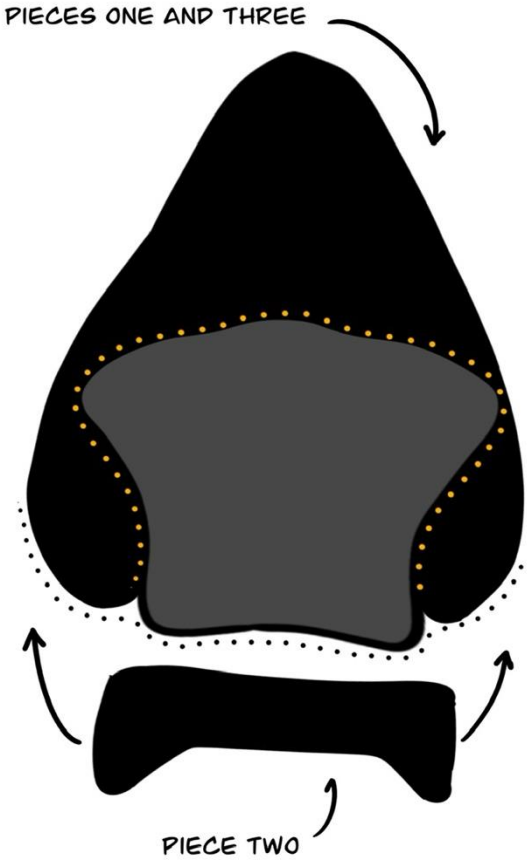


MATERIAL

BLACK TREAD

TASKS

1. SEW PIECE TWO TO PIECES ONE AND THREE WITH BLACK TREAD



Adaptive Air Ride Seat

Ducati Inspired Air Filled Moto Seat

Alex Gillingham

How The Seat Works

“Comfort Mode”

2015 Ducati Monster 821

Calculated seat height: 31.7"
Forward lean: 18°
Knee angle: 70° (smaller number means more bent)
Hip angle: 71° (smaller number means more crouched)

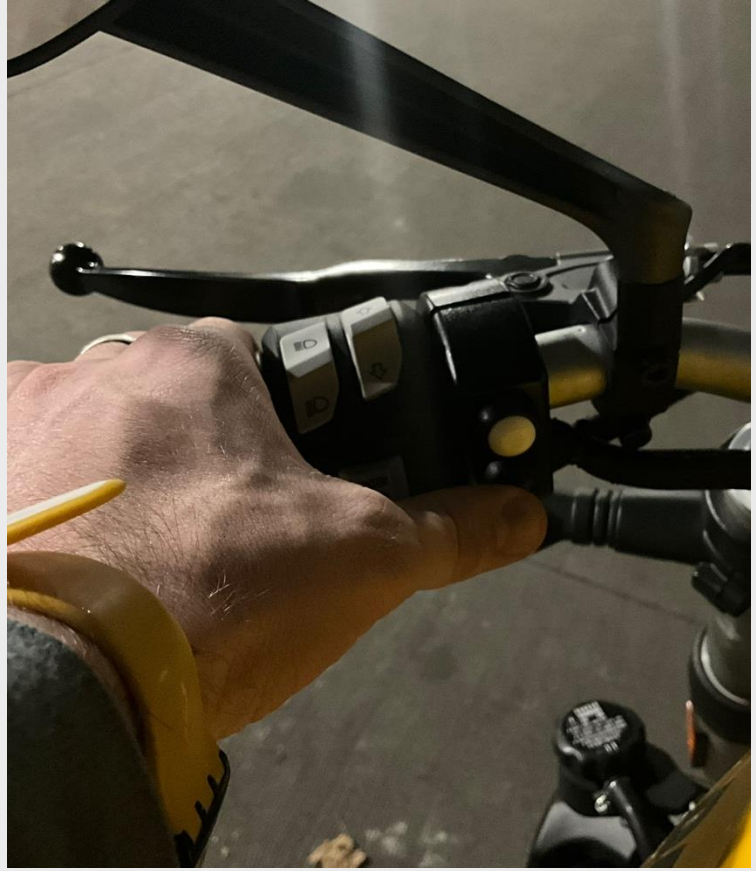
“Sport Mode”

2015 Ducati Monster 821

Calculated seat height: 33.2"
Forward lean: 20°
Knee angle: 77° (smaller number means more bent)
Hip angle: 76° (smaller number means more crouched)

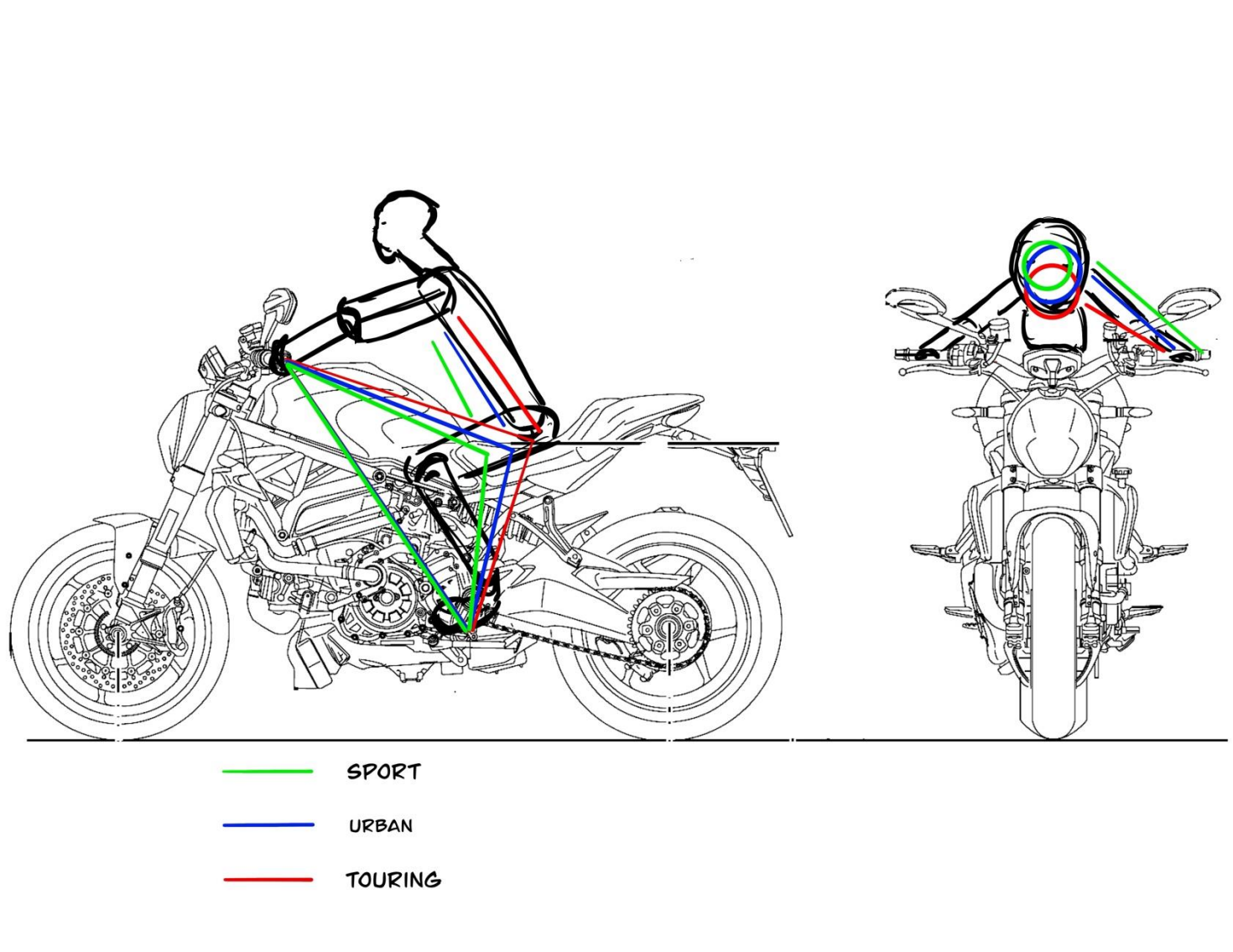
How The Seat Works

The system is designed to integrate seamlessly with the motorcycle's ECU, enabling automatic adjustments tailored to different riding conditions and modes—be it Sport, Touring, or Urban. Whether you're in Sport mode for aggressive cornering, Touring mode for long-distance comfort, or Urban mode for city maneuverability, the seat adapts to provide optimal support and grip. This dynamic seating solution not only combats rider fatigue but also enhances the motorcycle riding experience across diverse terrains and riding styles. As riders, we need more—more comfort, more support, and more control. And that’s exactly what the **Adaptive Comfort Seat** offers.



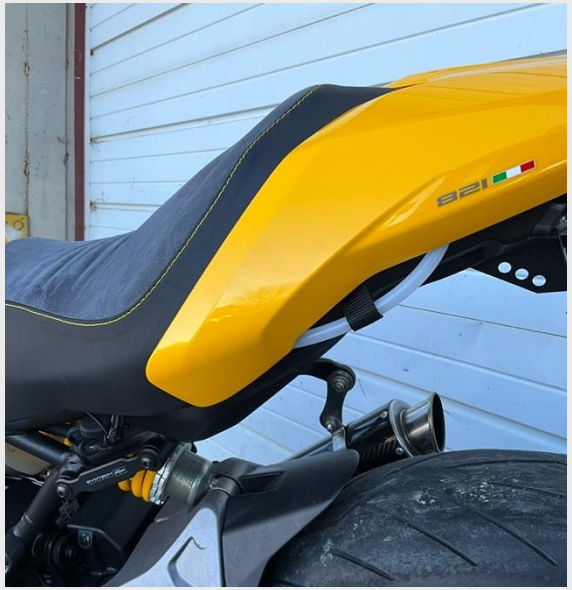
Ergonomics Study

While initially conceptualized for the Ducati Monster 821, this design can be adapted to various motorcycles with minimal modification. Inspired by MotoGP precision—where even the smallest adjustments can make a world of difference.

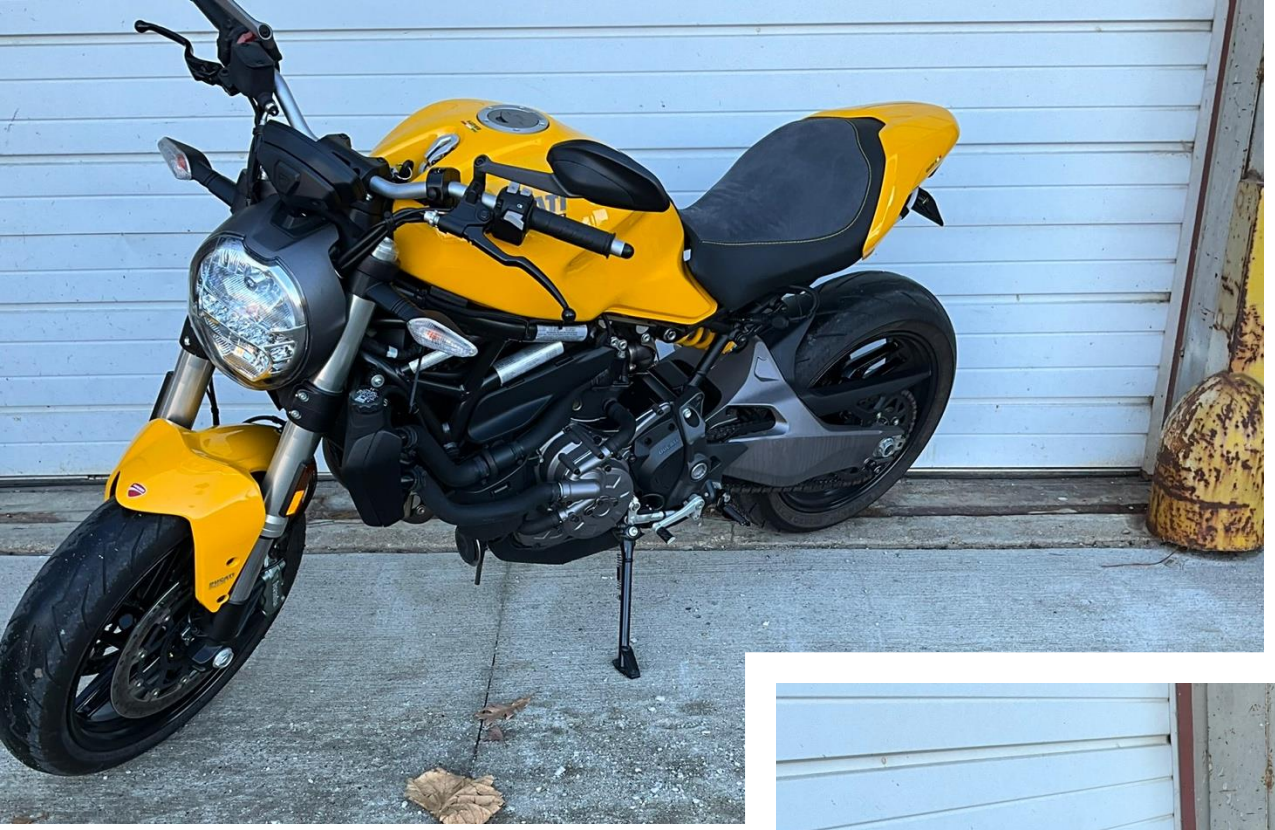


Final Product

Over the course of this project, I have personally tested this seat on my motorcycle and have noticed firsthand a difference when riding my bike… This system is not just conceptual—it’s practical, functional, and has already demonstrated real-world benefits. I see this design being implemented across the entire motorcycle industry with potential uses even in other automotive industries. I believe with the proper resources, advanced engineering, and dedicated testing, this concept can only be perfected.




821




DUCATI
MONSTER


DUCATI
MONSTER

Special Thanks

A heartfelt thank you to Chris Wiegers from A Stitch in Time, a custom upholstery shop here in Ames. Chris went above and beyond in guiding me through the process of crafting a motorcycle seat. As someone with no prior experience in seat-making, I learned invaluable skills and techniques thanks to Chris's expertise and generosity. This project wouldn't have been possible without his support, and I'm incredibly grateful for the knowledge and insight he shared along the way.

Thank You

Thank you for your attention. I look forward to the possibility of further discussions and collaboration to bring this vision to life.

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2. Author links open overlay panelMuthiah Arunachalam, Highlights•State of the art knowledge associated with motorcycle riding posture.•Effectiveness of various tools/techniques for motorcyclist's posture evaluation.•Future research scope in motorcyclist's posture prediction and evaluation.•Current bottleneck, AbstractThe incidence of fatalities with two-wheeler is more as compared to any other automotive in most of the south-east Asian countries. Out of the numerous causes of postural fatigue, Ma'arof, M. I. N., Chang, H. L., Balasubramanian, V., … Cope, C. E. (2018). Motorcycle riding posture: A Review. Retrieved from https://www.sciencedirect.com/science/article/pii/S0263224118309448?via%3Dihub
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