Designing a bicycle that can be 3d printed in modular section,easily assembled and customizable to on frame

Submitted in partial fulfillment of the requirements

of the degree of

Masters of Design

by

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Approval Sheet

The Mobility and Vehicle Design project report titled - "Diy print at home by Pratyush Mahapatra is approved in partial fulfillment of the requirements for a Master of Design degree in Mobility and Vehicle Design

Approved by

Guide:

Co-guide:

Internal examiner:

External examiner:

Chairperson

Declaration

This is a declaration that this M.Des Project report titled Diy print at home bicycle submitted to IDC School of Design, IIT Bombay, contains my original ideas and my own words. The report adheres to all principles of academic and research ethics and no data provided has been misinterpreted, or falsified. It is understood that violation of the above will cause disciplinary actions by the institute and can also lead to penal actions from the sources that have not been appropriately cited or from whom proper permission was not taken

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I am grateful to my family and friends who provided me with moral support and encouragement that kept me motivated throughout the duration of this project

Abstract

Imagine a world where you can build your own bike right in your living room—no fancy factories or big budgets needed. With just some tools and a bit of know-how, you can create a custom bicycle. This is the DIY Print-at-Home Bicycle, a concept that leverages new technology and innovative ideas to craft bikes tailored perfectly to you while being environmentally sustainable. It's all about empowering individuals with the means to produce their own bicycles efficiently and responsibly, merging convenience with eco-friendly practices.

Content

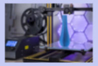
Introduction

A world where you can make your own bike right in your living room. No need for fancy factories or big budgets. Just you, some tools, and a bit of know-how. That's the DIY Print-at-Home Bicycle. It's all about using new tech and smart ideas to make bikes that fit you perfectly and are sustainable to the planet.

Why did I choose this topic ?

I am into cycling, diy and 3d printing both itself is a different topic to me and I wanted to explore the possibilities of 3d printing and diy in cycle, I am not looking to find solution doing this project.

Research: About bicycles and 3d printers

Types of 3d printing process	Materials	Strengths	Applications
 Polyjet	ABS, Simulated Polypropylene, Optically clear plastic	Accurate, Multi-Material, Biocompatible	Soft Products, Overmolding
 Fused Deposition Modeling (FDM)	ABS, PLA, ETG, Etc	Cheap, Easy to operate	Prototyping, Hobbyist parts, Manufacturing Jigs
 Stereolithography (SLA)	Polycarbonate-Like, ABS-Like, Polypropylene like	High detail	Casting patterns, Prototypes
 Selective Laser Sintering (SLS)	Polyamide 12, Glass Filled Nylon	Isotropic materials, No support structures needed	Flame retardant components, Medical devices
 Direct Metal Laser Sintering (DMLS)	Stainless Steel, Aluminum, Nickel Alloys, Titanium	High-strength metal parts	Aerospace & automotive components
 Electron Beam Melting (EBM)	Chromium, Titanium	Faster than DMLS	Aerospace, medical, & petrochemical components
 Digital Light Process (DLP)	Polycarbonate-Like, ABS-Like, Polypropylene like	Faster than SLA	Jewelry Casting, Dental Splints, Miniature Figurines
 Multi Jet Fusion (MJF)	Nylon PA 12, Polypropylene, Glass Filled Nylon	Highly Accurate, Multi-Material, Multi-Color	Visually accurate prototypes

3d printers availbale in india for home use

Bambu Lab X1-Carbon

Material
PLA, PETG, TPU, ABS, ASA, PVA, PET
Ideal for PA, PC, Carbon/ Glass Fiber Reinforced Polymer

Dimension:389 × 389 × 457 mm
Cost: Rs 99,867

Prusa MK4(quality)

Material
PLA, PETG, Flex, Nylon, ASA, PVA, PC, PP, composites

Dimension:250 x 210 x 220 mm
Cost: Rs 83,292

AnkerMake M5(fast)

Material
Polylactide (PLA), acrylonitrile butadiene styrene (ABS), PETG, thermoplastic polyurethane (TPU)

Dimension:235 x 235 x 250 mm
Cost: Rs 58,221

Anycubic Kobra Max(big models)

Material
PLA/ABS/PETG/TPU

Dimension:400x400x450mm
Cost: Rs 47,346

Types of Bicycle

Road Bike

Mountain Bike

Touring Bike

Folding Bike

Fixed Gear/ Track

Electric Bike

BMX

Recumbent Bike

Cruiser

Hybrid Bike

Cyclocross Bike

steel hardtail
mountain bike frame

diamond' frame'

open frame

folding bicycle

cantilever bicycle frame

carbon fiber Trek Y-Foil

modern truss frame

Difference between cycle frames

Bicycle Frame Materials

Steel: Durable, smooth ride; Heavy, rust-prone.

Aluminum: Lightweight, rust-resistant; Harsh ride, hard to repair.

Carbon Fiber: Very light, vibration-absorbing; Expensive, fragile.

Titanium: Lightweight, strong, rust-resistant; Very expensive, hard to repair.

Types of Frames

Road Bike: Lightweight, aerodynamic; Aggressive geometry.

Mountain Bike: Robust, with suspension; Slacker angles.

Hybrid Bike: Versatile; Upright and comfortable.

Touring Bike: Durable, stable for loads; Relaxed geometry.

Gravel Bike: Versatile for mixed surfaces; Wider tire clearance.

Frame Geometry

Aggressive: Aerodynamic, speed-focused; Less comfortable.

Relaxed: Comfortable for long rides; Less aerodynamic.

Suspension Types

Rigid: Light, efficient on smooth surfaces; Less comfortable on rough terrain.

Hardtail: Front suspension; Balance of comfort and efficiency.

Full Suspension: Front and rear suspension; Great comfort and control, heavier

3D printed bicycle

study of frames and printable parts

Future of cycles

Electric and Smart Bikes

Lightweight and Sustainable Materials

Foldable and Compact Designs

3D Printing and Customizat

Autonomous and Connected Features

Sharing and Mobility Services

Airless Tires

Energy Harvesting

Future of Bicycles

The future of bicycles is likely to see a blend of technological advancements, sustainability efforts, and changing societal needs.

Electric Assistance: Electric bikes (e-bikes) are already gaining popularity and will likely become even more widespread. Improved battery technology and motor efficiency will make e-bikes more affordable and accessible to a broader range of people.

Smart Features: Bicycles will likely incorporate more smart features such as GPS navigation, fitness tracking, and connectivity with smartphones for things like locking and unlocking. This could enhance safety and convenience for riders.

Urban Mobility Solutions: As cities continue to face congestion and pollution challenges, bicycles will play a more significant role in urban transportation systems. Infrastructure improvements, such as dedicated bike lanes and bike-sharing programs, will support this shift.

Sustainability: With increasing awareness of environmental issues, there will be a greater emphasis on sustainable materials and manufacturing processes in bicycle production. This includes the use of recycled materials, lightweight alloys, and energy-efficient manufacturing techniques.

Customization and Personalization: Advances in manufacturing technologies like 3D printing may allow for more customization and personalization of bicycles, catering to individual preferences and body types.

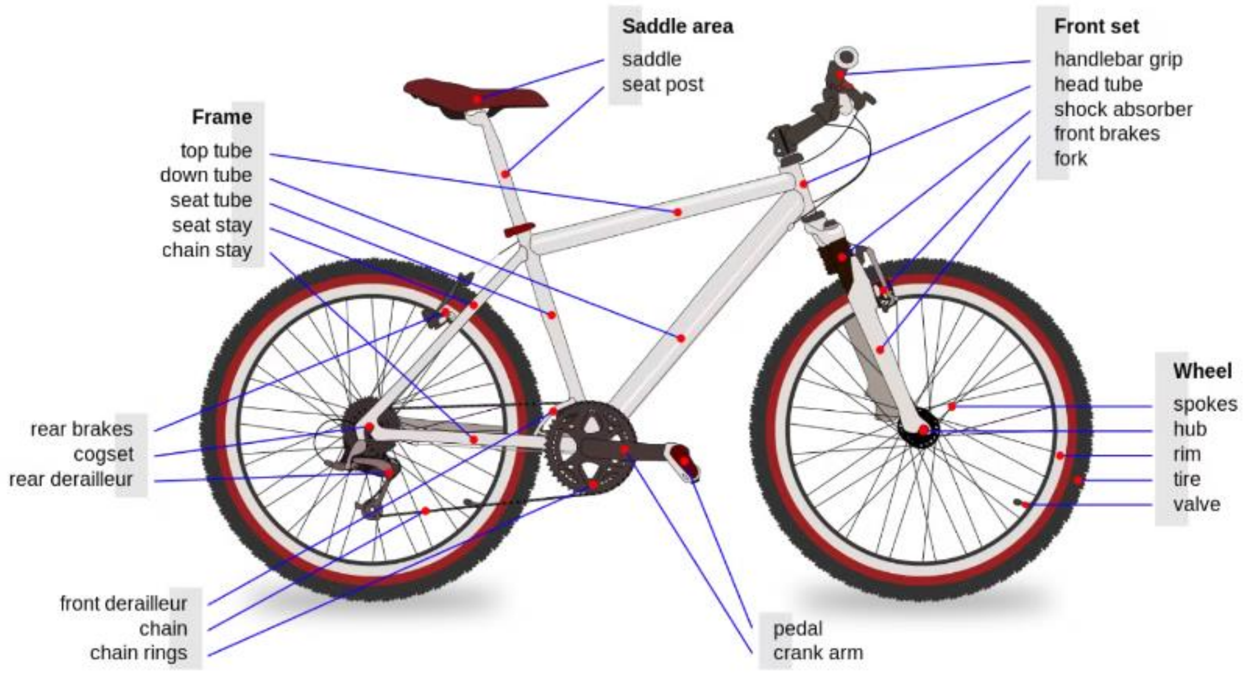
Foldable and Compact Designs: Compact and foldable bicycles will become more popular, particularly in urban environments where storage space is limited. These designs will make it easier for people to combine cycling with other modes of transportation like public transit.

Safety Innovations: Future bicycles may incorporate advanced safety features such as collision avoidance systems, automatic braking, and enhanced visibility through LED lighting and reflective materials.

Integration with Autonomous Vehicles: As autonomous vehicle technology progresses, bicycles may integrate with these systems for safer interactions on the road, potentially through communication protocols that allow vehicles to detect and react to nearby cyclists.

Overall, the future of bicycles is bright, with technology driving improvements in efficiency, safety, and sustainability, while also addressing the evolving needs of urban commuters and recreational riders.

Parts of bicycle



Non-Metalic parts

Handlebar Grips

Saddle (Seat)

Bottle Cages

Chain Guards

Pedals

Derailleur Hangers

Brake and Gear Levers

Spacers and Adapters

Bike Lights and Accessories

Valve Caps

Non metallic part that can be printed for bicycles

Saddles

Custom shapes for comfort

Integrated cushioning designs

Handlebar Grips

Ergonomic designs tailored to specific hand sizes

Pedals

Lightweight and customizable shapes

Bottle Cages

Lightweight, custom designs to fit different bottles

Chain Guards

Protective covers to keep the chain clean and reduce maintenance

Mudguards/Fenders

Custom sizes and designs for different bikes and tires

Headlight and Taillight Mounts

Customized to fit various light models and mounting positions

Brake Levers

Lightweight and ergonomically designed levers

Gear Shifters

Customized to fit rider preferences and hand sizes

Cable Guides and Clips

Custom-designed to neatly route cables along the frame

Frame Protection

Guards for chainstays and other vulnerable parts of the frame

Valve Caps

Custom-designed, aesthetic additions to tire valves

Reflectors and Mounts

Customized shapes and mounting systems for increased visibility

Bicycle parts and the most suitable 3D printing materials for each

Parts	Material	Reason
Frame	PETG	strong, durable, and have a good balance of flexibility and stiffness, which is crucial for the frame to handle stress and vibrations
Handle and seatpost	PETG	necessary strength and some flexibility, which is important for comfort and handling impacts.
Gear and chain	Nylon or PETG	Nylon is known for its durability and wear resistance, making it suitable for moving parts like gears and chains
Pedals	PLA reinforced with carbon fiber or ABS	materials provide the required strength and can withstand the frequent force applied to pedals.
Wheels and tire	TPU for tires, PLA or ABS for wheel rims	TPU is flexible and resilient, ideal for tires. Rims require a stiffer material like PLA or ABS.
Brakes	ABS or Nylon	materials can handle the friction and heat generated by braking systems
Seat	TPU or soft PLA for cushioning, ABS or PETG for the base	TPU or soft PLA can provide comfort, while a stronger material is needed for the base structure.
Fenders and Protective cover	PLA or ABS	These parts require less structural strength but need to be durable and resistant to environmental factors
Bolts and fastners	Nylon	Strong and durable, suitable for small, high-stress components

Macro trends in 3D printng

- widespread adoption across industries
- Advancements in material
- Improvements in speed and scale
- Focus on sustainbilty
- customization and personalization
- Integration with other technologies
- Development of 3d bioprinting
- Educational and Diy market growth
- Decentralized and on demand manufacturing
- Regulatory and intellectual property challenges

Macro trends in 3d printing

Industrial Adoption: 3D printing is increasingly being adopted by industries such as aerospace, automotive, healthcare, and manufacturing for rapid prototyping, tooling, and end-part production. As the technology matures, more companies are integrating 3D printing into their production processes to achieve cost savings, faster time-to-market, and greater design flexibility.

Materials Innovation: There is a growing emphasis on developing new materials for 3D printing to expand the range of applications and improve performance characteristics. This includes advancements in metal alloys, polymers, ceramics, composites, and bio-compatible materials, enabling the printing of more complex and functional parts.

Mass Customization: 3D printing enables mass customization by allowing products to be tailored to individual preferences or specific requirements without significantly increasing production costs. This trend is particularly evident in industries like healthcare (custom prosthetics and implants), consumer goods (personalized accessories), and fashion (customized apparel and footwear).

Scale-up and Production Efficiency: Efforts are underway to scale up 3D printing processes for high-volume production, leveraging technologies such as automation, robotics, and continuous printing methods. Improvements in speed, reliability, and post-processing techniques are essential for making 3D printing more competitive with traditional manufacturing methods.

Sustainability: Sustainability concerns are driving the development of eco-friendly 3D printing materials and processes. This includes the use of recycled materials, bio-based polymers, and additive manufacturing techniques that minimize waste generation. Additionally, localized production through 3D printing can reduce the carbon footprint associated with transportation and logistics.

Digital Supply Chains: 3D printing facilitates the creation of digital supply chains, where products are produced on-demand and distributed digitally, eliminating the need for large inventories and reducing supply chain complexity. This trend promotes agility, responsiveness, and cost-efficiency in manufacturing operations.

Bioprinting: In the field of healthcare, bioprinting technologies are advancing rapidly, enabling the fabrication of living tissues, organs, and medical implants. Bioprinting holds great promise for regenerative medicine, personalized healthcare, and drug discovery applications.

Distributed Manufacturing: The rise of distributed manufacturing networks, enabled by 3D printing, allows for decentralized production closer to the point of consumption. This trend enhances resilience in supply chains, reduces lead times, and enables customization on a local level.

Modularity products across all domain

Furniture and Interior Design

IKEA and Similar Brands
Shelving and Storage
Modular Sofas and Beds

Consumer Electronics

Modular Smartphones
PC Building:

Toys and Education

LEGO and Building Blocks
Educational Robotics Kits

Fashion and Accessories

Modular Watches
Modular Clothing

Outdoor and Camping Gear

Modular Tents
Multi-Tool Systems

Transportation and Vehicles

Modular Electric Bikes and Scooters
Modular Car Interiors

Home Appliances

Modular Refrigerators
Customizable Home Systems

Technology and Computing

Server Racks and Data Centers
Modular Networking Equipment

Kitchenware and Appliances

Modular Cooking Systems
Customizable Storage Solutions

Gardening and Landscaping

Modular Planters and Garden Beds
Modular Outdoor Furniture

Construction and Architecture

Modular Homes and Buildings
Modular Office Spaces

Modularity Across domains

Modularity is a fundamental principle that transcends various domains, influencing the design, development, and organization of systems across industries and disciplines. Here's how modularity manifests in different domains:

Product Design: Modular design principles are applied in engineering to create products composed of interchangeable modules or components. This approach facilitates customization, maintenance, and scalability.

Assembly Lines: Manufacturing industries use modular assembly lines, where individual workstations or modules are specialized for specific tasks. This enables efficient production processes and quick reconfiguration for different products.

Modular Buildings: In architecture, modular construction involves prefabricating building components off-site and assembling them on-site. Modular buildings offer advantages such as reduced construction time, cost savings, and flexibility in design and layout.

Furniture and Interior Design: Modular furniture and interior design systems allow users to customize living and working spaces by combining interchangeable modules like shelves, cabinets, and seating units.

Hardware Components: Electronics manufacturers produce devices with modular hardware components, such as computer parts and mobile devices. This enables users to upgrade or replace individual components without replacing the entire device.

Software Architecture: In software development, modular programming divides software into reusable modules with well-defined interfaces. Modular software architecture enhances code maintainability, scalability, and reusability.

Modular Vehicles: Automotive and aerospace industries utilize modular vehicle platforms to produce multiple vehicle models using shared chassis and drivetrain components. This streamlines production and reduces costs.

Public Transportation Systems: Modular transit systems feature vehicles and infrastructure components that can be interconnected or reconfigured to adapt to changing demands and urban environments.

Medical Devices: Medical equipment manufacturers design modular medical devices with interchangeable components for versatility and ease of maintenance.

Biological Systems: Biologists study modular organization in living organisms, where distinct functional modules, such as organs or protein domains, contribute to adaptability and evolutionary fitness.

Design Methodology

The research process was conducted in three parts.

1. Context/Environment Research.

2. User research.

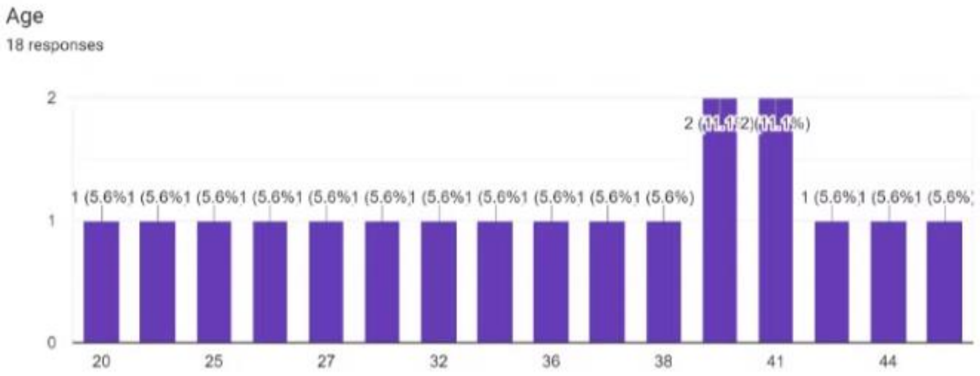
3. Technical/Product research.

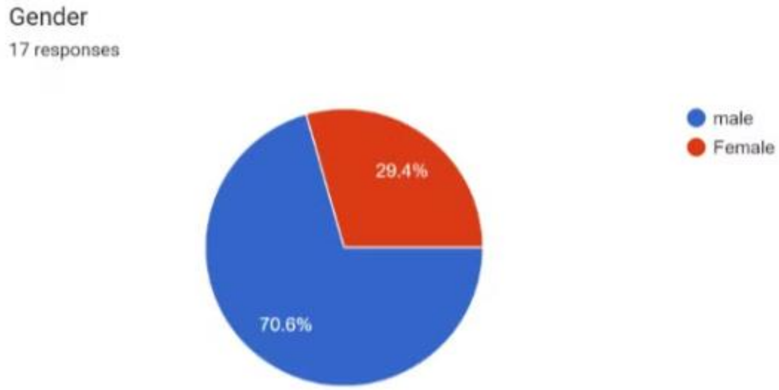
Then this research was further divided into various different parts asking why, where, who, what, and how. These questions were answered in the process itself. Throughout the process of interviewing & collecting images, some insights were collected and through these insights, a Design brief was made After the first set of ideations was made to explore the possibilities of what and how the problem could be solved.

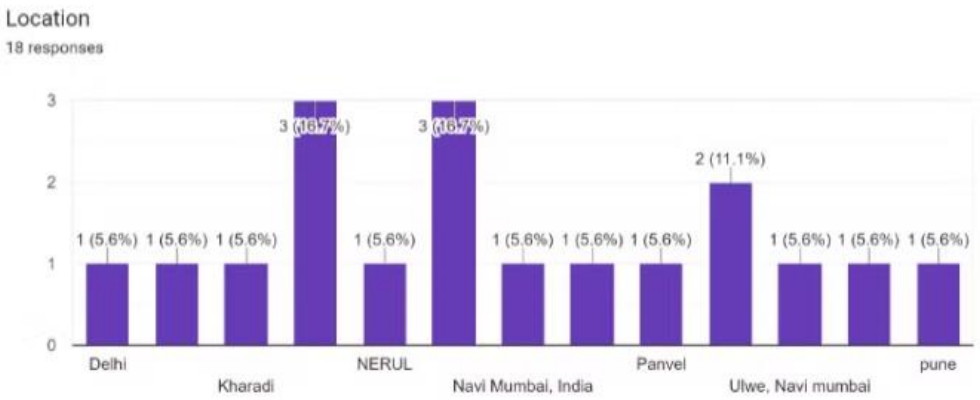
A mood board was made after this process. Then the concepts were further explored and some new ideas were created. The external forms were explored. Finally, the concepts were shortlisted and one concept was finalized. A 3D model was made using Blender to further envision the product. In the end, a prototype was created

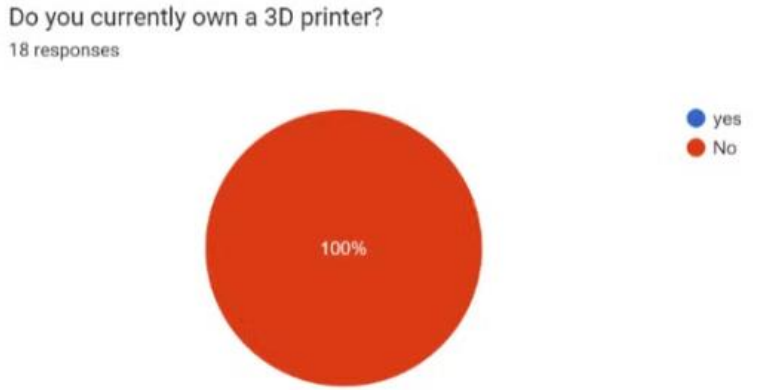
Store Visit

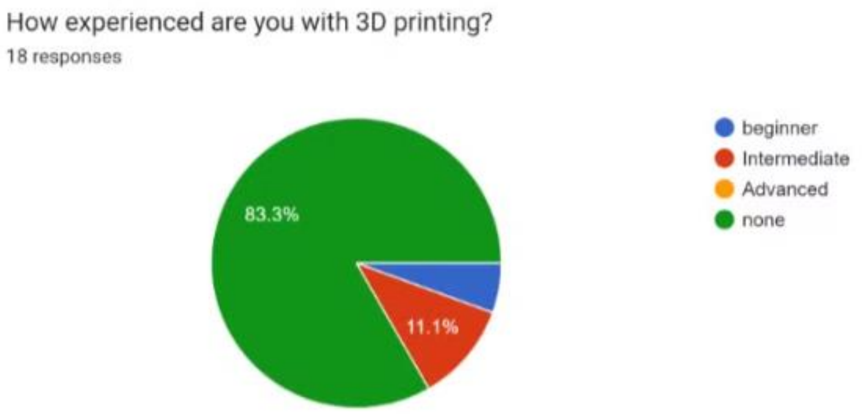
User Study

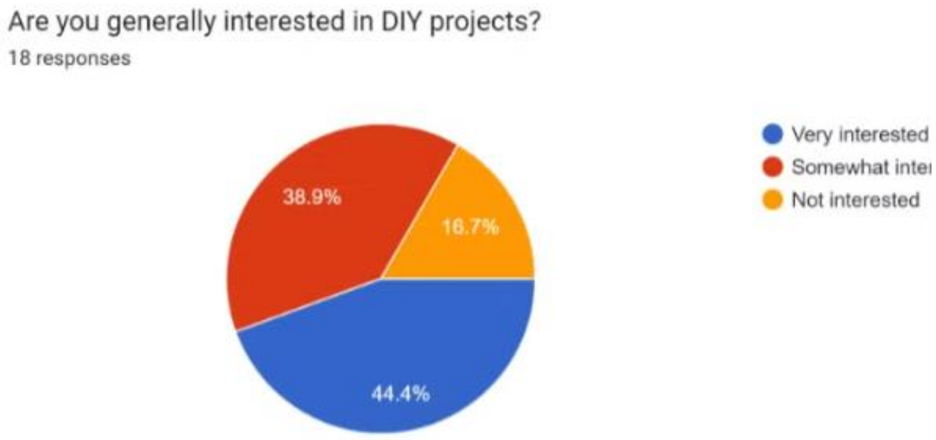

Age
18 responses
20
25
27
32
36
38
41
44

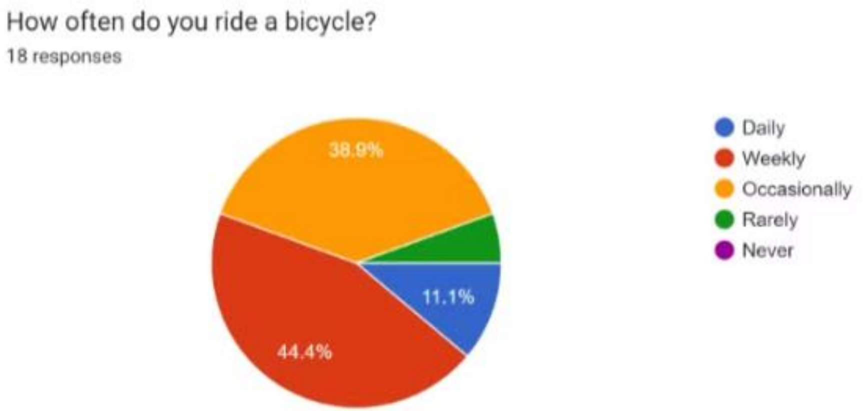

Gender
17 responses
male
Female
29.4%
70.6%

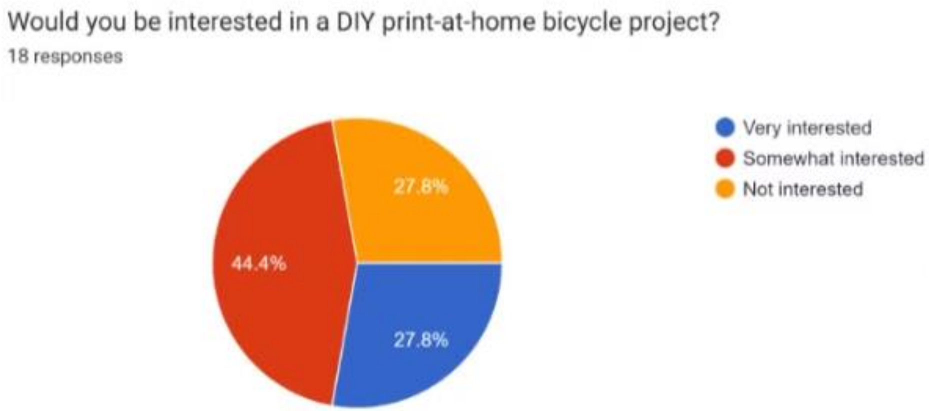

Location
18 responses
Delhi
Kharadi
NERUL
Navi Mumbai, India
Panvel
Ulwe, Navi mumbai
pune


Do you currently own a 3D printer?
18 responses
yes
No
100%


How experienced are you with 3D printing?
18 responses
83.3%
11.1%
beginner
Intermediate
Advanced
none

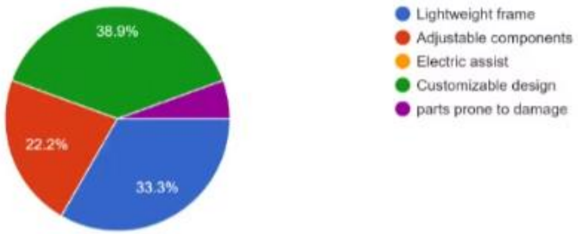

Are you generally interested in DIY projects?
18 responses
38.9%
16.7%
44.4%
Very interested
Somewhat inte
Not interested


How often do you ride a bicycle?
18 responses
38.9%
11.1%
44.4%
Daily
Weekly
Occasionally
Rarely
Never


Would you be interested in a DIY print-at-home bicycle project?
18 responses
27.8%
44.4%
27.8%
Very interested
Somewhat interested
Not interested

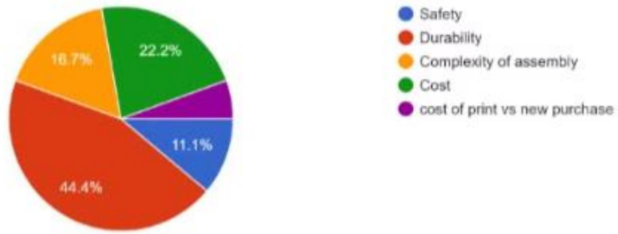
What features would you like in a print-at-home bicycle?

18 responses



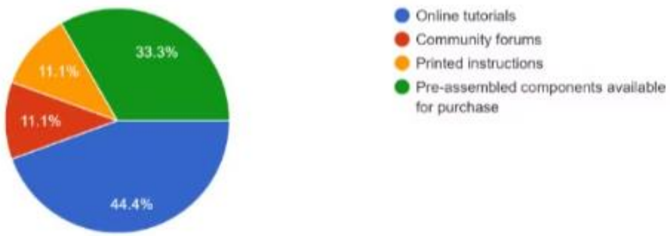
What concerns do you have about a print-at-home bicycle project?

18 responses



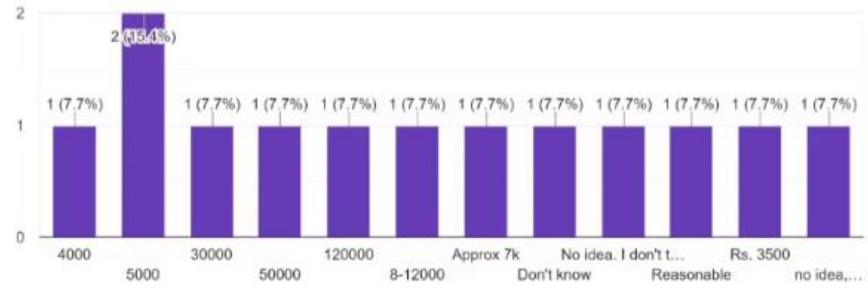
What support or resources would you find helpful for a DIY print-at-home bicycle project?

18 responses



What price range would you consider reasonable for a print-at-home bicycle project?

13 responses



Existing DIY bicycle

Existing diy bicycle

About the 1st image shown above

Wooden cycle

The 'Openbike' DIY wooden bicycle is part of an initiative created by Spain-based Arquimaña to encourage urbanites to take more control over the part they play when it comes to pollution. The bicycle has been designed to help make it as accessible as possible and can be downloaded in the form of files from the design studio for DIYers to create from a local manufacturer. This is hoped to empower citizens to feel more part of the solution to urban pollution rather than seeing it as a problem that they are removed from.

The 'Openbike' DIY wooden bicycle has been designed as part of the global fab city initiative that challenges cities around the world to produce everything they need and consume by the year 2054.

Trend Themes

1. **DIY Bicycles -** The rise of DIY bicycles, like the 'Openbike', presents an opportunity for affordable, eco-friendly transportation and disrupts the traditional bicycle manufacturing industry.

2**. Urban Sustainability** - Initiatives like the fab city challenge and the 'Openbike' DIY bicycle promote sustainable living and present opportunities for innovative solutions to combat urban pollution and waste.

3**. Open-source Manufacturing -** The 'Openbike' DIY bicycle's downloadable design files and local manufacturing present an opportunity for disruptive innovation in open-source manufacturing processes that empower citizens to take control of production and reduce environmental impact.

Industry Implications

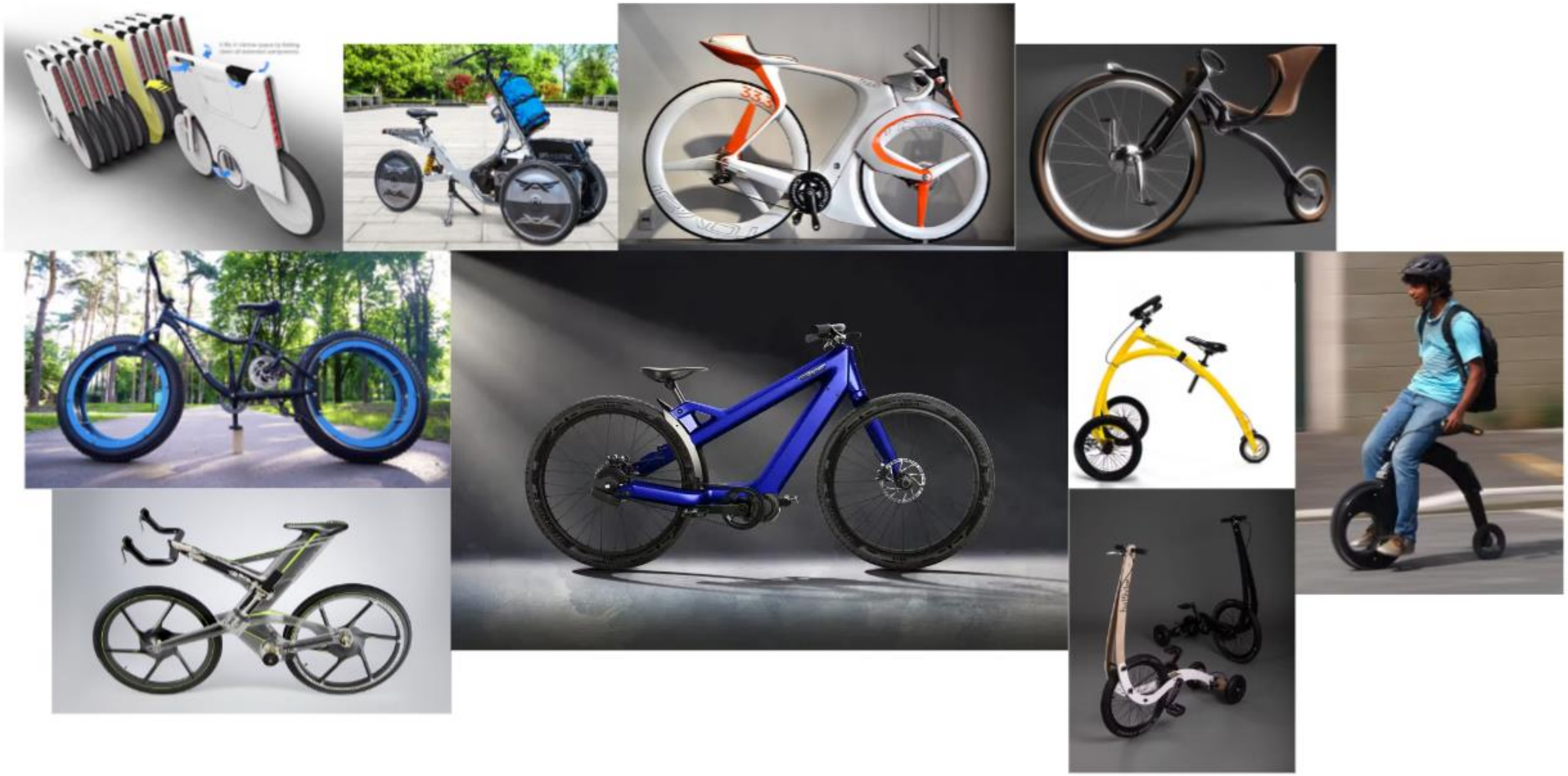
1**. Bicycle Manufacturing -** The rise of DIY, eco-friendly bicycles like the 'Openbike' presents an opportunity for the bicycle manufacturing industry to shift towards sustainable production processes and empower consumers to participate in the manufacturing process.

2. **Local Manufacturing** - The 'Openbike' DIY bicycle and other similar initiatives present an opportunity for disruptive innovation in the local manufacturing industry, allowing independent producers to compete with

traditional mass manufacturers and promoting more sustainable, community-based business models.

3. **Environmental Sustainability** - The 'Openbike' DIY bicycle and other urban sustainability initiatives present an opportunity for disruptive innovation in environmentally sustainable technology and sustainable business practices that take into account the full life cycle of products and services.

Radical Bike Designs



Kind of cyclist will prefer DIY print at home bicycle

Tech Enthusiasts and Early Adopters	DIY Hobbyists and Makers	. Environmentally Conscious Consumers	Customization Seekers	Urban Commuters
. Cycling Enthusiasts with Specific Needs	Educators and Students	Budget-Conscious Consumers	Experimental Riders	Community-Oriented Cyclists

DIY culture right now in bicycle

Custom Bike Building and Modifying	Restoration of Vintage Bicycles	. Upcycling and Recycling	Bicycle Maintenance and Repair	Custom Paint Jobs and Artistic Modifications
Use of Technology and Innovation	Community and Sharing	Adapted and Inclusive Bicycles	Economic Factor	Performance and Competitions

Who will prefer diy cycle?

Enthusiast Cyclists: These individuals have a passion for cycling and enjoy customizing their bikes to suit their preferences and needs. DIY 3D printing allows them to create unique, personalized components such as handlebar grips, saddle mounts, or aerodynamic accessories.

Tinkerers and Makers: DIY enthusiasts who enjoy experimenting with technology and creating custom solutions are drawn to 3D printing for its versatility and accessibility. They may design and print innovative bike accessories, storage solutions, or repair tools tailored to their specific requirements.

Budget-Conscious Cyclists: Cyclists who want to save money on aftermarket bike parts or accessories may turn to 3D printing as a cost-effective alternative. By downloading and printing open-source designs, they can create functional components at a fraction of the cost of commercially available products.

Custom Fit Seekers: Cyclists who struggle to find off-the-shelf components that fit their body size or riding style may use 3D printing to create custom-fit solutions. This includes personalized bike grips, pedal extenders, or saddle adapters designed to enhance comfort and performance.

Innovators and Problem Solvers: Cyclists who encounter specific challenges or limitations with traditional bike components may leverage 3D printing to develop innovative solutions. Whether it's addressing ergonomic issues, improving aerodynamics, or enhancing durability, these individuals use 3D printing as a tool for problem-solving and innovation.

Environmental Advocates: Cyclists who prioritize sustainability and reducing their environmental impact may appreciate 3D printing for its potential to minimize waste and energy consumption compared to traditional manufacturing methods. By printing bike parts on-demand using eco-friendly materials, they can contribute to a more sustainable cycling ecosystem.

Diy cycle trends in current market

Customization: DIY cyclists often enjoy customizing their bikes to reflect their personalities and preferences. This can involve painting frames, adding decals, or installing aftermarket components to create a unique look and feel.

Repairs and Maintenance: Many cyclists take pride in maintaining and repairing their bikes themselves. DIY enthusiasts learn basic bike mechanics and invest in tools to perform tasks such as adjusting gears, replacing brake pads, or truing wheels. Online tutorials, forums, and community workshops provide valuable resources for learning and sharing knowledge.

Upcycling and Recycling: DIY cyclists embrace sustainability by upcycling old or discarded bike parts into new creations. This can involve turning worn-out tires into belts, transforming broken spokes into jewelry, or repurposing salvaged frames into furniture or art installations.

Home Bike Workshop Setup: With the rise of home workshops and garage tinkering, DIY cyclists invest in tools, workstands, and storage solutions to create functional bike repair spaces at home. This allows them to work on their bikes conveniently and efficiently, saving time and money on professional repairs.

Custom Bike Builds: Some DIY cyclists undertake ambitious projects to build custom bikes from scratch. This can involve sourcing frame materials, selecting components, and assembling the bike according to their specifications. Custom bike builds offer a rewarding challenge and the satisfaction of riding a one-of-a-kind machine.

Open-Source Design and 3D Printing: DIY cyclists leverage open-source design files and 3D printing technology to create custom bike accessories, components, and tools. From handlebar mounts and smartphone holders to pedal adapters and chain guides, 3D printing allows for endless possibilities in customization and innovation.

Community and Collaboration: DIY cyclists often form communities and online forums where they share ideas, projects, and resources. These communities foster collaboration, mentorship, and camaraderie among like-minded individuals who share a passion for bikes and DIY culture.

Event Participation and Competitions: DIY cyclists showcase their creativity and craftsmanship at events such as bike shows, maker fairs, and DIY competitions. These events provide opportunities to display custom bikes, share knowledge, and connect with fellow enthusiasts.

Insights

Design and Customization

Modular Designs
Personalization

Sustainability

Eco-friendly Materials
Reduced Waste

User Experience and Skill Level

Ease of Assembly
Education and Guidance
AR

Market and User Acceptance

initially appeal to tech enthusiasts, DIY hobbyists, and environmentally conscious consumers

Community and Collaboration

Open Source and Sharing
Feedback:community support can help in refining and improving the designs

Economic Implications

Cost-Effectiveness
Potential Market Disruption

Safety and Standards

Durability and Safety

Technological Feasibility

Challenges

Technical Limitations: Current home 3D printers may have limitations in terms of size, material strength, and precision.

Possible design brief ideations

1. Modular and Customizable Design:

Objective: Create a bicycle that can be printed in modular sections, easily assembled, and customizable to different body types and riding preferences.

Focus: User-friendly assembly, adjustable components for fit and comfort, and options for personalization in aesthetics

2. Sustainable Material Use:

- **Objective:** Utilize eco-friendly, sustainable materials that are suitable for 3D printing and can withstand the rigors of regular bicycle use.
- **Focus:** Research and identify biodegradable, recycled, or upcycled materials that are strong and durable.

3. User-Centric Design for Assembly and Maintenance:

- **Objective:** Ensure that the assembly process is straightforward and requires minimal tools or technical knowledge.
- **Focus:** Simple, intuitive connections and fittings; include easy-to-follow instructions, possibly augmented with AR (Augmented Reality) guides

4. Aesthetics and Style:

● **Objective:** Create a visually appealing design that resonates with modern aesthetic trends while maintaining functionality.

● **Focus:** Sleek, contemporary designs that allow for customization such as color choices or decorative elements

5. Adaptability for Different Cycling Disciplines:

● **Objective:** Develop designs that can be adapted for various cycling needs, such as urban commuting, off-road, or long-distance touring.

● **Focus:** Interchangeable parts or add-ons for different types of cycling (e.g., different tire sizes, luggage racks).

Design Brief :

To create a bicycle that can be printed in modular sections, easily assembled, and customizable to one frame.

Focus: Explorations of assembly process of 3d printed parts to make User-friendly frame and options for personalization.
(bike frame so it uses less material, reduces the time required to print each part.)

Scenario

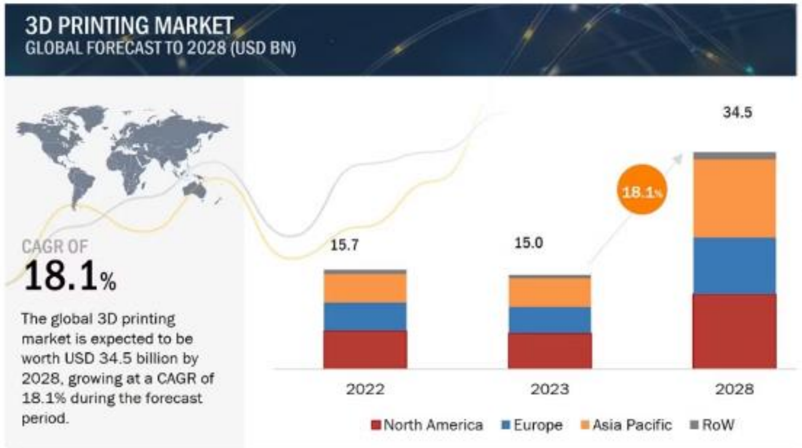
A future where anyone with access to a 3D printer and internet at home will be able to manufacture tools/products that they will use in their everyday lives, and that those around them can use in their everyday lives.

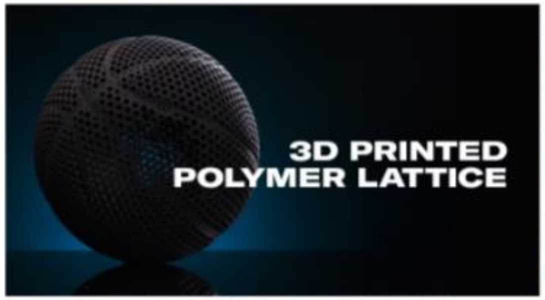
Why 3D Printing ?

Modern bicycles are an efficient design that has been nearly perfected in the years, since they were invented.

I think that it will be a new option for people looking for a new bike, and that it will offer a new perspective on what a bicycle can be.

Additive manufacturing technology





3D Printing

Customization: One of the most significant advantages of 3D printing is its ability to create highly customized and personalized products. With 3D printing, it's possible to tailor bicycle components to individual preferences, body measurements, and riding styles. This level of customization is difficult to achieve with traditional manufacturing methods.

Complex Geometries: 3D printing allows for the fabrication of intricate and complex geometries that would be challenging or impossible to produce with conventional manufacturing techniques. This opens up new design possibilities for lightweight, aerodynamic, and structurally optimized bicycle components.

Rapid Prototyping: 3D printing enables rapid prototyping and iteration cycles, allowing designers to quickly test and refine their ideas. This iterative design process can accelerate product development and innovation in the bicycle industry, leading to faster time-to-market for new designs and concepts.

On-Demand Manufacturing: With 3D printing, bicycles and components can be produced on-demand, eliminating the need for large inventories and reducing lead times. This decentralized manufacturing approach can be particularly advantageous for small-scale production, custom orders, and niche markets.

Material Efficiency: Additive manufacturing processes like 3D printing can be more material-efficient compared to subtractive manufacturing methods, where material is removed from a larger block or sheet. This can result in reduced waste and lower material costs, especially for complex geometries and low-volume production runs.

Supply Chain Flexibility: 3D printing offers greater flexibility in supply chain management, as it enables localized production and distributed manufacturing networks. This can enhance responsiveness to changing market demands, reduce reliance on centralized production facilities, and minimize transportation-related carbon emissions.

Design Freedom: With 3D printing, designers have greater freedom to explore unconventional shapes, structures, and material compositions. This freedom from traditional manufacturing constraints can lead to innovative and avant-garde bicycle designs that push the boundaries of performance, aesthetics, and functionality.

Why Modularity ?

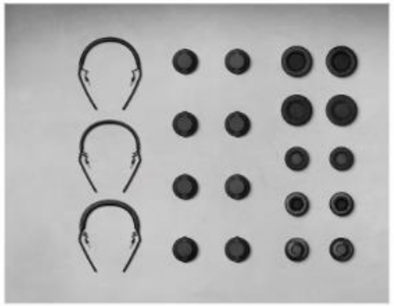
Modular approach allows users to replace pieces and parts more easily as well as allowing incremental upgrades over time.

Blocks Smartwatch

Google Project Ara

Lego Technica

Infinity One



AIAIAI TMA-2 Modular Headphones

Modularity

Flexibility and Adaptability: Modularity allows cyclists to easily customize and adapt their bicycles to suit changing preferences, needs, or riding conditions. By using interchangeable modules or components, cyclists can quickly modify their bikes without the need for specialized tools or expertise.

Ease of Repair and Maintenance: With modular design, repairing and maintaining a DIY 3D printed bicycle becomes more straightforward. Individual modules can be easily replaced or upgraded as needed, minimizing downtime and reducing the complexity of repairs.

Cost-Effectiveness: Modularity can help reduce costs associated with bicycle ownership by allowing cyclists to replace only the specific components that require upgrading or repair, rather than replacing the entire bike. This cost-effective approach is particularly advantageous for DIY enthusiasts on a budget.

Scalability and Upgradeability: Modular bicycles can be easily scaled or upgraded over time as the cyclist's skills, preferences, or riding needs evolve. Cyclists can start with a basic configuration and gradually add or swap out modules to enhance performance, comfort, or functionality.

Interoperability and Compatibility: Modular design promotes interoperability and compatibility between different bicycle components and accessories. Cyclists can mix and match modules from various manufacturers or designs, ensuring seamless integration and optimal performance.

Innovation and Experimentation: Modularity encourages innovation and experimentation by providing a platform for DIY enthusiasts to design, build, and test new bicycle components or configurations. Cyclists can explore novel ideas, materials, or technologies without committing to a fully integrated design.

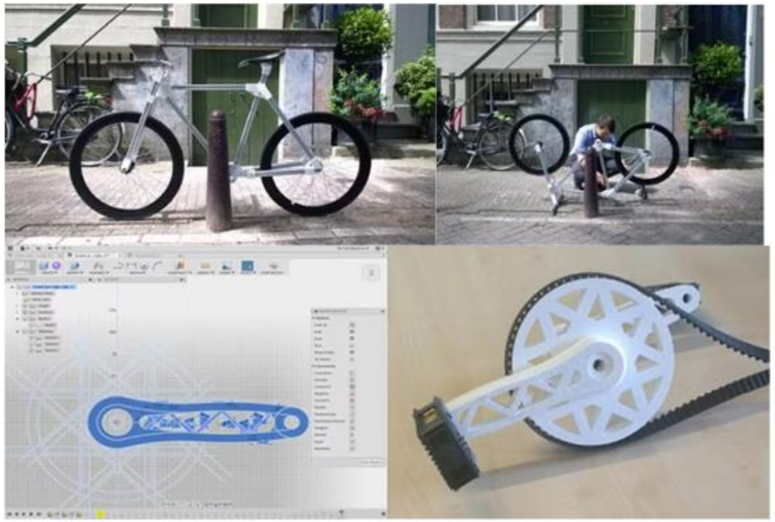
Sustainability and Environmental Impact: By allowing for component-level replacement and customization, modular bicycles promote sustainability and reduce environmental impact. Cyclists can extend the lifespan of their bikes by upgrading individual modules instead of discarding entire frames or assemblies.

Community Collaboration and Sharing: Modular DIY bicycles foster collaboration and knowledge sharing within the cycling community. Enthusiasts can exchange ideas, designs, and feedback on modular components, contributing to a culture of innovation and continuous improvement.

For Whom ?

Existing DIY-3D Printed Bicycle

Bhulk 3D Printed, Compostable Bike Frame



The OBI (Open Bicycle)

Existing diy printed cycle

1.Bhulk 3D Printed

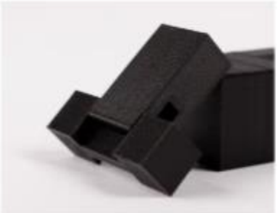
As a 3D printing material derived from renewable, plant-based materials, the Bhulk frame can either be melted down and turned into new 3D printed objects, or simply ground up and composted. And to make it even greener, it takes significantly less energy to 3D print a frame than it would to create a metal bike frame using traditional tooling methods, and it even takes less power than if it was 3D printed using ABS or PET materials. On top of all of that, Eurocompositi's Aenimal production facility is also solar-powered. They're probably just showing off at this point, but that makes the Bhulk one of the greenest vehicles ever manufactured.

2.The OBI (open bicycle)

Industrial design students Stef de Groot and Paul De Medeiros from Amsterdam, are currently designing the first 3D printed open source bicycle as part of "The Bike Project".

Dubbed OBI 0.5, the open bicycle consists of several parts that can be printed with a common desktop 3D printer. OBI features a modular, customizable design. All 3D printable parts are created using the CAD software Autodesk Fusion 360 and once finished, the designs will be made available for anyone to improve on or change.

3D Printed Joinery and Joints in furniture

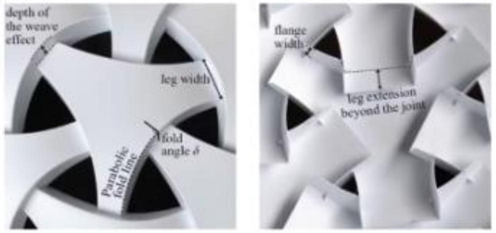


T-bridle joint

Classic dovetail joint

Sliding dovetail box

Classic dovetail joint



Mortise and Tenon Joint

Half Lap Joint

Biscuit Joint

Butt Joint

Types of snap-fit joints

Cantilever Snap Fit: In this type of joint, a flexible cantilevered beam on one component snaps into an undercut or recessed feature on another component. The beam flexes during assembly and then snaps into place, creating a secure connection. Cantilever snap fits are often used for covers, enclosures, and lids.

Tongue and Groove Snap Fit: This type of joint consists of a tongue or projection on one component that fits into a corresponding groove or slot on another component. The tongue provides alignment and retention, while the groove provides stability and prevents lateral movement. Tongue and groove snap fits are commonly used for panels, panels, and enclosures.

Annular Snap Fit: An annular snap fit involves a circular or ring-shaped feature on one component that snaps into a corresponding groove or recess on another component. The annular snap fit provides 360-degree engagement, offering high retention and resistance to pull-out forces. Annular snap fits are often used for caps, plugs, and closures.

Snap-in Snap Fit: In this type of joint, one component features snap-in tabs or hooks that engage with corresponding features or receptacles on another component. The snap-in tabs flex during assembly and then snap into place, providing a secure connection. Snap-in snap fits are commonly used for mounting brackets, clips, and connectors.

Living Hinge Snap Fit: A living hinge snap fit incorporates a flexible hinge feature that allows one component to bend or flex during assembly. The living hinge provides a simple and cost-effective way to create movable or hinged connections without separate hinge components. Living hinge snap fits are often used for lids, covers, and access doors.

Types of adhesive and bonding material

Super glue (Cyanoacrylate glue)

Joining 3D prints with super glue is probably the most simple way to join 3D printed parts. Super glues will form a permanent bond in just a few seconds, and will form a good bond with most 3D printing materials - so long as surfaces are clean and dry.

Cyanoacrylates are best used for very small components, that will not be under serious stress, such as the figurine example above, which was printed in multiple pieces for optimum orientation. Apply a very thin layer to each piece, and then hold together for a few seconds. It's best to wear gloves as super glue will bond your skin (to just about anything) in only a few seconds, if you spill any.

Epoxy resin (e.g. Araldite®)

For larger, more substantial components, the best glue to use is two-part epoxy. This will form a very strong bond, but most types take from 24 to 48 hours to fully cure. Most formulas require you to mix the two parts in a one to one ratio for a couple of minutes, and then apply very thin layers to each of the surfaces to be bonded. Most epoxies will produce some heat, as they rely on an exothermic chemical reaction.

Once the epoxy is partially cured, excess glue can be trimmed away using a scalpel, to create a near invisible seam once left to cure completely. Use epoxies on rigid materials that require a stronger bond than super glue can provide.

Hot glue gun

A hot glue gun is a familiar sight in most workshops, but we have found it to be of very little use in bonding 3D printed parts. Typically, hot glue produces a bond that is very brittle, and doesn't adhere well without extensive surface preparation. Applying glue is difficult and messy - best avoided.

Other methods of bonding surfaces

If you need a way to permanently join 3D prints, that doesn't rely on adhesives - there are a few alternative options available. These are generally more difficult to use, and or rely on more specialised equipment, and so are best avoided unless there is no alternative.

Friction welding

Friction welding is a process that can be used to join both metals and plastics. One component is rubbed against the other at high speed, which heats the materials. Eventually the material on the surface of both components softens, and the components are moved into the desired position. The movement stops, the surfaces cool, and the parts are now joined together.

This process requires expensive, specialised equipment, but can produce excellent results when done correctly.

Solvent welding

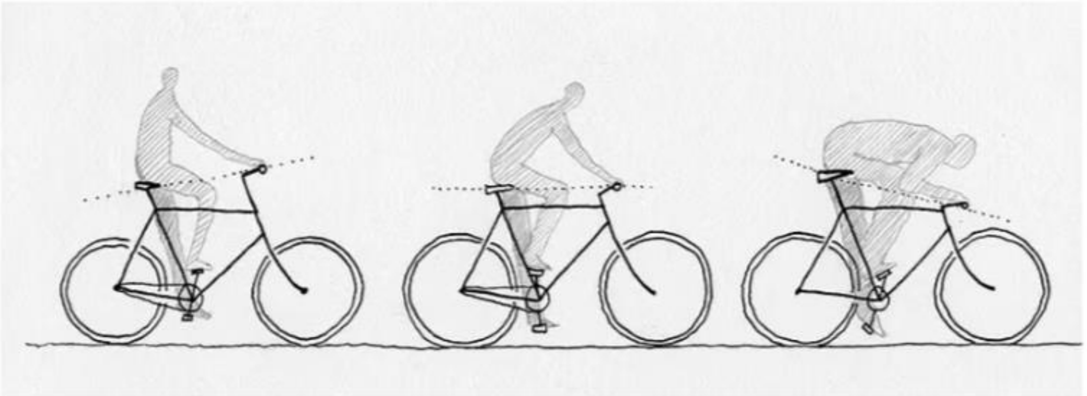
This is where an appropriate solvent is applied to one or both surfaces to be joined, which chemically dissolves the surface. The surfaces are then brought into contact with one another, allowing the dissolved material on the surfaces to mix. The solvent then evaporates, leaving the two surfaces permanently bonded.

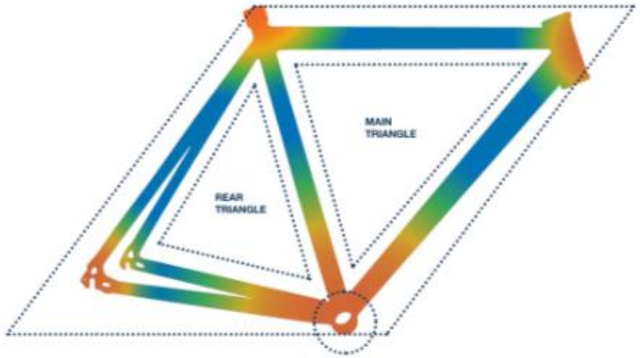
A common example of this process used in 3D printing, is the application of acetone to ABS parts. The main drawback is that the chemicals required can be quite dangerous for certain polymers, and it is easy to spill the solvent and completely ruin the part. When done properly however, a strong permanent join is possible.

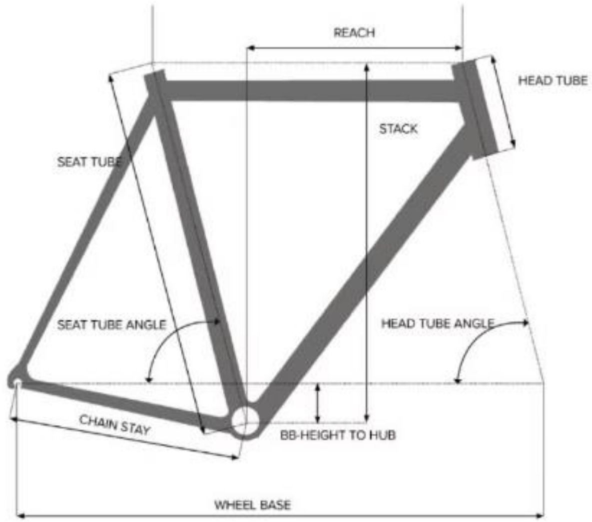
Theme Board

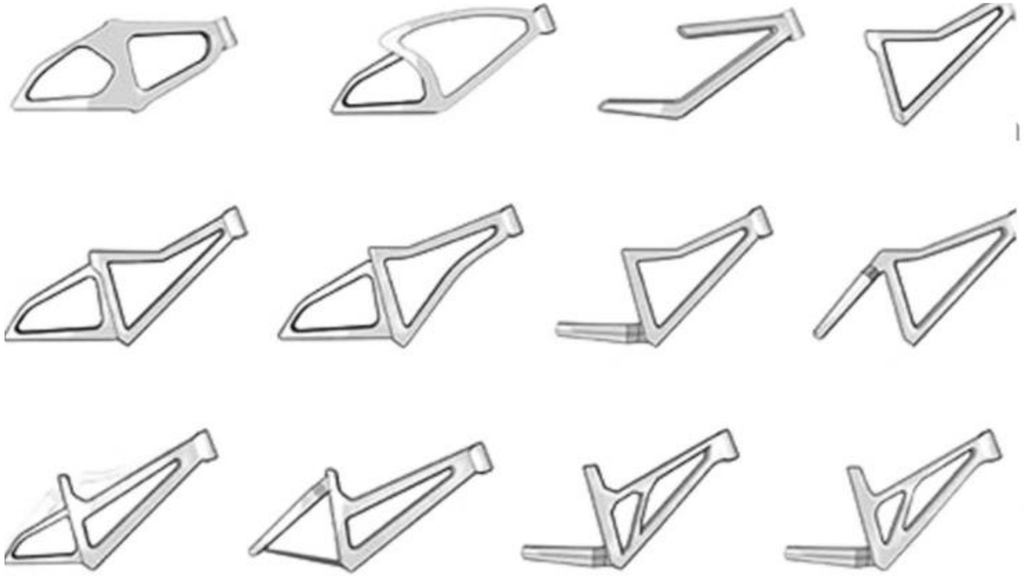
Dynamic • Modular

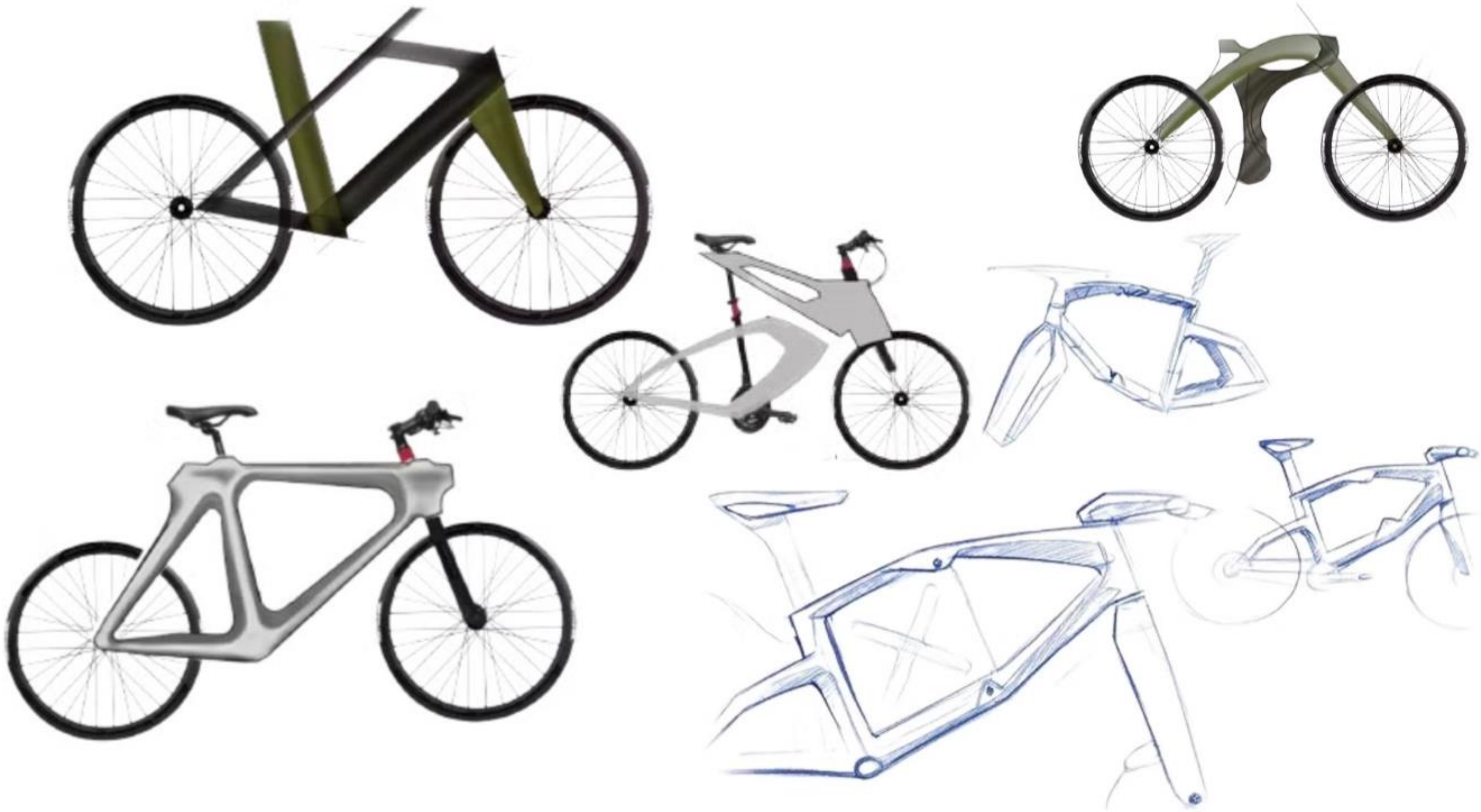
Mood Board

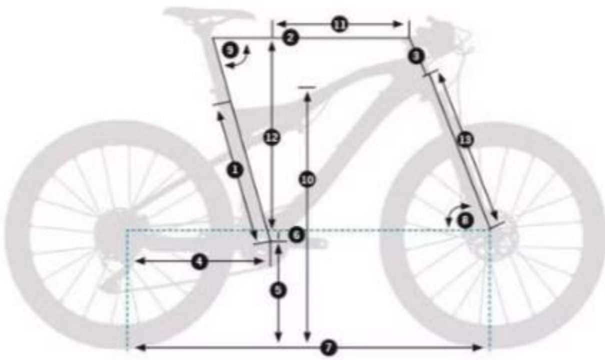



MAIN TRIANGLE
REAR TRIANGLE


REACH
HEAD TUBE
STACK
SEAT TUBE
SEAT TUBE ANGLE
HEAD TUBE ANGLE
CHAIN STAY
BB-HEIGHT TO HUB
WHEEL BASE

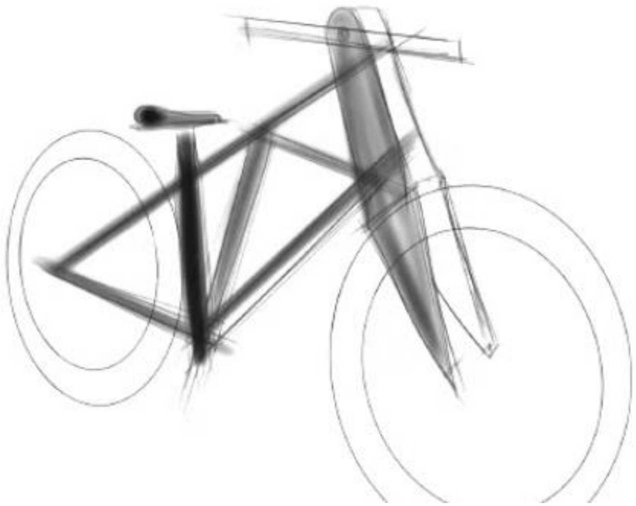
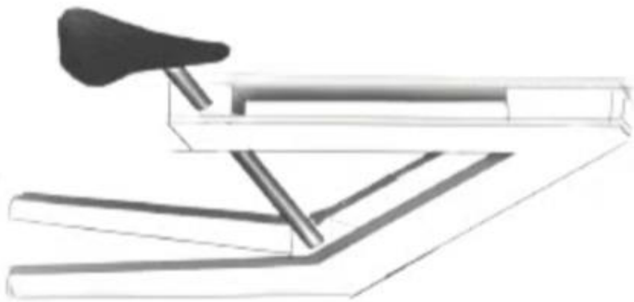






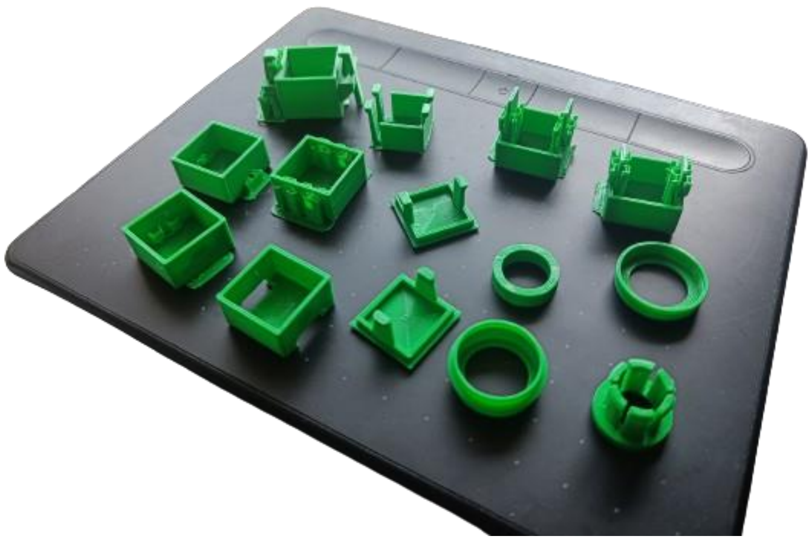
TALLA	S−27.5"	M−27.5"	L−27.5"	M−29"	L−29"	XL−29"
1 - TUBO DEL ASIENTO (C-C)	405	432	470	432	470	520
2 - TUBO HORIZONTAL (EFF)	552	580	607	589	439	638
3 - TUBO FRONTAL	100	110	120	100	110	120
4 - VAINA	425	425	425	440	440	440
5 - ALTURA EJE PEDALIER			325			
6 - CAÍDA EJE PEDALIER	27	27	27	45	45	45
7 - DISTANCIA ENTRE EJES	1057	1085	1113	1090	1122	1148
8 - ÁNGULO FRONTAL			70°			
9 - ÁNGULO DEL SILLÍN			74°			
10 - ALTURA BASE						
11 - LARGO DEL CUADRO	390	415	440	417	439	451
12 - ALTURA DEL CUADRO	565	574	584	597	606	616
13 - LONGITUD HORQUILLA (A-C)	487.7	487.7	487.7	500.8	500.8	500.8

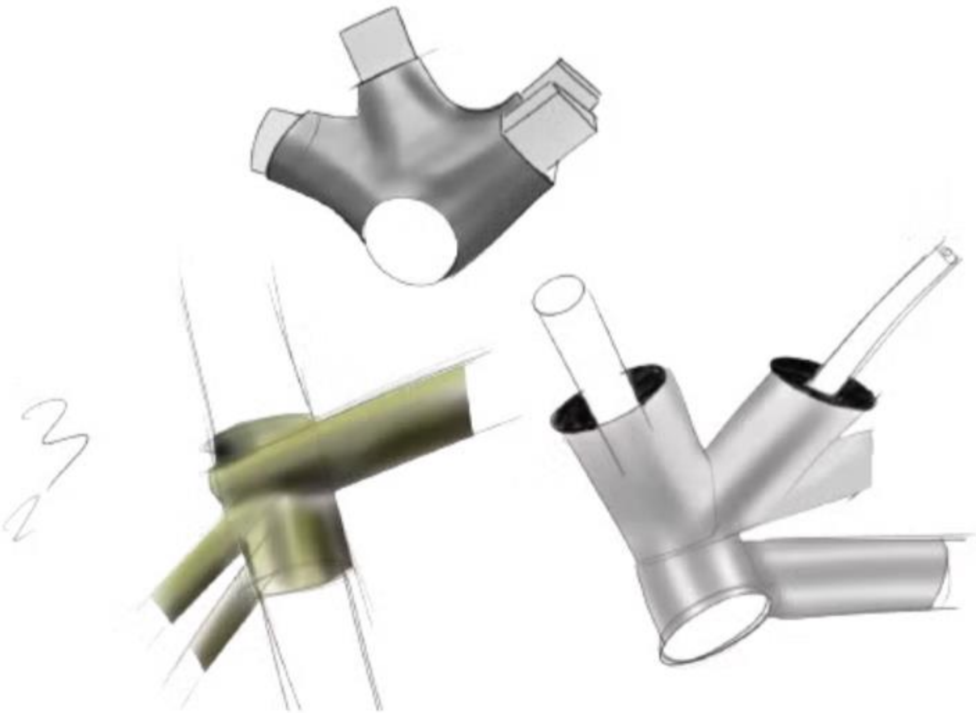


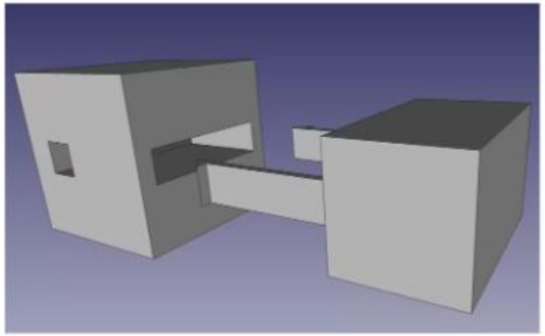



Tried Snap fit Mockups

In the given image (green) below I have tried few mockups for the joinery through 3d printer just give me an idea how snap fits and joinery works





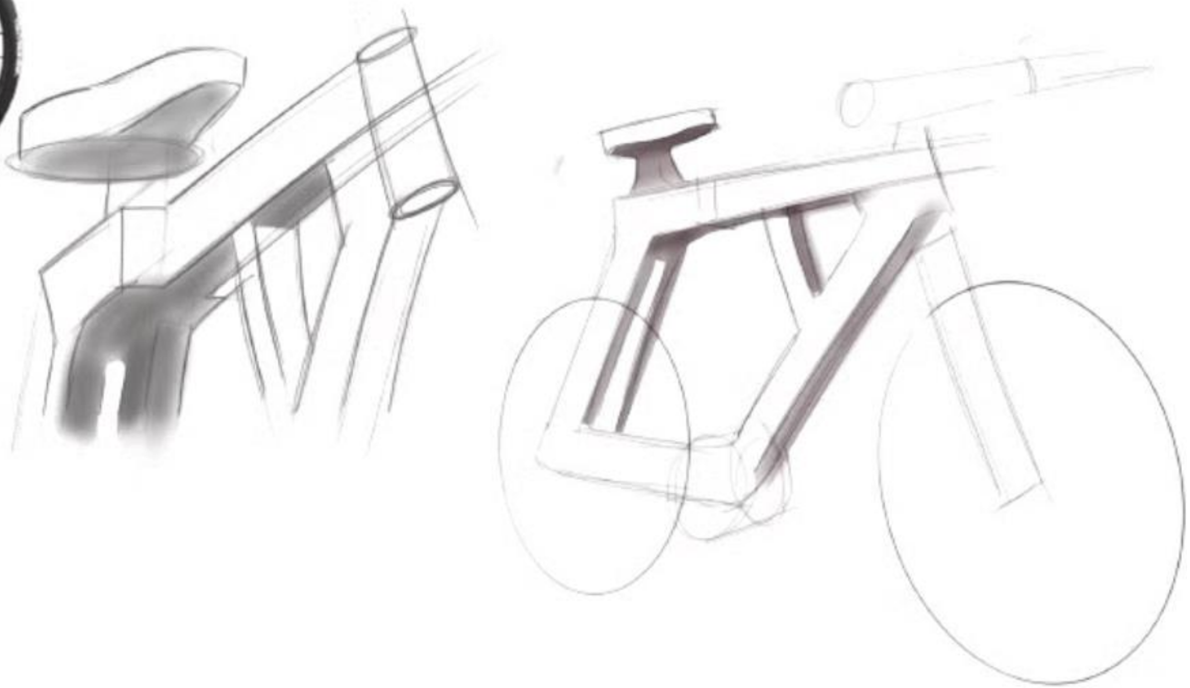


Direction 1

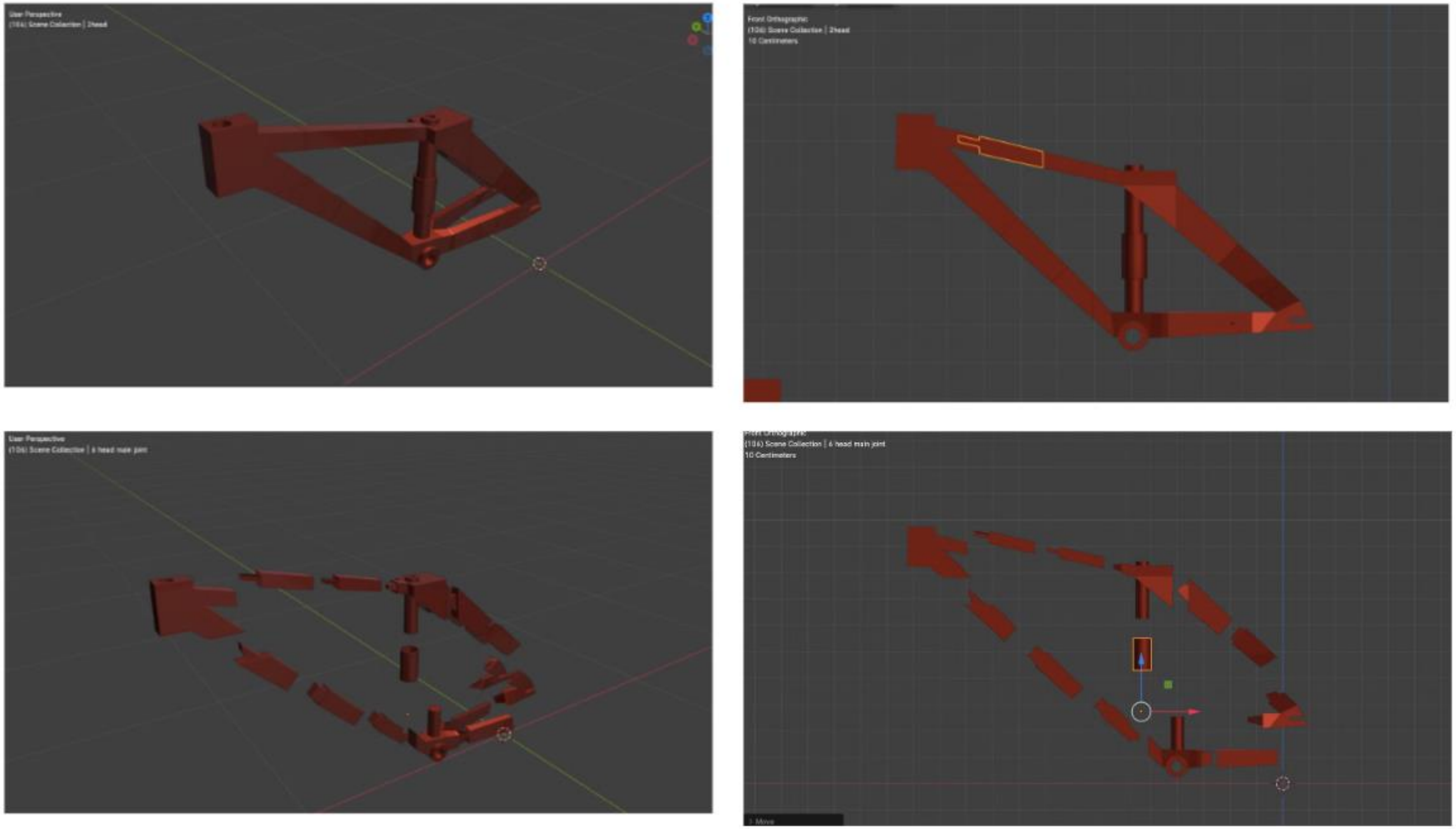
Inspired by few ideations of mine I went up with this sketch ,I was making a model keeping few parameters in mind that is size of the 3d printer that I was going to print,sections and joineries and the material I thought making the shape thicker will solve the material problem.

Conclusion

The model is 1:1 scale, it looked like normal diamond frame chassis,got divided in too many section not giving safety



3d model according to pla as material

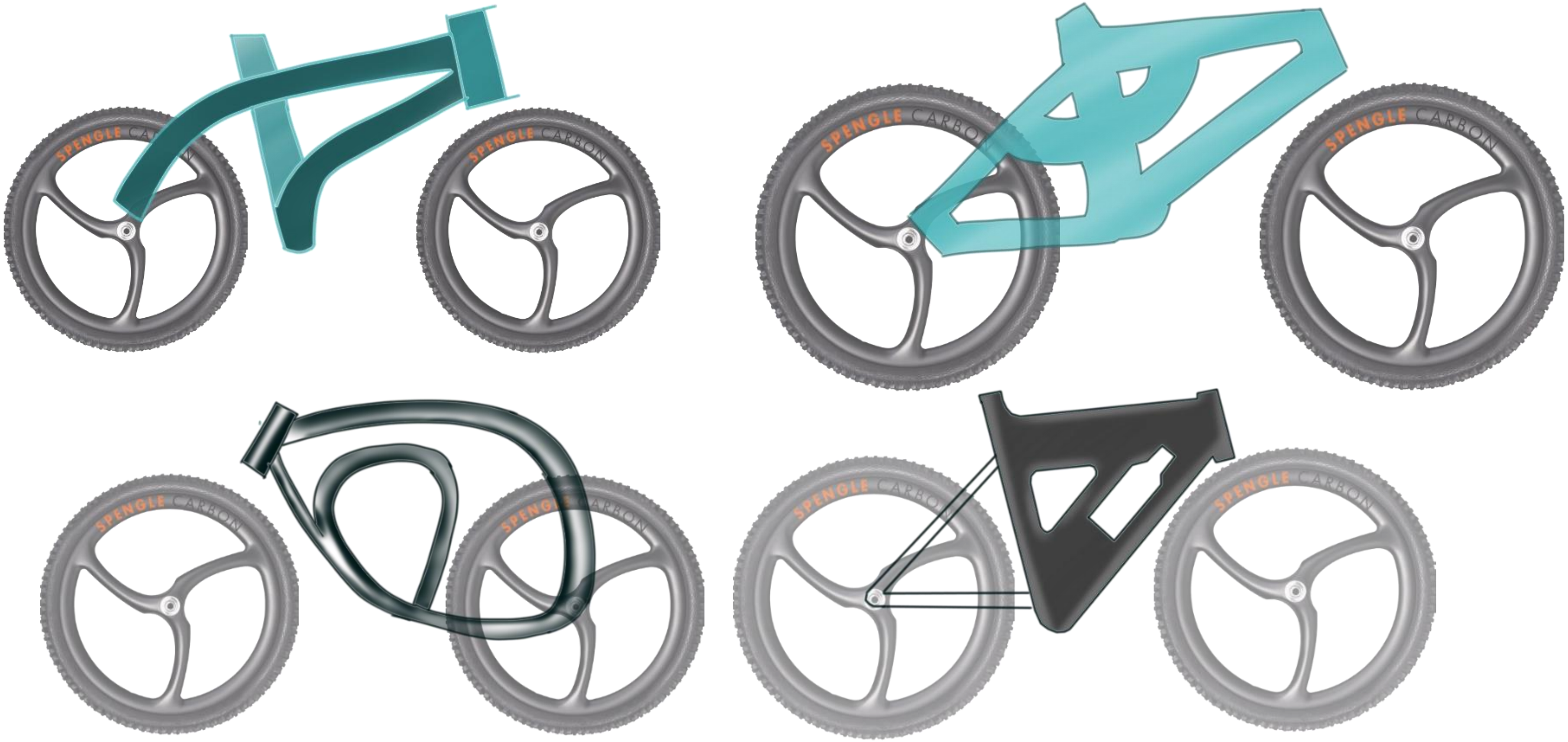


1:1 scale sample mockups for joinery and printed a head tube for above model

Direction 2(Final)

I started with few more ideation this I kept no parameters in mind and started designing, while ideating I learned about how ai and 3d printing is used by designers and engineers to come with new forms and learned about ai generative manufacturing in fusion 360. I wanted to come u with organic shape which can or canot be manufactured by regular process.


SPENGLE CARBON


SPENGLE CARBON


SPENGLE CARBON
SPENGLE CARBON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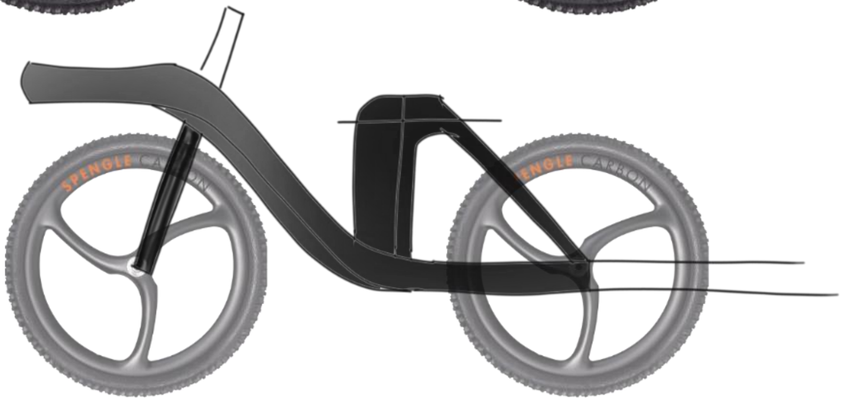
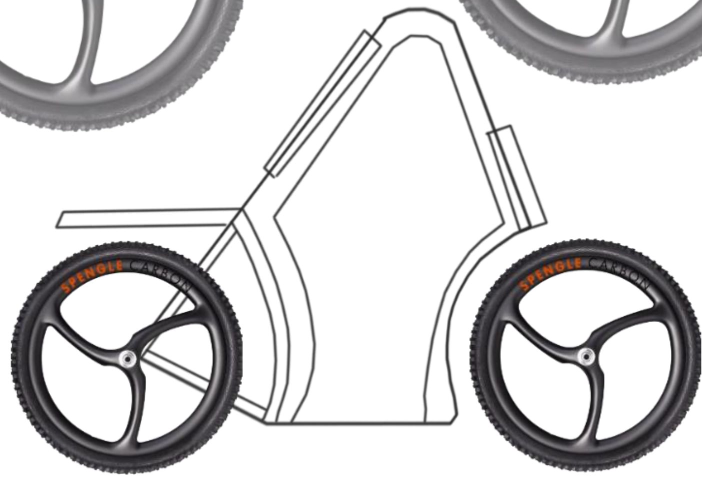
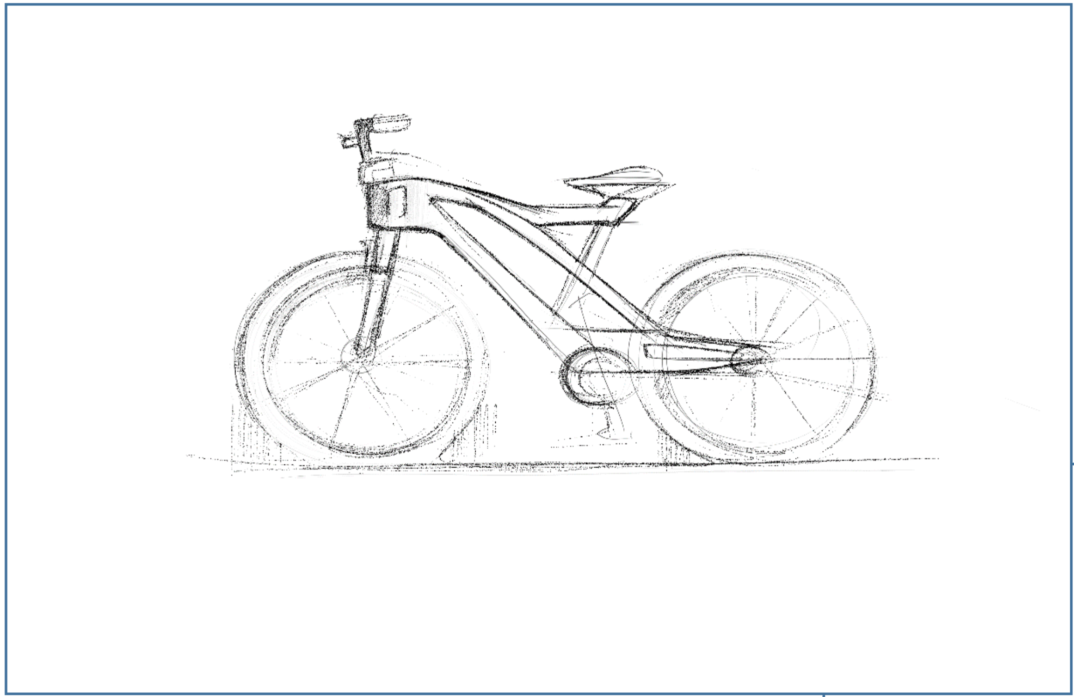
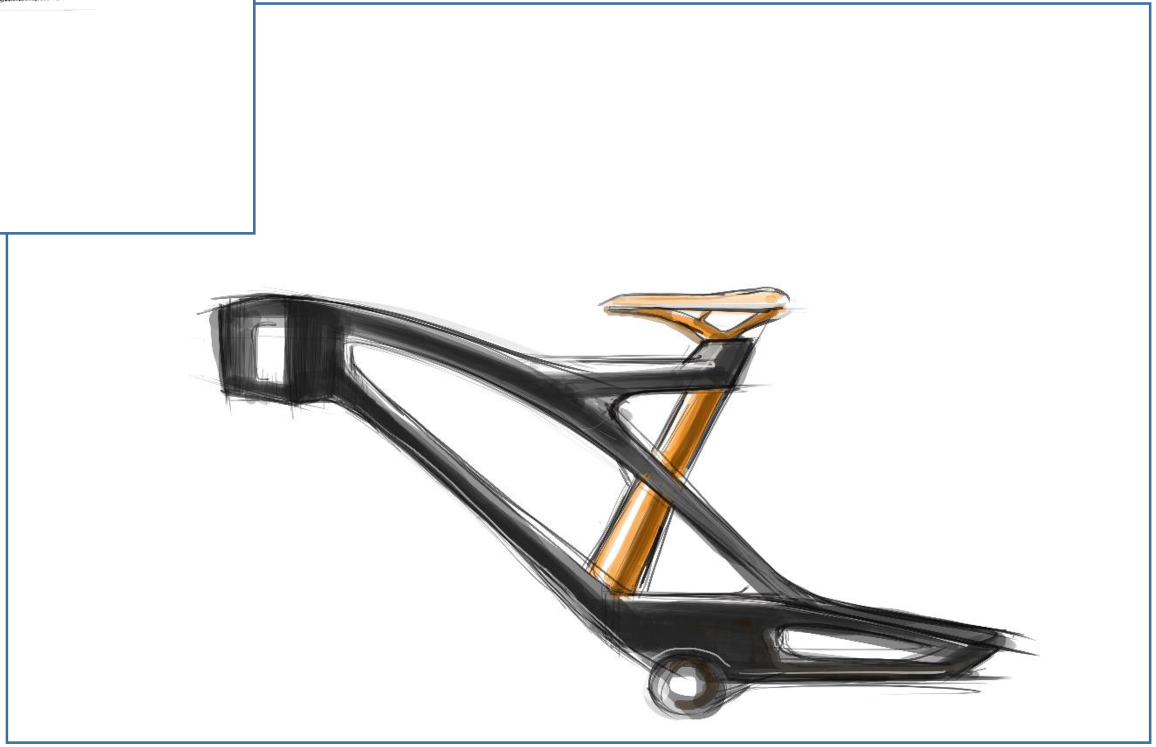

SPENGLE CARBON
SPENGLE CARBON


SPENGLE CARBON
SPENGLE CARBON

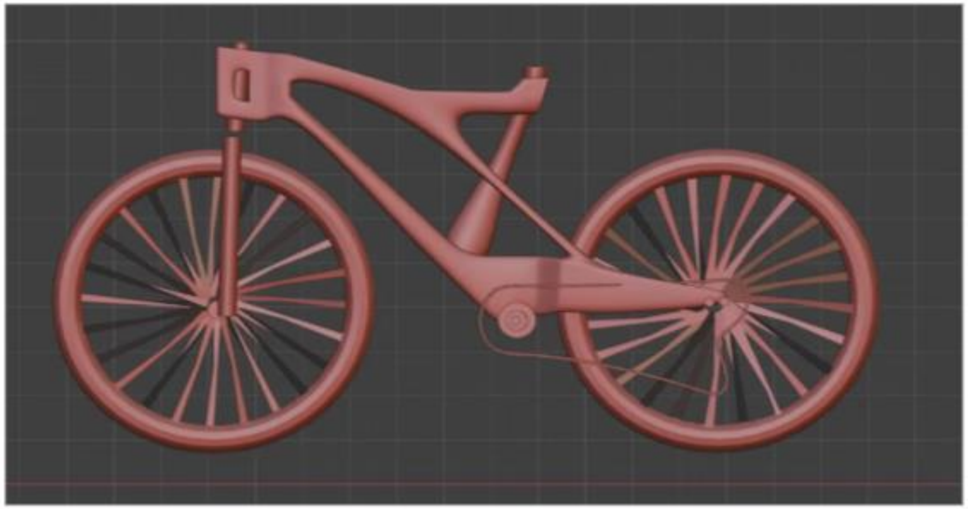
Final concept sketches

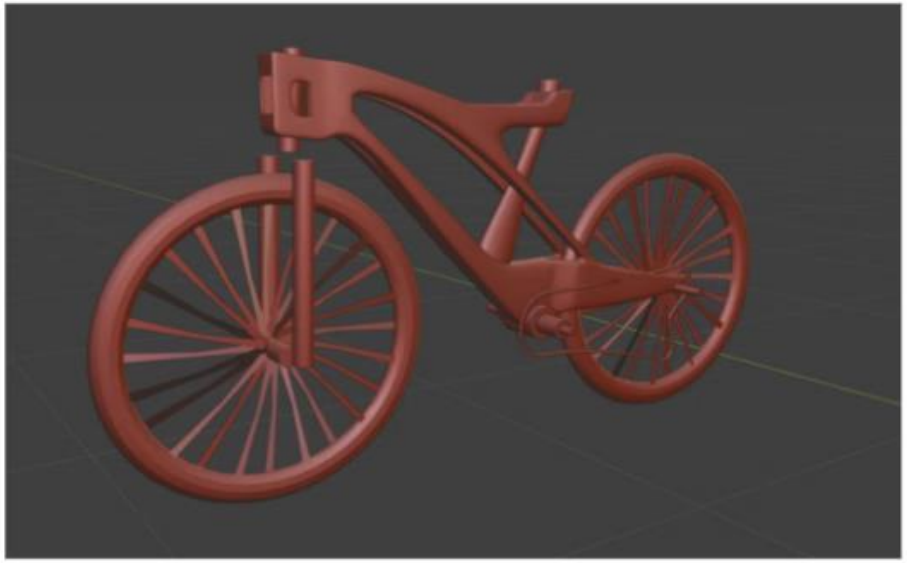
Final concept sketches

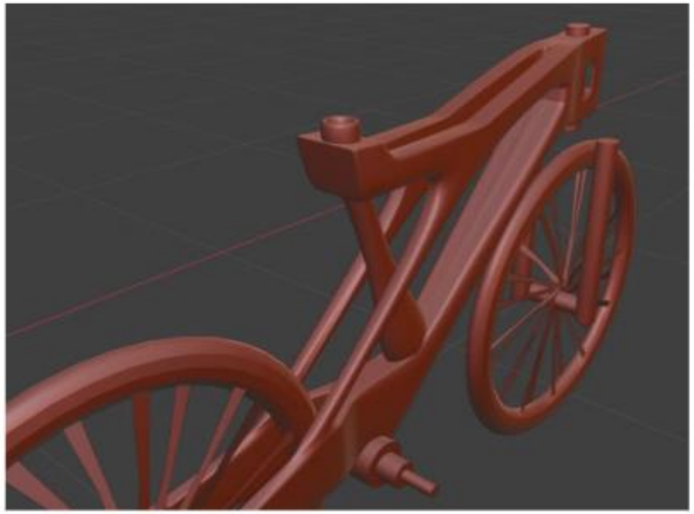




3D model

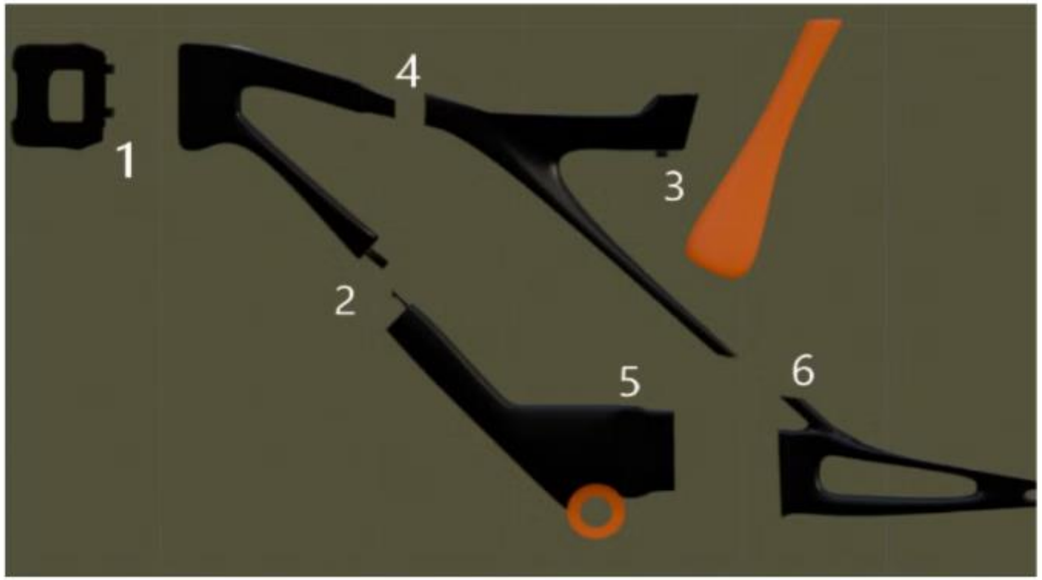






Implementing joineries

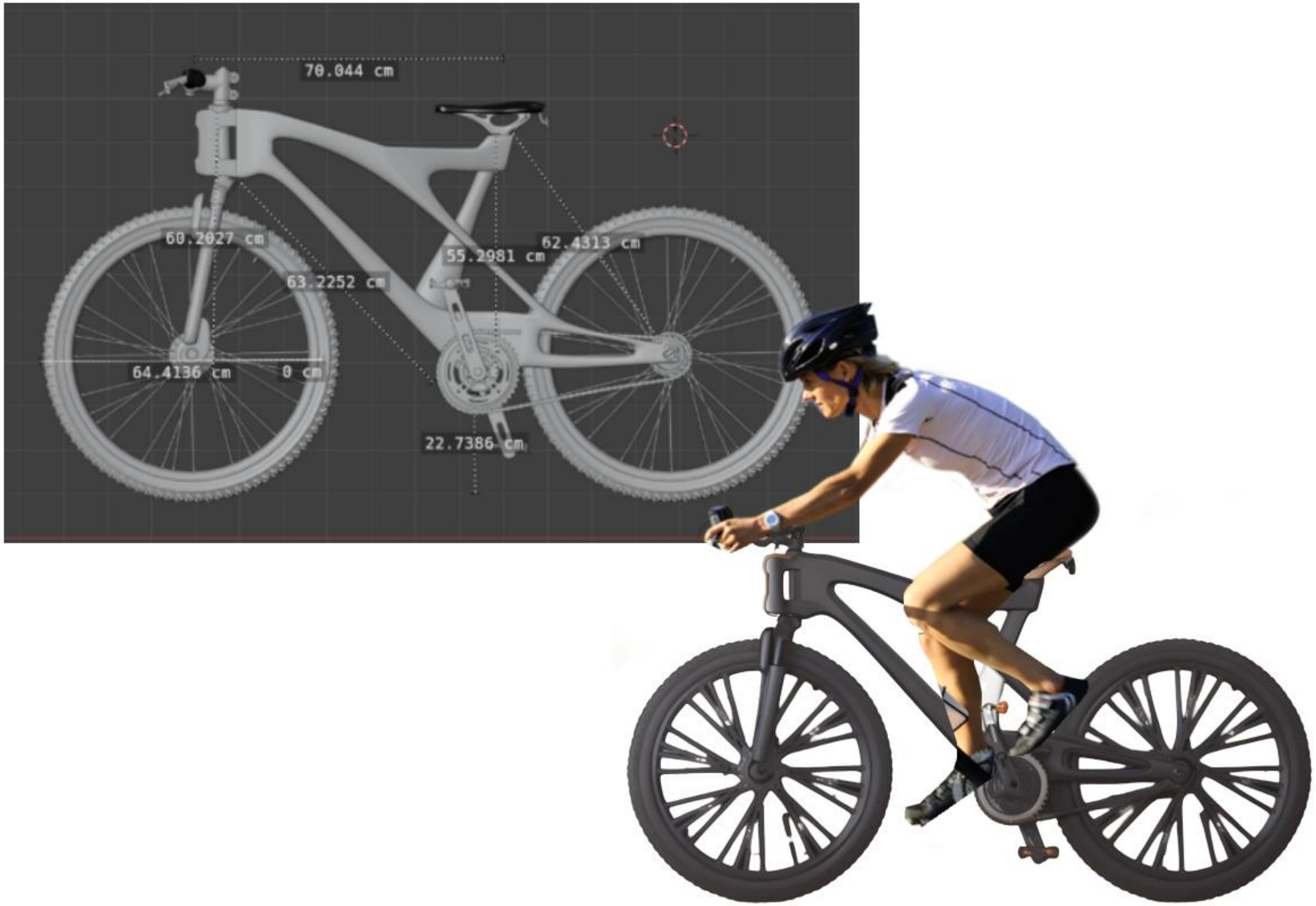
Implementing joineries



Joineries for 400mm x 400mm printer base

1.Snap-joint
2.Snap-joint
3.Snap-joint
4.Less tolerance
5.Less tolerance
6.Less tolerance

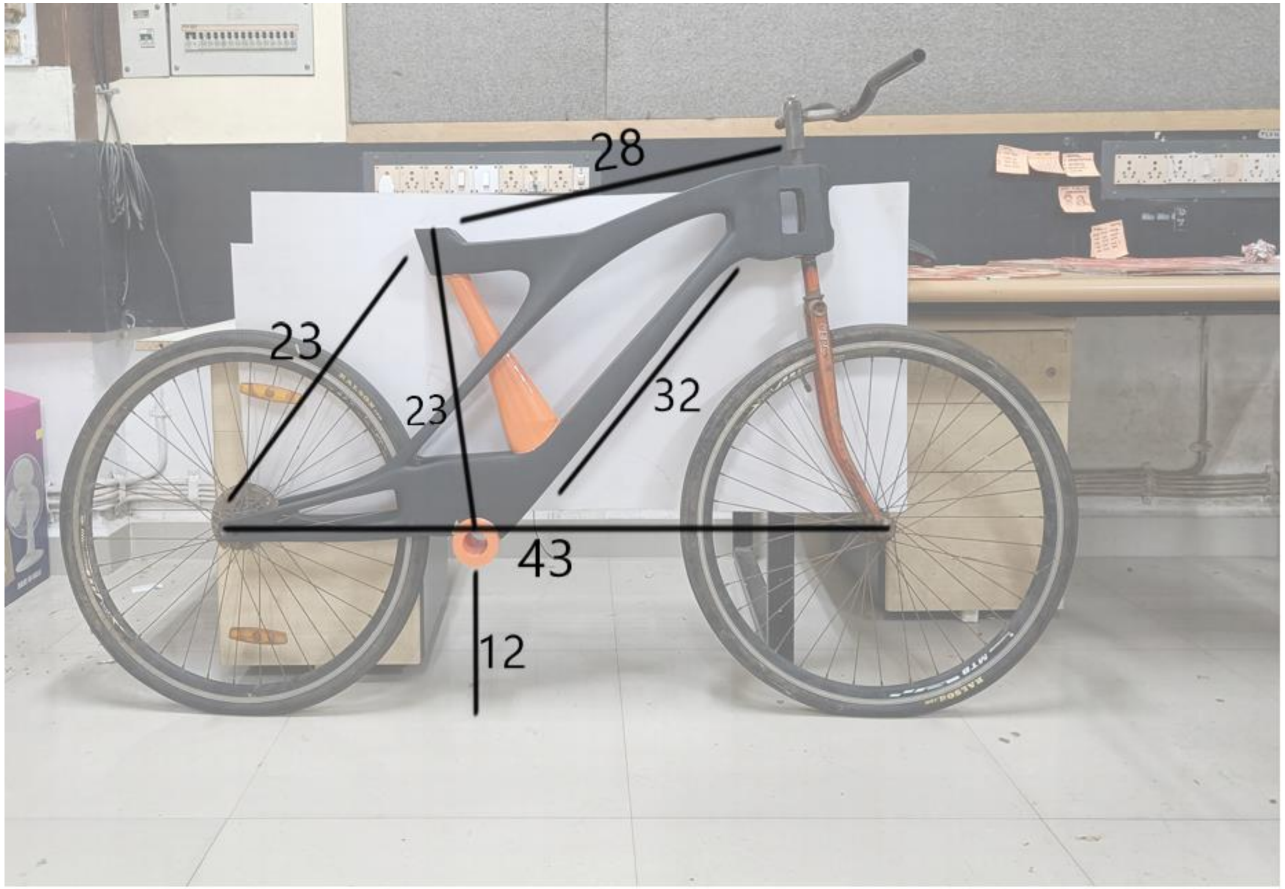
Frame size


70.044 cm
60.2027 cm
62.4313 cm
55.2981 cm
63.2252 cm
64.4136 cm
0 cm
22.7386 cm

Renders

Prototype (Process)

Prototype dimensions



Frame size:23 inch
Wheel base:43 inch
Tyre size: 29inch

Prototype