User and Product Manual Instructions

This document is a template of a user and product manual. The client may wish to make improvements on the prototype or need to fix it if something goes wrong or another group of students may work to make a more rugged prototype. The document needs to be clear for someone else who is not an engineer **to use, maintain or reproduce the project**. Include as many images and diagrams for a better understanding. Keep it plain, simple, visual and logical.

In general, if you are not sure exactly what to include, imagine that this document was the only thing that you had. Imagine also that your job was to add a new feature to the project that is described in your document. What would you need to know?

GNG5140

Design Project User and Product Manual

uOttawa

Bio-composite Spoke Protector

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Table 1. Acronyms

Acronym	Definition
UPM	User and Product Manual

Table 2. Glossary

Term	Acronym	Definition
Bio-composite material		A material composed of multiple substances, specifically flex fiber and a bio-polymer mixture.
Flex fiber		A flexible and resilient material used in the bio-composite, contributing to the spoke protector's durability.
Bio-polymer		A biodegradable polymer used in the bio-composite material, adding an eco-friendly aspect to the spoke protector.
Spoke Protector		A component designed to prevent interference between the bicycle chain and spokes, enhancing overall safety and performance.

1. Introduction

User and Product Manual for Flex Fiber and Bio-Polymer Mixture Material Spoke Protector for Bicycles

1.1 Basic Context and Assumptions:

The primary objective of our project is the development of a spoke protector for bicycles using a bio-composite material composed of flex fiber and a bio-polymer mixture. The spoke protector is a crucial component in bicycles, preventing the interference of the bicycle chain with the spokes. Our approach involves leveraging the unique properties of flex fiber and bio-polymer to create a durable, lightweight, and environmentally friendly solution.

Assumptions made during the project include the compatibility of the bio-composite material with standard bicycle components, its ability to withstand varying weather conditions, and its ease of integration into existing bicycle designs. The assumption is also made that users have a basic understanding of bicycle maintenance and assembly.

1.2 Overview of Document Structure:

In this project, we have pioneered the development of a spoke protector for bicycles using an innovative bio-composite material. This material combines flex fiber and a bio-polymer mixture, offering a sustainable and advanced solution. The spoke protector serves the crucial function of preventing interference between the bicycle chain and spokes, enhancing overall functionality.

The unique properties of flex fiber and bio-polymer bring several benefits to our spoke protector. Flex fiber provides resilience and flexibility, ensuring durability even in challenging conditions. The bio-polymer mixture adds an eco-friendly dimension, making the spoke protector a sustainable choice for environmentally conscious users.

1.3 System Description:

Our bio-composite material is meticulously crafted by combining flex fiber and a bio-polymer mixture. Flex fiber, known for its resilience and flexibility, is blended with a bio-polymer, resulting in a robust material suitable for the spoke protector. The composition ensures a balance of strength, lightweight design, and environmental sustainability.

The spoke protector system boasts features such as enhanced durability, reduced weight, and eco-friendly attributes. This makes it a standout choice for bicycle enthusiasts seeking a reliable and sustainable solution.

1.4 Installation Guide:

Installing our spoke protector is a straightforward process designed for various bicycle models. The step-by-step instructions provided in the manual guide users through the installation, ensuring a hassle-free experience. The compatibility information included caters to a wide range of bicycles, facilitating easy integration into different models.

1.5 User Instructions:

Clear and user-friendly guidelines are presented for using and maintaining the spoke protector. Users are provided with tips to optimize performance and extend the longevity of the product. This section caters to both novice riders and seasoned technicians, ensuring everyone can make the most of our innovative spoke protector.

1.6 Safety Considerations:

While the bio-composite material is designed for safety, it's essential to be aware of potential risks. The manual provides information on mitigating these risks and outlines guidelines for safe usage and handling. Following these safety measures is crucial for ensuring a secure and reliable biking experience.

1.7 Troubleshooting:

To address common issues users may encounter, the troubleshooting section offers practical solutions. Additionally, contact information for technical support is provided, offering users further assistance if needed.

1.8 Environmental Impact:

Our commitment to environmental sustainability is detailed in this section. The manual explains the eco-friendly aspects of the bio-composite material and provides disposal instructions.

Recommendations for minimizing environmental impact are included, aligning with the values of environmentally conscious individuals.

1.9 Intended Audience:

Bicycle enthusiasts, riders, and technicians.

Bicycle manufacturers and retailers interested in adopting sustainable materials.

Environmentalists and individuals interested in eco-friendly products.

1.10 Security and Privacy Considerations:

Our commitment to environmental sustainability is detailed in this section. The manual explains the eco-friendly aspects of the bio-composite material and provides disposal instructions. Recommendations for minimizing environmental impact are included, aligning with the values of environmentally conscious individuals.

The User and Product Manual aim to provide comprehensive information to different user groups on the proper installation, usage, and maintenance of the spoke protector. It serves as a guide for both end-users and professionals, ensuring a smooth integration of the bio-composite material into the existing bicycle infrastructure.

2. Overview

Problem Statement:

The problem at hand revolves around the interference between the bicycle chain and spokes, a common issue that can lead to wear and tear, affecting both the performance and safety of the bicycle. This interference is particularly problematic during intense rides or off-road biking, where the chain may unpredictably engage with the spokes, potentially causing damage and compromising the overall biking experience. Addressing this problem is crucial for maintaining the integrity and functionality of bicycles, ensuring a smooth and secure ride for users.

Importance of the Problem:

The interference between the chain and spokes not only jeopardizes the structural integrity of the bicycle but also poses safety risks to riders. A reliable spoke protector is vital for preventing accidents, reducing maintenance costs, and enhancing the overall longevity of bicycles. As bicycles continue to be a popular and sustainable mode of transportation, ensuring their reliability and safety becomes paramount.

User's Fundamental Needs:

Users fundamentally need a spoke protector that is easy to install, effectively prevents chain-spoke interference, and requires minimal maintenance. They also value environmental sustainability, seeking products that align with eco-friendly practices. Additionally, users desire a spoke protector that is compatible with a variety of bicycle models, ensuring widespread applicability.

Product Differentiators:

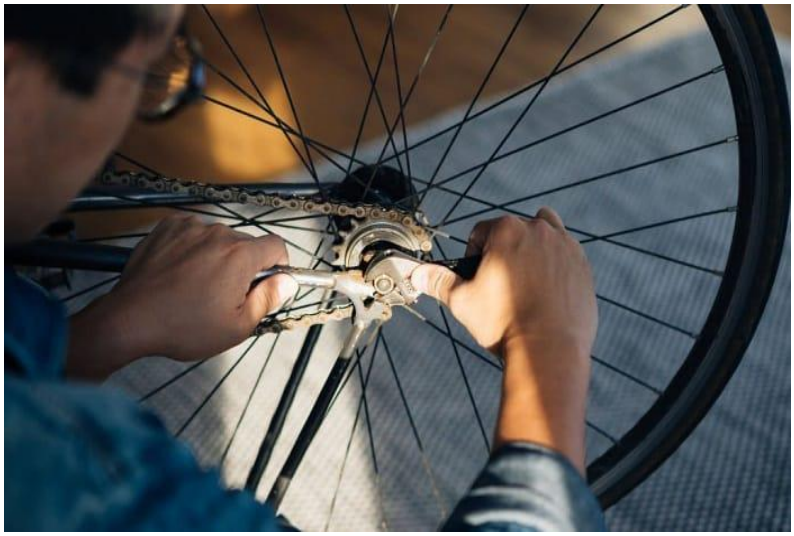
Our spoke protector stands out due to its use of a bio-composite material composed of flex fiber and a bio-polymer mixture. This unique combination not only ensures durability and flexibility but also addresses environmental concerns, making it a sustainable choice. The spoke protector's ease of installation, compatibility with various bicycle models, and its focus on safety set it apart from conventional solutions in the market.

Key Features and Major Functions:

- **Material Composition**: Bio-composite material comprising flex fiber and a bio-polymer mixture.
- **Durability**: Robust design to withstand varying weather conditions and intense biking activities.
- **Environmental Sustainability**: Eco-friendly material for a greener biking experience.
- **Compatibility**: Suitable for a wide range of bicycle models, ensuring broad applicability.
- **Easy Installation**: Simple and user-friendly installation process for both novice riders and technicians.

System Architecture (Non-Technical Terms):

Our spoke protector operates without the need for complex electronic components or microcontrollers. It's a purely mechanical system designed to seamlessly integrate with existing bicycles. Users interact with the system through a straightforward installation process, involving manual adjustments and fitting. The system doesn't rely on a web-based interface or complex user controls. It is engineered to function seamlessly in diverse environmental conditions, making it suitable for all types of biking activities.



The Image illustrates the simplicity of our system, showcasing the interconnection between the bio-composite spoke protector, the bicycle chain, and the spokes. The user's interaction is primarily during the installation phase, with no ongoing need for electronic controls or user interfaces. This straightforward architecture ensures reliability and ease of use for a wide range of users.

2.1 Conventions

In this User and Product Manual, we have employed clear and consistent conventions to enhance readability and guide users effectively. These conventions are designed to facilitate easy understanding and action when necessary.

Action Items:

Actions required from the reader are explicitly indicated by a line starting with the word 'Action.' This ensures that users can quickly identify steps they need to take to install, use, or maintain the spoke protector.

For Example

Action Tighten the securing bolts with a wrench until snug.

Noteworthy Information:

Important or noteworthy information is highlighted using a bold font or presented within a shaded box. This draws attention to critical details that users should be aware of during installation, usage, or troubleshooting.

For Example
Ensure that the bio-composite material is securely fastened to prevent any potential interference.

Bullet Points for Lists:
Lists of items, steps, or key features are presented in bullet point format. This aids in clarity and makes it easier for users to follow instructions or locate specific information quickly.
For Example

- *Compatibility with various bicycle models.*
- *Eco-friendly material composition.*
- *Easy and user-friendly installation process.*

Italicized Terms:
Technical terms or those requiring emphasis are italicized to distinguish them from regular text. This helps users recognize specific terms that may be important for understanding the functionality or maintenance of the spoke protector.
For Example
*Ensure the *bio-composite material* is aligned correctly before securing the bolts.*

Step-by-Step Format:
Instructions are presented in a step-by-step format to guide users through installation or troubleshooting processes. Each step is numbered, providing a sequential flow for easy comprehension.
For Example
Step 1: Align the spoke protector with the bicycle frame.
Step 2: Secure the bolts using the provided wrench.

These conventions are implemented consistently throughout the manual to create a user-friendly and accessible document. By adhering to these stylistic and command syntax conventions, we aim to ensure that users can navigate the manual effortlessly and successfully engage with the spoke protector for an optimal biking experience.

2.2 Cautions & Warnings

Caution: Bio-Composite Material Handling

Description:

The spoke protector is crafted from a bio-composite material during manufacturing, which may result in sharp edges. These edges could potentially pose a risk during handling.

Precaution:

To avoid any injuries, users are advised to exercise caution when handling the spoke protector. It is recommended to wear protective gloves during the installation process, especially when securing the bolts.

Warning: Secure Installation

Description:

Improper installation of the spoke protector may compromise its effectiveness and, more importantly, could pose safety hazards during bike usage.

Precaution:

Users must diligently follow the step-by-step instructions outlined in the installation guide. Any uncertainties regarding installation should prompt users to seek professional assistance to ensure the spoke protector is securely and correctly attached to the bicycle frame.

Caution: Environmental Impact

Description:

While the bio-composite material is designed to be eco-friendly, improper disposal practices could have adverse environmental effects.

Precaution:

Users are encouraged to dispose of the spoke protector responsibly, adhering to local environmental regulations. Recycling options should be explored where available to minimize the environmental impact.

Warning: Compatibility Check

Description:

Incompatibility between the spoke protector and specific bicycle models may compromise its functionality.

Precaution:

Before initiating the installation process, users should verify the compatibility of the spoke protector with their bicycle model. This information is provided in the manual, and users are urged to refer to it to avoid any complications.

Caution: Routine Maintenance

Description:

Neglecting routine maintenance may result in diminished performance of the spoke protector over time.

Precaution:

Users are advised to adhere to the recommended maintenance schedule outlined in the user instructions. Any signs of wear or damage should be addressed promptly, and worn components should be replaced to maintain optimal performance.

Waiver Use or Copy Permissions

No special waiver use or copy permissions are required for regular use of the spoke protector in accordance with the provided instructions. Users are granted the standard right to install and utilize the product for personal or intended purposes.

However, it's important to note that any attempt to modify the spoke protector, reproduce the user manual for commercial purposes, or distribute it without explicit permission from the manufacturer is strictly prohibited. This prohibition is in place to ensure the integrity of the product and to maintain the accuracy and reliability of the user manual.

3. Getting started

Collect all the requirements to get started with the Flex Fiber and Bio-Polymer Mixture Material Spoke Protector system which may include a spoke protector, bicycle and basic tools. Be sure to observe compatibility with your bicycle. Take a short bicycle ride to test its workings under normal conditions. Make sure that after installation, the spoke protector is properly aligned and affixed. The process has been simplified with troubleshooting tips and a simplified user guide to aid in the installation process.

3.1 Set-up considerations:

When setting up, it is required for one to identify the key components required for the set-up. These include the spoke protector, bicycle, and tools. It is also important to carry out compatibility checks with your bicycle. There is minimal communication since the system works mechanically. The input entails manual dexterity in installation, and the output comprises of appropriate functioning of the spoke protector.

3.2 Consideration of User's Access:

In this regard, the possible users will be various groups, including enthusiasts, riders, engineers, and manufacturers. Categorization in this manual of various user groups is not limited in terms of accessibility since it is inclusive of most factors essential for its usage by any prospective user.

3.3 Accessing the System:

Ensuring that the spoke protector is correctly installed on the bicycle is necessary to activate the system. Installing the system will not require a user ID, log-on, or password management because it will function passively.

3.4 System Organization and Navigation:

Physical inspection and verification of the spoke protector's correct installation and alignment are part of the navigation process. Other than preventing chain-spoke interference, there is no digital system menu or further functionality.

3.5 Using the System:

The spoke protector's primary purpose is to stop chain-spoke interference, which makes riding safe and enjoyable. There are no further digital features or functionalities.

4. Troubleshooting & Support

4.1 Special Considerations

While the bio composite spoke protector is designed for durability and long-lasting performance, there are some special situations to consider for optimal care and use:

- ***Extreme Temperatures***: Avoid storing or exposing the bio composite spoke protector to extreme temperatures (both hot and cold). This can affect the resin and potentially affect its properties.
- ***Chemical Exposure:*** Avoid contact with harsh chemicals like solvents or strong cleaners, as these can damage the bio composite materials. If such contact occurs, rinse the protector thoroughly with clean water and dry it immediately.
- ***Heavy Impacts:*** While durable, the bio composite protector is not indestructible. Avoid direct hard impacts, as this may cause damage or cracks.
- ***Saltwater Exposure:*** While occasional riding in light rain or coastal areas is fine, prolonged exposure to saltwater can accelerate material degradation. Rinse the protector with clean water and dry it thoroughly after riding in saltwater conditions.
- ***UV Light:*** Constant exposure to direct sunlight can slowly fade the protector's color over time. This is purely aesthetic and does not affect performance.

4.2 Maintenance

Maintaining your bio composite spoke protector is simple and essential for ensuring its longevity:

- ***Cleaning:*** Regularly wipe down the protector with a damp cloth and mild soap to remove dirt and grime. Avoid using abrasive scrubbers or harsh chemicals.
- ***Inspection:*** Before each ride, visually inspect the protector for any cracks, chips, or signs of wear. If you notice any damage, discontinue use and contact support for warranty claims or replacement options.
- ***Removal and Storage:*** When storing your bike for extended periods, remove the spoke protectors and store them in a cool, dry place away from direct sunlight and extreme temperatures.
- ***Warranty and Support:*** Refer to the warranty information included with your purchase for details on coverage and how to contact support for any issues or replacement needs.

Additional Tips:

- Avoid overtightening the screws when installing the protector. Follow the provided instructions for optimal torque.
- If you experience any difficulties or have questions about your bio composite spoke protector, don't hesitate to contact our support team for assistance.

By following these simple considerations and maintenance tips, you can ensure your bio composite spoke protector performs its best for years to come!

4.3 Support

For now, anyone requiring the emergency contact information can get assistance from our team.

Nikhil Dawar: ndawa039@uottawa.ca
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Pradip Pahadi: ppaha035@uottawa.ca
Ali Baksh: mkhos054@uottawa.ca
Advaith: akula015@uottawa.ca

5. Product Documentation

Our prototype production had four phases, Design, Mold Construction, Material Selection and Part Construction.

5.1 Phase 1: Design

Equipment list

A capable computer with access to SolidWorks, 3D scanner (relevant software for file analysis and conversion), pen and paper, measuring tape, caliper, and commercially available products (spoke protectors).

Instructions

The design process started by gathering several different commercially available spoke protectors; These parts had different designs and were for bikes of different drivetrains with different gear ratios, however, all had a relatively similar build quality and material (injection molded plastic parts).

We chose a spoke protector that was made to be used for a “cassette” system drivetrain of 6 to 8 speed. The reason behind this choice was the simplicity of the design and the fact that 6 to 8 speed bikes are the most sold bike in the industry.

Spoke protector for a 6 speed “Freewheel” drivetrain system.

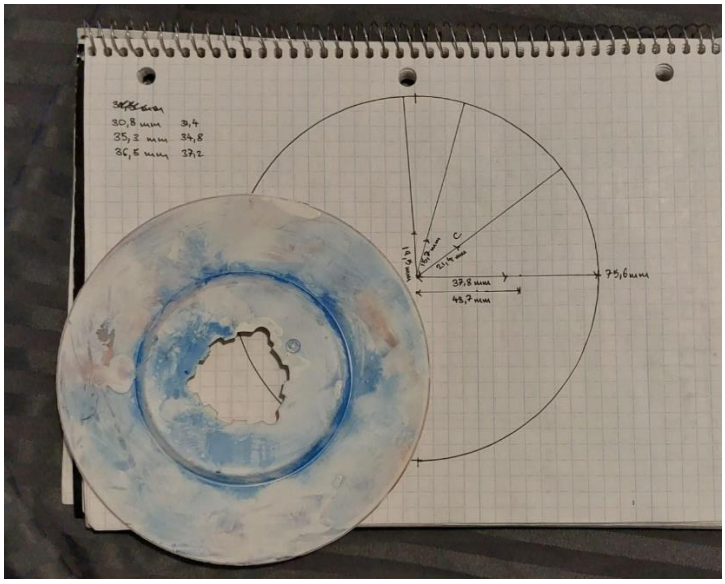
Spoke protector installed on a wheel with an 8 speed “cassette”.

The chosen spoke protector for our base design.

We based our design off this existing spoke protector; We used the same dimensions and inner ring indentation configuration.

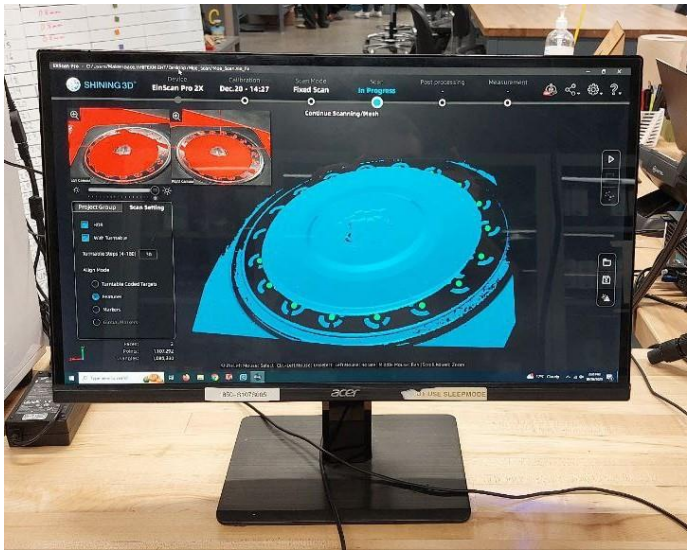
To take these measurements we first tried using conventional measuring tools such as measuring tape and caliper; However, due to the concave shape of the part, traditional methods proved to be ineffective.

We then decided to use a 3D scanner to get a ready CAD model with exact measurements. Since our spoke protecter was clear and passed light through, we had to paint it white to get a proper scan.



Initial measurements taken using traditional methods.

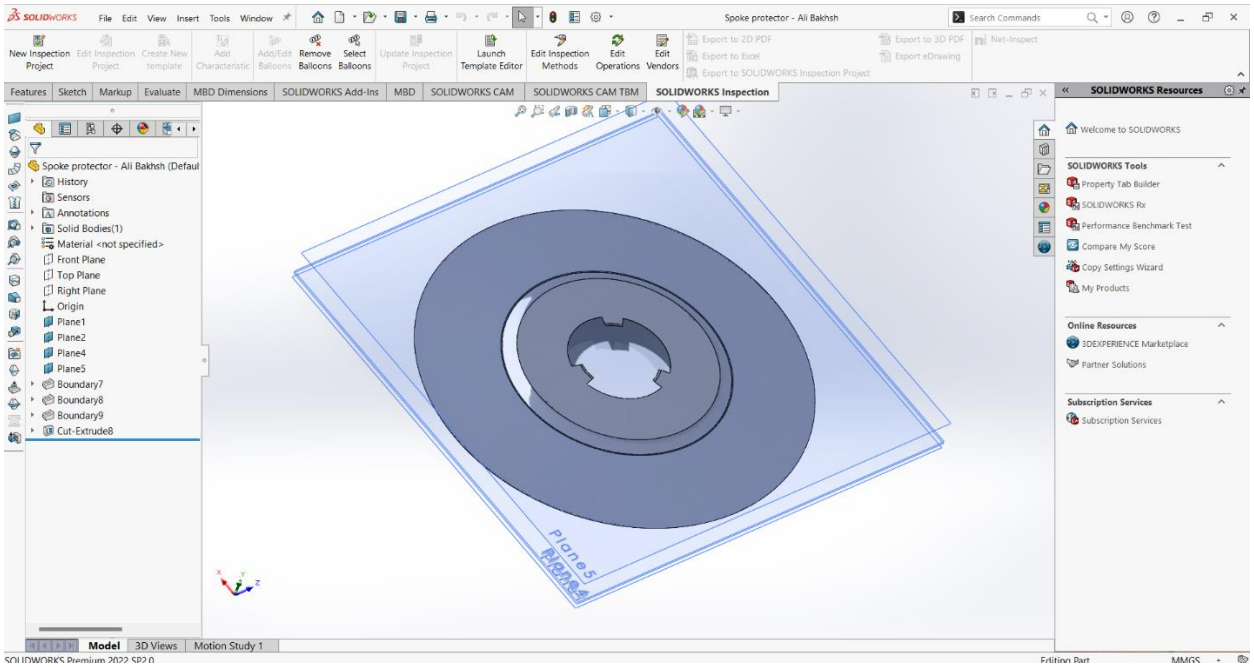
Colored spoke protecter under the 3D scanner.



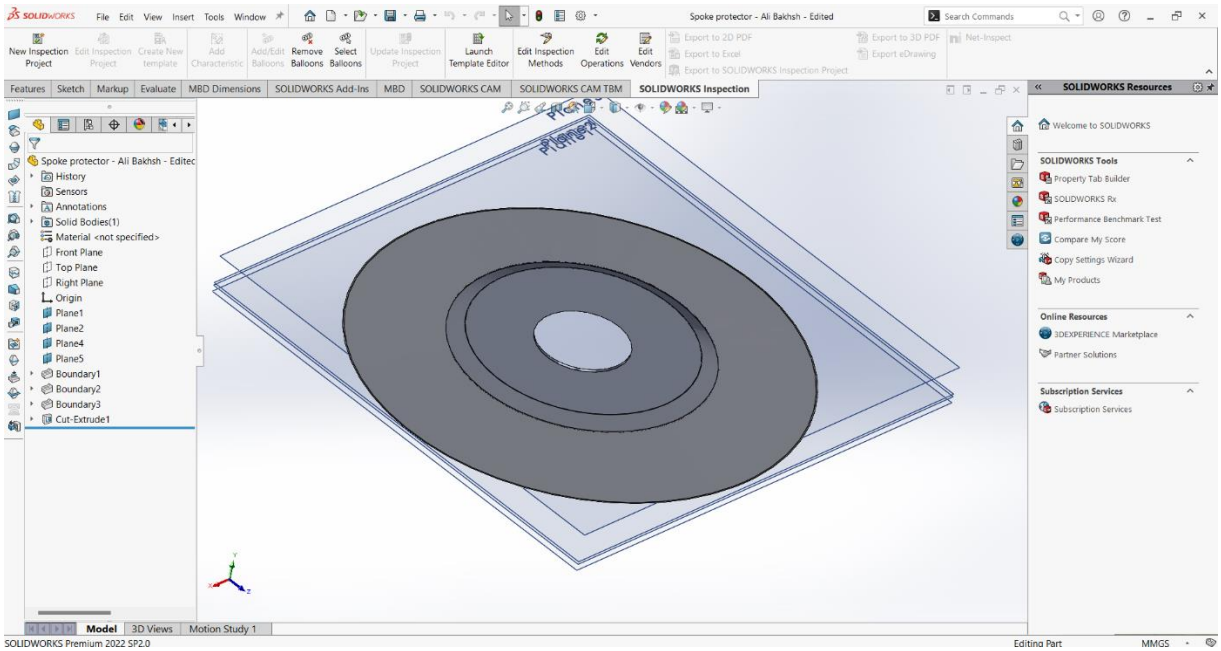
The CAD model as a result of 3D scanning.

We took the results from the scanned 3D model and completed our own initial CAD model using SolidWorks. Our initial design had the exact measurements and thickness of the acquired spoke protecter.

Later, due to some difficulties in our mold construction phase we iterated our design and simplified it by excluding the inner ring indentations.



Initial SolidWorks Design.



Iterated SolidWorks design.

5.2 Phase 2: Mold Construction

BOM

A 22.6 lbs. piston shaped slab of aluminum that was given to us by the uOttawa machine shop at STEM.

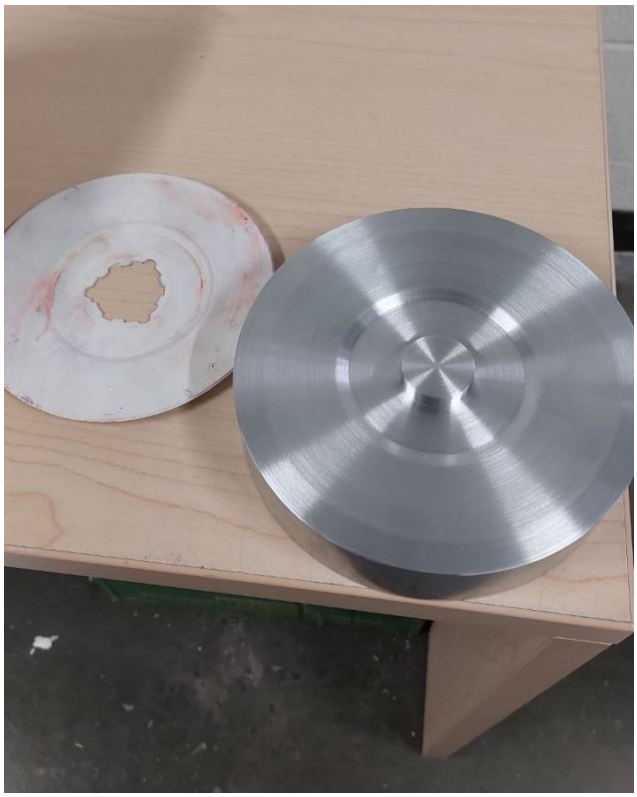
Instructions

At this stage we delivered our initial CAD model to the Engineering department's machine shop at STEM building. After explaining the model and how we wanted the mold to be constructed, the head technician suggested simplifying the model, so that they would not have to use a Wire EDM machine, which in term increased the mold production processes speed.

To produce the mold, the machine shop took our simplified CAD model and made a CAD mold model based on that. Then they utilized a CNC machine to carve out material to construct the mold out of the aluminum slab.

The total process took approximately 10 days.

The aluminum slab, before the mold construction process.



The finished mold.

5.3 Phase 3: Material selection

BOM

Flax Fiber woven sheet roles, Epoxy Resin, and Polyurethane Resin. All material was purchased and given to us by Dr. Robitaille, our client for this project.

Instructions

After doing some research about Bio-Composites and their construction, we realized that for reinforcement we were going to use flax fiber and for matrix, a type of bio-resin. The matrix phase in bio-composites is formed from polymers derived from renewable and nonrenewable resources.

Dr. Robitaille was able to order some roles of differently woven flax fiber, however, due to logistical difficulties we were not able to secure any biodegradable resin. So, to finish the work we decided to go with available resins.

Dr. Robitaille had some Epoxy and Polyurethane resin in his lab that he suggested that we could use. We tested a bit of both, and we decided to go with Polyurethane resin. Polyurethane resins

can provide flexibility, impact resistance, and toughness, making them suitable for applications where the composite needs to withstand dynamic loads, such as automotive parts and sports equipment.

Due to the geometry of the part, we were going to make, we decided to use a fiber sheet with a cross woven pattern.

A sample of the Flax Fiber woven sheet that we used and its pattern.

5.4 Phase 4: Part Construction:

BOM

Cross woven flex fiber sheet (75cm X 30cm), Polyurethane Resin.

Equipment list

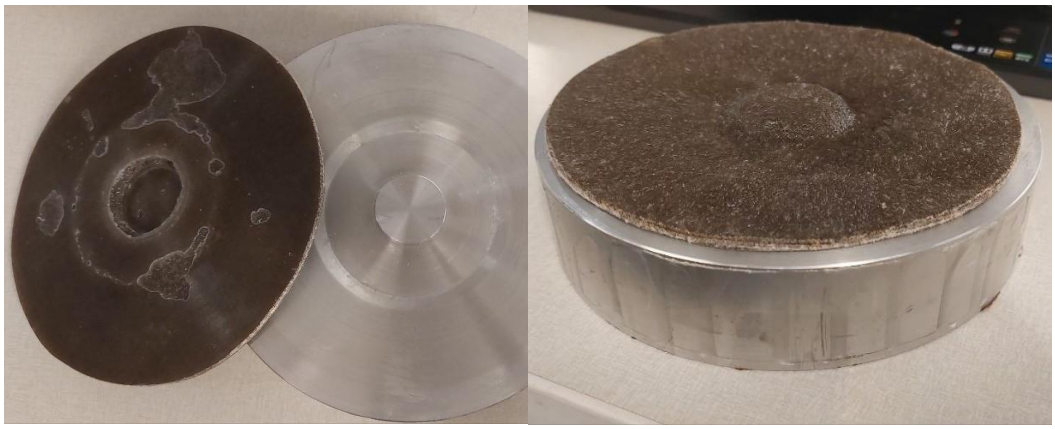
Our mold, sealant tape, release agent, vacuum film, vacuum faucet, vacuum machine, electric saw, and sander. gloves, mixing cups, and protective masks.

Instructions

This was our last phase of the project, in which we built our protype. To complete this phase, we used the Resin Film Infusion (RFI) method of composite production. In this method, dry fabrics are laid up interleaved on a mold that has been coated with release agent. The lay-up is vacuum bagged to remove air through the dry fabrics, and then the resin hose is connected to the vacuum and resin would be allowed to flow into the air-free fabrics, and then left for a certain amount of time, to cure. After curing vacuum film (bag) would be ripped apart and part would be carefully detached from the mold.

In our case we used 3 layers of cross woven flex fiber sheets as our dry fabric; After vacuuming for about 5 hours, we used Polyurethane as resin, and we left the resin hose connected for 24

hours to let the part cure. After curing was done and we carefully recovered the part from the model, we did some post processing using an electric mini saw and sander to cut out the inner hole and smoothen the edges.



The final part with the mold.

The final prototype was smooth and shiny on one side (facing the mold), and nonreflective and pores on the other side (facing outwards from the mold).

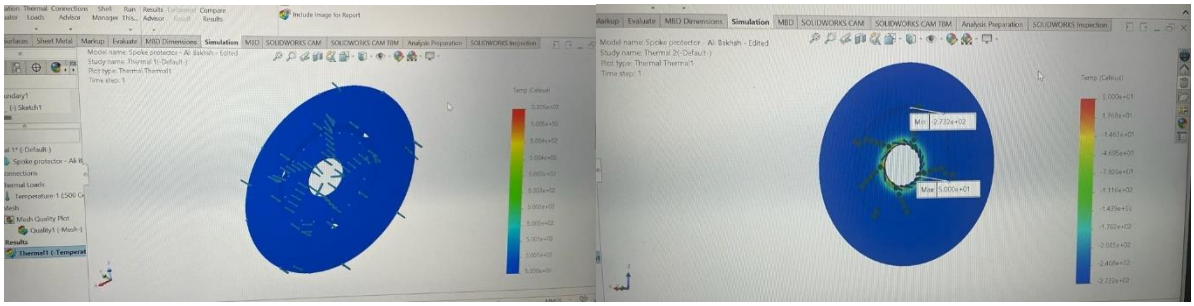
The smooth side of the cured part.

The pores side of the cured part.

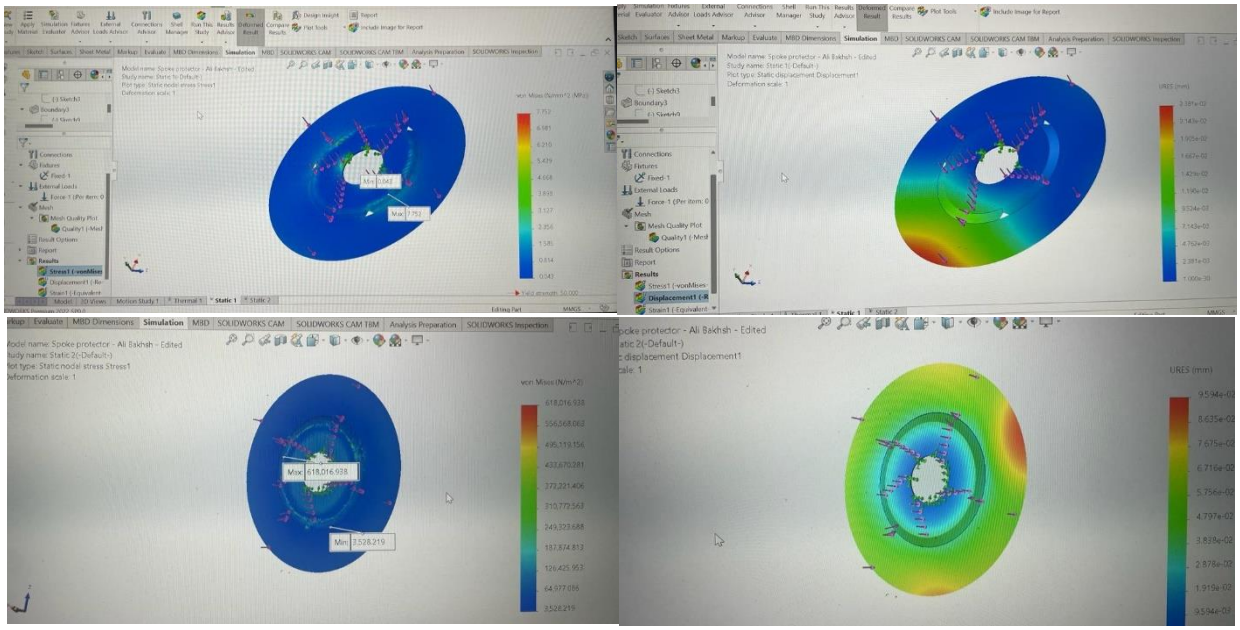
5.5 Testing & Validation

We completed a series of computer simulations, to determine the thermal resistance and structural integrity of our design, with consideration for material (bio-composites). These simulations also compared our design with the exciting spoke protecters made of injection molded plastics.

These simulations were implemented on the edited CAD design. The results proved the success of our design.



Thermal simulation and comparison of the same design in flax fiber reinforced thermoplastics and plastic abs material.



Static simulation and comparison of the same design in flax fiber reinforced thermoplastics and plastic abs material.

We did not get to complete physical thermal and static tests, due to time constraints. However, we did manage to install the prototype on a bike and conduct some real-world testing. The prototype performed well; No deformation or cracking was noticed, and the prototype proved to be effective in controlling the chains direction when out of alignment.

The final prototype installed on a bike.

6. Conclusions and Recommendations for Future Work

Our journey in crafting a biocomposite spoke protector unveiled valuable lessons that pave the way for future innovations. We successfully demonstrated the feasibility of flax fiber and epoxy polymer as a sustainable alternative to traditional materials. The prototype met most target specifications for strength, strain, and thermal conductivity, showcasing its potential for durability and functionality.

6.1 Key Learnings:

- Material Selection Matters: Flax fiber proved promising, but optimizing its alignment and resin composition could unlock further performance gains.
- User-Centric Design is Crucial: Incorporating user feedback is essential. We needed more extensive user testing to refine the design for functionality and aesthetics.
- Industrial Standards are Key: Adhering to relevant standards ensures compatibility, safety, and wider market acceptance. This was an area for earlier consideration.
- Environmental Impact Assessment is Essential: A comprehensive assessment from the outset would have helped minimize our footprint and maximize sustainability.
- Iterative Prototyping is Vital: Building and testing multiple prototypes allows for continuous improvement. We could have iterated more with additional time.

6.2 Recommendations for Future Work

To build upon our work and propel this project forward, here are some key avenues for future exploration:

- Material Optimization: Research advanced composite formulations and processing techniques to enhance flax fiber properties and explore bio-based resin alternatives.
- User-Focused Design: Conduct extensive user testing and incorporate feedback into design iterations, focusing on functionality, aesthetics, and user experience.
- Scalability and Manufacturing: Develop efficient and scalable production processes while ensuring consistent quality and optimizing costs.
- Life Cycle Assessment: Perform a comprehensive assessment to understand the environmental impact of the entire product lifecycle, including material sourcing, production, use, and end-of-life.

- Market Analysis and Commercialization: Conduct thorough market research and develop a comprehensive commercialization strategy to target environmentally conscious cyclists.

6.3 Opportunities with More Time

Given additional months, we would have prioritized the following:

- Extensive User Testing: In-depth user testing involving diverse bicycle models and riding styles would provide invaluable insights for design optimization and user experience enhancement.
- Prototyping Refinement: With more time, we could have iterated on the prototype, incorporating user feedback and exploring different design variations to refine its functionality and aesthetics.
- Sustainability Deep Dive: Investigating bio-based resin alternatives and exploring partnerships with local flax fiber producers could significantly improve the project's sustainability profile.

By building upon our work and addressing these proposed areas of future exploration, the bio composite spoke protector has the potential to become a game-changer in the cycling industry, offering a sustainable and cost-effective solution for riders who value both performance and environmental responsibility.

7. Bibliography

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3. https://cozybeehive.blogspot.com/2008/01/bio-composite-race-bicycle-part-1.html
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Honorable mentions

This project would not have been completed without the support of Professor François Robitaille from Mechanical Engineering Department at University of Ottawa.

8. APPENDICES

Modular Ultralight eV Prototyping Info

Table Board + All tasks Start date Group Fields Subitems ...

	Name	Assignee	Status	Start date	Due date	Duration
1	Project Initiation	SV Subina Verma	Completed	07/09/2023	20/09/2023	10d
2	Team Contract	PP pradip pahadi	Completed	07/09/2023	13/09/2023	5d
3	Stakeholder Identification and Analysis	PP pradip pahadi	Completed	14/09/2023	20/09/2023	5d
4	Project Planning	PP pradip pahadi	Completed	21/09/2023	27/09/2023	5d
5	Budget	AK Advaith Kulasekaran	Completed	21/09/2023	22/09/2023	2d
6	Communication Plan	SV Subina Verma	Completed	22/09/2023	25/09/2023	2d
7	Stakeholder Management	PP pradip pahadi	Completed	22/09/2023	27/09/2023	4d
8	Risk Management Plan	MA Mohammad Ali Khosro Bak...	Completed	25/09/2023	26/09/2023	2d
9	Setting Scope and Goals	ND Nikhil Dawar	Completed	26/09/2023	27/09/2023	2d
10	Project Execution	ND Nikhil Dawar	Completed	28/09/2023	19/12/2023	59d
11	PD A:Client meeting prepration	AK Advaith Kulasekaran	Completed	12/09/2023	12/09/2023	1d
12	PD B		Completed	14/09/2023	27/09/2023	10d
13	Benchmarking and specifications	PP pradip pahadi	Completed	14/09/2023	20/09/2023	5d
14	Design status review, need identification and me	ND Nikhil Dawar	Completed	20/09/2023	27/09/2023	6d
15	Existing Product Test Plan and test results	MA Mohammad Ali Khosro Bak...	Completed	20/09/2023	27/09/2023	6d
16	PD C		Completed	28/09/2023	11/10/2023	10d
17	Material and Manufacturing Process Selection	PP pradip pahadi	Completed	28/09/2023	11/10/2023	10d
18	Material Sourcing	PP pradip pahadi	Completed	06/10/2023	09/10/2023	2d
19	Revised project plan	MA AK ND	Completed	09/10/2023	11/10/2023	3d
20	Client meet 2	MA Mohammad Ali Khosro ... +1	Completed	04/10/2023	10/10/2023	5d
21	PD D		Completed	26/10/2023	01/11/2023	5d
22	Bill of Material	AK Advaith Kulasekaran	Completed	26/10/2023	31/10/2023	4d
23	Detailed design	MA Mohammad Ali Khosro Bak...	Completed	27/10/2023	01/11/2023	4d
24	Simulation of Prototype	MA Mohammad Ali Khosro ... +1	Completed	30/10/2023	01/11/2023	3d
25	Simulation Testing	ND Nikhil Dawar	Completed	31/10/2023	01/11/2023	2d
26	Client meet 3	PP SV MA AK ND	Completed	01/11/2023	07/11/2023	5d
27	PD E		Completed	02/11/2023	15/11/2023	10d
28	Prototype 1 and revision based on Simulation ar	MA Mohammad Ali Khosro ... +1	Completed	02/11/2023	15/11/2023	10d
29	Design and analysis reports	PP SV AK	Completed	09/11/2023	15/11/2023	5d
30	PD F: Final project presentation	PP SV MA AK ND	Completed	16/11/2023	22/11/2023	5d
31	PD G: Design Day//Client meeting 4	PP SV MA AK ND	Completed	23/11/2023	30/11/2023	6d
32	Client meeting 1	PP SV MA AK ND	Completed		19/09/2023	
33	Project Monitoring and Control	MA Mohammad Ali Khosro Bak...	Completed	01/11/2023	30/11/2023	22d
34	Project Objectives	ND Nikhil Dawar	Completed	01/11/2023	09/11/2023	7d
35	Project performance and cost	AK Advaith Kulasekaran	Completed	09/11/2023	16/11/2023	6d
36	Quality of deliverables	SV Subina Verma	Completed	16/11/2023	22/11/2023	5d
37	Schedule status	PP pradip pahadi	Completed	16/11/2023	22/11/2023	5d
38	Project Closure	PP pradip pahadi	Completed	27/11/2023	20/12/2023	18d
39	PD H: Video and user manual	PP SV MA AK ND	Completed	30/11/2023	18/12/2023	13d

Gantt chart made in Wrike to track the progress of the project.

9. APPENDIX II:

Design Day Photos

Poster for design day

Design Day CEED and uOttawa Banner

Name Tags

Our Biocomposite spoke protector in acction


Honda Racing
India
OUR PRODUCT IS
• ECO FRIENDLY
• PROVIDES STRE
• ENHANCED D

The Mould

The Team