SENIOR CAPSTONE/
SENIOR DESIGN EXPERIENCE
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MB Human-Powered Mobility Chair

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Executive Summary

In developing nations, 90% of those who need a wheelchair to move do not have access to one. Due to the large number of unpaved roads in these countries, traditional wheelchairs lack the terrain capability and durability to operate successfully under these conditions. To address this, our team designed an affordable, low-cost, three wheeled, lever driven wheelchair. Through testing, we determined that our design is more capable of operating on unpaved roads than the other models provided for comparison. Capable of carrying 300lbs and operating on slopes of 10 degrees, this design met our sponsor's objectives.

Research and Context

Through extensive research, three key focus areas were identified: powering methods, terrain adaptability, and durability. Terrain adaptability and durability are crucial due to the rough landscapes prevalent in developing countries, which require durable designs capable of navigating unpaved roads and steep slopes. Overall, the project aims to address the mobility challenges faced by disabled individuals in developing countries by designing an affordable, durable, and user-friendly off-road wheelchair.

Project Characteristics

Project Criteria
- Durable
- Low cost
- Safe / stable
- Easy to operate
- Manufacturability
- Comfortable
- Multi-terrain capability

Project Constraints
- Cost less than $500
- Maintains traction on rough terrain
- Operates on 10° slopes
- 300lbs weight capacity

Decision Matrix				
Category	Weighting	Lever Driven 3 Wheels	Dual Hand Crank	Off-road Pushrim
Durability	6.5	3.5	2.5	3.5
Cost	5.8	3.0	2.8	3.8
Availability	3.3	2.8	2.3	2.8
Comfortability	3.3	2.8	3.3	2.5
Safety	3.8	3.3	3.0	2.8
Ease of operation	4.8	3.0	2.8	3.0
Terrain capability	7.8	4.0	2.8	1.5
Total		115.3	95.6	97.6

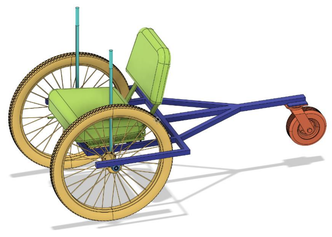
Solution Ideas and Alternatives

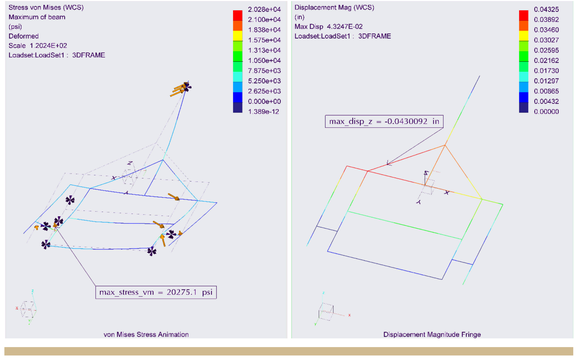
The two main wheelchair characteristics considered in the design selection were the drive system and wheel configuration. Four solutions were evaluated using a decision matrix, resulting in the selection of the three-wheeled lever-driven design due to its low cost, maneuverability, ease of operation, and high terrain capability.

Design Process

Fusion 360 was used to model the wheelchair. Creo was used to test multiple iterations of the frame until the optimal design was found.

The results of the FEA are shown below:
- Max Von Mises Stress of 20 KSI
- Factor of Safety of 2.3 (yield strength of 48 KSI)





Final Design & Test Results

Our final design features a 1.5-in tube steel frame capable of carrying 300lbs on rough terrain. The lever drive system and 26-in mountain bike wheels were chosen to improve the rough terrain capability and ease of operation of this wheelchair, while also being materials easily found in developing countries.

Testing was performed comparing our design to other models including a hand crank mobility cart, an off-road push rim wheelchair, and a traditional push rim wheelchair. The results showed our design outperformed these designs in three key areas:
1. Maintaining traction on loose or wet terrain
2. Climbing and descending inclines of up to 10°
3. Ease of operation off of paved roads

Economic Analysis

Utilizing easily accessible material is critical for the economic viability of creating this product. By providing detailed construction plans, individuals can manufacture the mobility chair at a lower cost with diverse building materials. This project prioritizes inclusivity over profit, aiming to get affordable mobility to a wide demographic rather than solely pursuing financial gains.

Part	Quantity	Cost (USD)
Steel		
Frame	40ft	$ 75.26
Levers	4ft	$ 12.45
Plating	2ft	$ 5.50
Angle	4ft	$ 17.80
Wheels		
Bike	2	$ 20.00
Castor	1	$ 20.00
Brakes		$ 40.00
Seat		$ 15.00
Hardware		$ 15.00
Total (USD)		**$ 241.01**

Project Value Proposition

Worldwide, there are millions of people in need of a wheelchair and many of those are people in developing countries. This project has the potential to add value to the lives of millions by improving independence and empowerment among individuals. By providing a budget option for mobility, this will hopefully impact the lives of many.

Maximizing Project Impact

The impact of this project is to allow for a cheap and obtainable means of mobility for people who need it in developing countries. The goal of this project is to be assembled by not-for-profit organizations and distributed to individuals in need of a wheelchair.

Customer Feedback

Throughout the project weaknesses and areas for improvement were identified by the design team and sponsor:
- A basket for carrying cargo
- Equally sized freewheels for uniform propulsion
- Foot rest for improved stability and comfort
- Method of reversing

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