Jorge's Custom Modification Car Kit

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Background

Jorge grapples with the challenges imposed by Coffin-Lowry Syndrome (CLS), impacting his mobility, communication, and focus. His attention struggles to center on a singular focus, and it has become evident that his solace lies in a toy car. Unfortunately, existing vehicles in the market fail to meet his unique mechanical and physical requirements, consistent and reliable remote control, lacking nocturnal lighting, and providing inadequate space. To address these issues, we propose a custom vehicle with features like a screen holder and hitch attachment, tailored to Jorge's needs. This specialized conveyance will possess the necessary power and suspension for traversing the challenging terrains around his home. Encouragingly, our efforts have garnered support from other families facing similar circumstances, who believe that this customized vehicle will provide comparable benefits to their children.

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Design and Methodology

We approached the problem by first analyzing the key challenges and user needs, focusing on improving mobility, remote control functionality, and safety for Jorge. Collaborating as a team, we brainstormed solutions and made design choices that balanced functionality, feasibility, and cost. We modified the steering shaft to enhance maneuverability and a 3D-printed a free-rotating wheel to improve turning radius. Additionally, we integrated a remote control system to ensure caregivers could intervene when necessary. Constraints such as budget, weight limits, and material availability guided our decisions, leading us to select durable yet lightweight materials for fabrication. Using Fusion 360, we developed CAD models to prototype and refine our designs, complementing our initial sketches and exploded views to visualize assembly and functionality.

Prototype Development

Hot-Swappable Battery System: The battery housing and quick-release mechanism have been installed, allowing seamless swapping during initial tests.

Extended Bluetooth Remote Control: A Bluetooth module with an enhanced antenna has been integrated, and initial range tests have been conducted successfully.

Free-Rotating Steering Mechanism: The modified steering shaft with a free-rotation capability has been manufactured using 3D printing and assembled, ensuring smooth operation without affecting the car's movement.

Testing and Evaluation

We tested the durability of the steering shaft prototype by applying force with a hammer, and it withstood **80 N of direct force**, confirming its strength. Jorge will not be able to generate enough force to break it while steering, ensuring its reliability. To assess battery performance, we conducted a test by driving the modified vehicle around campus with Brian driving, who is significantly heavier than Jorge. The batteries lasted **30 minutes**, demonstrating their capacity under more demanding conditions. Since the batteries are also easily swappable, the prototype meets the design requirements for durability and usability.

Figure 1. Steering Shaft Design

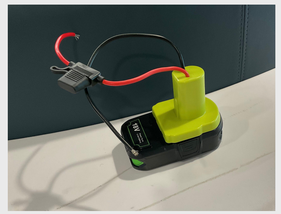

Figure 2. Hot-Swappable Battery

Figure 3. New Remote Control

Table 1. Label in 20pt Arial.

Results and Analysis

The testing data confirms that our design meets key performance requirements. The steering shaft withstanding 80 N of direct force indicates that it is highly durable and unlikely to fail under normal use, aligning with our expectations for structural integrity. The battery lasting 30 minutes with a heavier rider suggests that under normal conditions with Jorge, it will last even longer. Strengths of our design include the reinforced steering mechanism, which ensures safety and longevity, and the easily swappable battery system, which allows for extended use. However, potential areas for improvement include further optimizing battery efficiency to extend runtime and conducting additional impact tests to confirm long-term durability under different conditions. Overall, the prototype performs as expected and provides a reliable, safe mobility solution for Jorge.

Conclusions

Our testing showed that the steering shaft is tough enough to handle real-world use, withstanding 80 N of force, meaning Jorge won't be able to break it while driving. The battery also held up well, lasting 30 minutes with a much heavier rider, so it should last even longer for him. Overall, the prototype meets our goals by providing a strong, reliable steering system and an easily swappable battery. Moving forward, we could make the steering shaft lighter but just as strong and explore ways to extend battery life for even more convenience. The next steps would be testing long-term durability, considering alternative power options, and getting feedback from Jorge and his caregivers to fine-tune the design and make sure it fully meets his needs and contacting next year's class.

References and Acknowledgements

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