Public summary:

Adapting a tricycle to achieve a more natural riding experience

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Client:

Van Raam is a manufacturer and global market leader in unique customized bicycles for people with disabilities. They produce single and multi-person bicycles, specializing in tricycles, wheelchair bicycles, tandems, duo bikes, mobility scooter bikes, and low-step bicycles. The Ideeënfabriek is an open-source collaboration between Van Raam and other local companies in the technical sector with a strong focus on pre-development. The project will be done for the Ideeënfabriek department of Van Raam

Assignment:

Van Raam is currently developing trike with a cargo bike feature. It has this feature in order to make the trike more trendy and have less stigma compared to a traditional trike which might look more like a strict medical aid. The trike is targeted at the so called ‘young-elderly’, more specifically, people who are starting to struggle with balance issues. The Assignment is to make this trike feel more like a two-wheeled bike by making it carve while cornering and to find out if carving trikes is something Van Raam should look into. The reason Van Raam is curious about this is due to the fact that trikes are generally stable at low speeds but actually less stable at higher speeds compared to leaning bicycles. This due to the fact the inside wheel in a corner might lift up, which can not happen on a 2 wheeled bike.

Research

Research included studying bicycle dynamics, such as the theory behind cornering and going straight on a bike, as well as analysing existing carving trike designs. The formative study tested various configurations like parallelogram mechanisms and evaluated their effectiveness through user trials. Key findings from this research informed the design of a functional prototype.

Design features

The design focused on creating a parallelogram mechanism to replicate the leaning dynamics of a two-wheeled bicycle. Key considerations included:

- Ensuring the fulcrum and centre of gravity moved naturally during leaning. As is the case on a bike
- Maintaining a realistic range of lean angles (up to 30°).

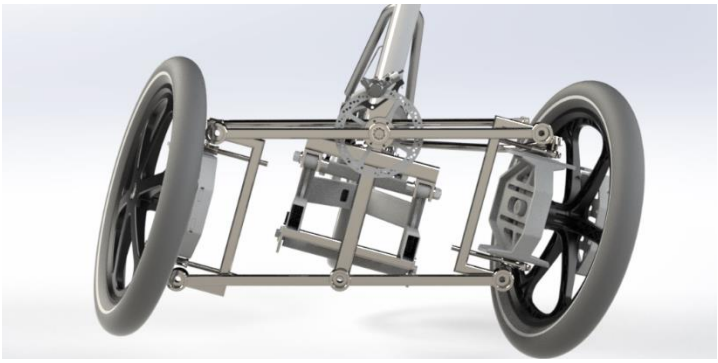

Figure 1, the parallogram allowing the trike to lean

- Adjustable geometry in order to test carving over several different settings
- a balance brake for low speed stability, allowing users to block the leaning at low speed

Testing Insights:

a small test was performed with employees of Van Raam. Though the test group was very small, some insights were gained:

- Leaning was intuitive and enhanced the riding experience at higher speeds.
- Stability at low speeds remained a challenge, with some users expressing difficulty adapting to the balance dynamics.
- The lean-steer effect, where handlebars turned counter-intuitively during leaning, emerged as an issue requiring correction.

Figure 2, riding and testing the prototype

Recommendations

To further refine the carving trike and evaluate its potential for production, the proper development of a functional balancing system is strongly recommended. This can be done two ways:

- Refine the balance brake to improve low-speed stability and ensure smooth transitions to carving mode at higher speeds.
- Explore alternative mechanisms (e.g., springs or dampers) for intuitive and safe balancing.

Figure 3, the balance brake calliper and disc

Conclusion

The prototype showed the potential of a leaning tricycle as is it felt more natural to ride at higher speeds than a traditional rigid trike. However, challenges such as low-speed stability and lean-steer highlight areas requiring further development. A reliable balance mechanism is critical for ensuring user confidence and broader acceptance.