**Electric Mobility Tricycle: Front End Redesign**

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**Introduction**

Imagine living in a place where daily household tasks, such as fetching clean water, require you to travel miles on foot. Now imagine living this life with a mobility impairment. Your mobility would be slow and difficult, likely limited to crawling on hands and knees, and your household contributions would be restricted. For the physically impaired living in Mahadaga, Burkina Faso, this picture of life is a very real one.

The Mobility Tricycle Project originated in 1999 with a hand powered tricycle design for people with limited mobility in Mahadaga, Burkina Faso. In 2004 there was a special request for a tricycle that requires much less demand on the upper body than the hand powered tricycle and thus the electric version of the tricycle was born. The Mobility Tricycle Project is now working to improve and fine tune the current hand powered and electric tricycle models. Our goal is to produce designs that are simple, cost-effective, and locally sustainable in Burkina Faso.

The front end redesign team focuses on the front portion of the tricycle structure, including the steering handle, head tube, fork, and front wheel, which impact tricycle handling and steering characteristics.

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**The Problem**

The main issue that the Front End Redesign team has been tasked with addressing is an imbalance in the handling of the electric tricycle. This imbalance causes the tricycle to pull to the left, which significantly increases the steering force required to maneuver the tricycle. Any increase in the force required to steer the tricycle is a sizeable concern since the clients who use the electric tricycle have limited upper body strength.

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**Results**

We considered a number of different issues that might have contributed to this imbalance, including the one-sided drive, the one-sided brake, and the effect of weight distribution on the handling of the tricycle. After testing each one of these and finding those results to be inconclusive, we decided to explore the possibility of the imbalance being due to factors in the geometry. Careful scrutiny of the geometry revealed that the fork on the front of the tricycle appeared to be bent. We switched out the bent fork with a symmetrical one and performed a straightening test that measured the steering force required to keep the tricycle on a straight line. The results of this test are summarized in the graph below.

![Graph showing steering force required for uniform and non-uniform forks](image)

From this we were able to conclude that the bend in the fork was causing the steering imbalance. This nonsymmetrical bend in the fork occurs during the tricycle assembly process. In order for the fork to accommodate different wheel widths, the two blades of the fork are pulled apart, by hand, when fitting the dropouts onto the axle of the front wheel. Since both blades are not of equal strengths, the weaker one will bend out while the other remains mostly in place.

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**Solution**

The discovery of this assembly defect prompted us to produce a tool that would allow the fork to remain uniform as the blades are spread outward to fit onto the axle of the wheel. Our design uses the concept of a wedge to evenly separate the blades of the fork.

This bending tool consists of a boot that fits over the existing head tube, a large threaded rod that is welded to the boot, a large pipe that acts as the wedge, and a nut. The large pipe is slid onto the threaded rod and forced between the blades of the fork by the nut.

On one side of the large pipe, there is a metal block welded above the hole that the threaded rod fits through. This metal block is used to house a set screw that slides through the groove that is milled along the top of the threaded rod. The set screw is used to prevent the large pipe from rotating about the threaded rod.

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**Conclusions**

Ease of handling is a dominant specification for our clients and through our testing we were able to conclude that a symmetrical fork is crucial for achieving this in the electric tricycle. Any sort of bend or imbalance in the fork will inevitably cause the tricycle to pull to one side. The tool that we developed has allowed us to minimize the difference between the distance from the left blade to the centerline and the right blade to the centerline to a tolerance of 5 mm.

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**Further Information**

For more information about the Mobility Tricycle Project, please visit: [http://www.thecollaboratoryonline.org/wiki/Mobility_Tricycle_Projects](http://www.thecollaboratoryonline.org/wiki/Mobility_Tricycle_Projects)

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**Acknowledgements**

I would like to thank my advisors Dr. Tim Van Dyke and John Meyer, as well as my fellow teammates Taylor Eberly and Lauren Long for their contributions to this project.