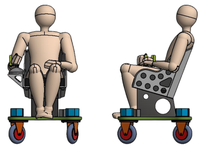
Solving the Modern Mobility Crisis with Technology

Whats the Problem?

Modern society's infrastructure has insufficient features of accessibility such as ramps, elevators, and properly maintained sidewalks, causes significant challenges for wheelchair users. This hinders their mobility and integration into public spaces and transportation systems

Possible Solution

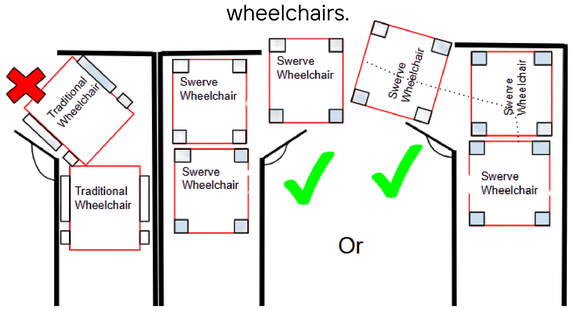
A possible solution is the multi-directional drive, also known as swerve drive. Swerve drives enhance wheelchair mobility with precision control, obstacle detection, and versatility. This can reduce the physical strain, as well as improving safety, and can be customized to individual needs, greatly improving user accessibility and quality of life.



Mockup Drawing by Skyeg3 on Robotshop

How does this help?

Due to the tight nature of modern infrastructure, it is getting harder for people with disabilities to get around even with more ramps and elevators. With simple controls and a onboard auto alignment system it will be incredibly easy to drive through before near impossible areas. This can be done by something as simple as rotating all wheels 90 degrees to slide in front of a doorway, normally this would require the user to shift back and forth for a long period of time. This means that swerve drive would beat even the most versatile current wheelchairs.



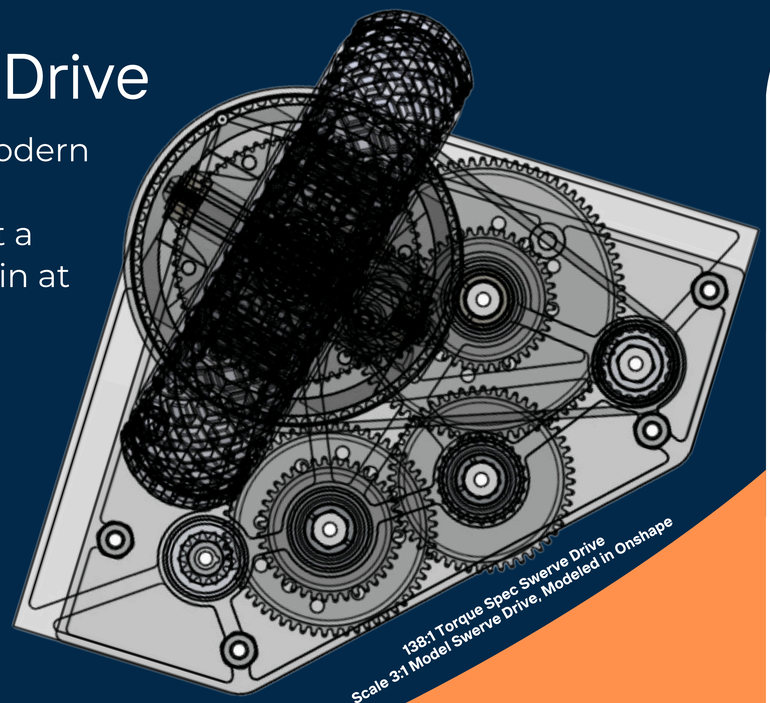
Swerve Drive Benefit Drawing
Made in Google Drawings by Mason Schulte

Has this been done?

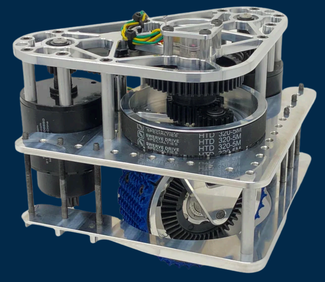
Currently there is no working 100% swerve wheelchair. Unfortunately it seems like the broad idea of differential swerve, driving and turning on the same axle, is under patent US20230303154A1. In addition there is a current patent on drive modules on agricultural vehicles, not applying to transportation assistance.

Multi-Directional Drive

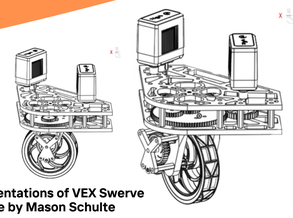
Multi-Directional Drive is a modern 360 degree variable speed transmission. This means that a wheel of any diameter can spin at any speed in any direction.



Current Design based off SDS MK4I Swerve



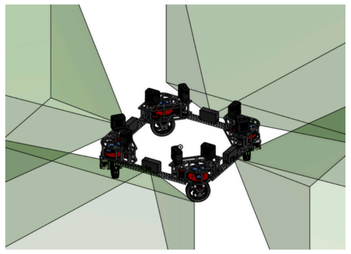
Swerve Drive Specialist MK4I Swerve Drive



Different orientations of VEX Swerve Onshape by Mason Schulte

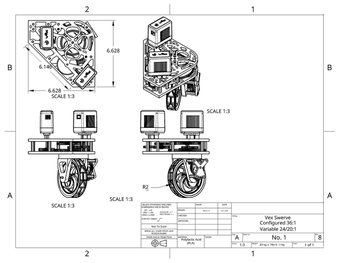
CAD Designs

Swerve Vision System



Designed and drawn in Onshape by Mason S.

Swerve Dimensions



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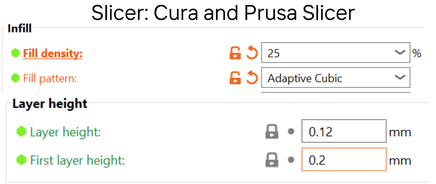
Print Settings

Material: Polymaker PLA
Printer: Creality CR6SE
Time: 12 Hours / Module
Slicer: Cura and Prusa Slicer



All setting's Derived from Prusa Slicer

Why have a Swerve Vision System?

A great reason to create the vision system is for those who are affected by Muscular dystrophy. The genetic disease muscular dystrophy robs individuals of muscle control, making wheelchair use challenging and risky. Swerve drive vision technology offers crucial safety and freedom by revealing dangers and preventing them without human intervention This can lead to a decrease in the large danger caused from the loss of fine motor function.

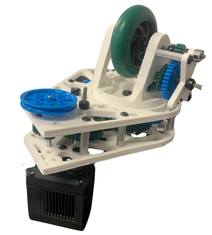
How would this work?

Swerve drive wheelchairs offer the significant advantage of incorporating sensors. By employing both basic distance sensors and advanced large-scale vision systems, these wheelchairs can prevent numerous accidents, particularly benefiting individuals with muscle deterioration. A common complaint about traditional wheelchairs is the damage they cause to walls and doorways due to accidental collisions. This issue is mitigated by the ability to lock the wheels, preventing such damage.

Iterations and Development

First Build

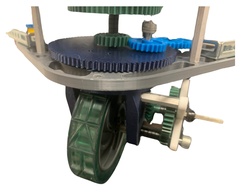
There were significant issues with the first prototype. VEX manufacturing results in a large amount of play in the system. This means that the final wheel made a half of rotation before the motor could apply resistance.



First iteration Swerve Module
Photo by Mason Schulte

Second Build

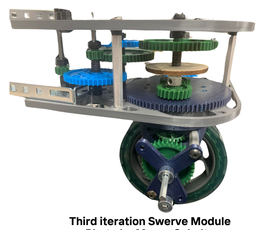
The 2nd iteration of the VEX Swerve solved a large amount of resistance within the system. Another key part of this upgrade was allowing the motors to effectively work seperate unlike the last build.



Second iteration Swerve Module
Photo by Mason Schulte

Third Build

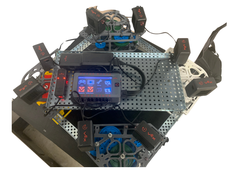
In the third build of the module the goal was to removed the slop, or the play in the system. A laser cut piece of bass wood was used to stop a bit of freedom which removed a lot of unwanted movement.



Third iteration Swerve Module
Photo by Mason Schulte

Current Model

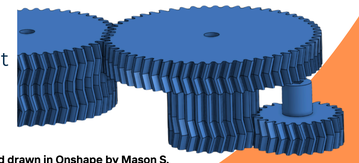
In the current model the swerve is configured with a 36 to 1 gear ratio. This means that for every 36 rotations of the motor the wheel will turn once. With this ratio, the torque on the wheel is strong enough to pull over 25 kg.



Full Vex Swerve
Photo by Mason Schulte

Future Improvements

By swapping out Vex injection molded gears for custom 3D printed gears I plan to remove up to 75% of the harmful freedom in the system. To prevent damage to the 3D printed gears I am using what is known as a hering bone gear. These gears use teeth aligned at an angle to provide a large contact area.



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