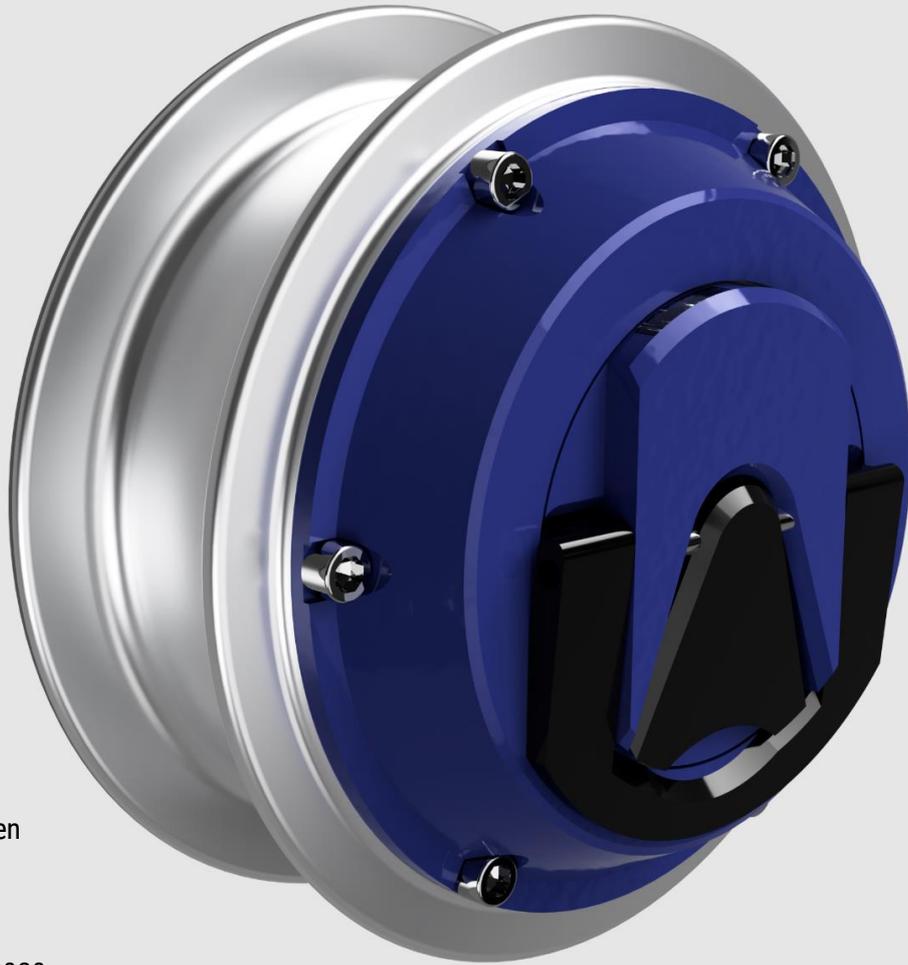


# Development of a power-assisted wheelchair

Bachelor thesis Industrial design engineering



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## Public summary

A power-assisted wheelchair (PAW) is a wheelchair that is operated in the same way as a manual wheelchair, however, a PAW adds electrical support corresponding to the user input, much like the way in which e-bikes work. This can be of great value for users whose condition causes a decrease in arm strength, or users who experience physical complaints from using manual wheelchairs.

This project covered the development of the wheel hub of a power-assisted wheelchair. The development of this wheel hub is aimed at solving some of the problems with existing assisted wheelchairs, being: The reliability on battery charge to be movable, Difficulties in disassembling for transport and controllability at low speeds. All while keeping usability and appearance in mind. The final product of this project is a complete newly designed wheel hub based on an earlier prototype made by the client: IMS Medical. This newly designed wheel hub includes a novel cycloidal drive transmission, freewheel function, New emergency brake system and a new wheel mounting system. All these developments are represented in a working prototype. The final prototype is smaller and lighter than the client's existing prototype. The freewheel function makes it so that the wheelchair can still be moved without battery power. The new brake system consumes less power, is smaller and lighter than the original brake system. The new transmission increases the gear ratio, providing the possibility of more precise control at low speeds. This does however come at the cost of increased transmission friction losses. The new wheel mounting system reduces the need to lift the wheel for mounting as well as reducing the disassembly time, there are however still improvements to be made on the mounting system consisting of, more forgiving wheel placement and visual indications to the user.

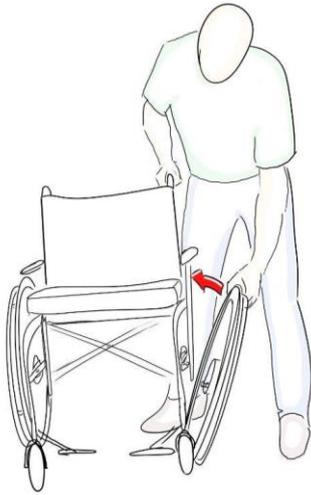
The new design has reduced the weight by 2.3 kg. The frontal area of the wheel hub is reduced by 35% allowing for a more subtle design. The new design features two handles: One functions as a freewheel function by disengaging the drive mechanism, which allows for the wheel to be used as a conventional manual wheel. The second handle is used to operate the new wheel release mechanism



The new design features a novel cycloidal drive transmission that is designed to feature a larger gear ratio within a smaller space. While also providing a smooth power delivery and high load capability's

Additional to the new transmission a freewheel function is integrated that uses a clutch to engage and disengage the drive mechanism. Effectively transforming the PAW to a manual wheelchair. This freewheel function doubles as the emergency brake release.

A new brake mechanism uses the existing motor as a braking mechanism, Eliminating the need for an additional brake mechanism. This reduces weight and size. The new brake mechanism consumes 66.67% less energy than the existing brake mechanism.



The New mounting system works by hinging the wheel on the wheelchair, instead of inserting the axle into a hole. this reduces the need to lift the wheel. At the same time making the alignment easier.

After evaluation of the design, several possible improvements were identified, The most important being: The mounting system should include a visual indication of which insertion angle is required for assembly and the drive mechanism has to be optimized to be back drivable for more natural controllability. Overall the design contains several new experimental mechanisms which can be used to inform further design decisions.