

Technology Offer

Manual to hybrid manual-electric wheelchair conversion kit

Offer type

- invention + know-how (invention no. P.427855 + Operation and Maintenance Manual)
- research service
- measurement service
- consulting service

Offer

Subject of the offer:

The subject of the offer is a prototype at the highest technology readiness level of a hybrid drive based on the invention no. P.427855 including an Operation and Maintenance Manual "A prototype of an electrical-manual hybrid drive module for wheelchairs". An included control software allows to implement an adaptive algorithm supporting manual wheelchair propulsion.

The offered solution involves a conversion of a standard pushrim wheelchair with an auxiliary electric drive while maintaining all its functions available prior to conversion. The solution adds four propulsion modes: standard manual, standard electric, assisted acceleration and reduced resistance to motion.

Solution concept:

The following invention is a conversion kit for hybrid manual-electric wheelchair. The invention consists of an auxiliary electric drive module installed without any modifications to the pushrim system. The conversion kit includes a module for manual wheelchairs with large rear drive wheels and pushrims. The device allows to maintain the functionality of a standard manual wheelchair without propulsion aides with an added electric wheelchair functionality for independent control of left and right wheel using two levers and two independent disk brakes. Wheelchair manoeuvring in electric mode is identical to using pushrims and uses a difference in left and right wheel velocity. The hybrid electric-manual drive module is an auxiliary wheelchair module installed at the disassembled drive wheels without any modifications to the wheelchair frame, front wheels, brakes and footrests. The conversion kit is mounted on the main wheelchair frame.



Advantages:

In manual mode, the user uses conventional pushrims in the same way as in the manual wheelchair before conversion.

In electric mode, the user controls the velocity of two rear wheels using two independent controllers. The wheels are controlled independently, like in the manual mode.

The acceleration assist mode requires manual propulsion, however, after the wheelchair is moving, its velocity is maintained until the next push phase. The mode reduces the variations in wheelchair velocity in the recovery phase (hand return into the initial position).

The reduced resistance to motion mode requires manual propulsion, however, the control system detects the wheelchair tilt and the electric motors generate the driving torque to reduce the resistance to motion due to inclination.

The device's functionality is defined by basic functions of the wheelchair design and the functions of the hybrid electric-manual module. Functions of the basic wheelchair design:

- seat, backrest, cushions, footrest and armrest (frame, wheelchair seat and footrests);
- wheelchair pushing by another person (wheelchair frame);
- wheelchair immobilization (manual friction brake);
- wheelchair direction change using differential steering.

Functions of the hybrid electric-manual module:

- manual wheelchair propulsion using pushrims;
- wheelchair propulsion using electric drive;
- simultaneous manual and electric wheelchair propulsion;
- electric controller deactivation during deceleration with a brake lever;
- battery charging control (acceleration potentiometer with battery charging lever indicator, LCD, smartphone);
- monitoring the operating parameters and configuring the module parameters (LCD, smartphone);
- reversing mode;
- electric safety switch.

Technical parameters of a wheelchair with hybrid electric-manual module

Weight	46	kg
Battery voltage	36	V
Motor rated power	1,400	W
Motor peak power	1,817.82	W
Maximum power input	51.52	A
Maximum speed	290	RPM
Maximum torque	114.2	Nm
Maximum continuous discharge current	25	A
Battery operating temperature:		
- operation (discharging)	- 20 to + 50	°C
- charging	0 to + 40	°C
Service life	1,000	Charging cycles
Maximum operating weight	125	kg
Compatible accessories	<ul style="list-style-type: none"> - battery <i>Li-Ion 36V 13Ah</i> - throttle <i>Magic Pie 5</i> - LCD <i>Magic Pie 5</i> - Bluetooth adapter for <i>Magic Pie 5</i> - emergency brake lever <i>Magic Pie 5</i> - battery charger for <i>Li-Ion 36V</i> - mobile app for monitoring and configuring operating parameters and logging motor data <i>Magic Pie 5</i> 	
Folding method	Cross frame	
Brakes	<ul style="list-style-type: none"> - disk - push/pull lock 	
Drive wheels	Pneumatic wheels (inflated tyres)	
Driven wheels	Rubber wheels	
Safety switch	Yes	
Brake lever	- activates disk brake system	

	- decouples propulsion system
Driving direction	- forward - reverse
Reverse indicator	- yes
System parameters and operating parameters monitoring	- LCD - smartphone
Propulsion	- manual - electric
Anti-tipping device	Yes
Maximum permissible tilt angle for anti-tipping device	20°

Related intellectual property (patent applications, patents etc.):

“Hybrid electric-manual conversion kit for wheelchairs” – invention no. P.427855

Related projects:

Research and development project by the Poznan University of Technology and the National Centre for Research and Development - Lider VII project “Study of the biomechanics of manually propelled wheelchair for innovative manual and hybrid drives”.

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