LEMELSON-MIT

Seung Hwan (Sonny) An and Maya Burhanpurkar
Harvard University
$10,000 "Move it!" Lemelson-MIT Student Prize
Undergraduate Team Winner

Adventus Robotics: A hardware and software kit that can be retrofitted to power wheelchairs to make them fully autonomous, self-driving wheelchairs

The Challenge: There are people all over the world who use power wheelchairs due to a variety of disabilities resulting from illness or injury. Existing power wheelchairs rely on the occupant to control steering and direction through a joystick or alternative input device. People with significant neurodegenerative illnesses may have difficulty using those controls due to limited motor skills. In addition, millions of people with conditions such as quadriplegia, advanced ALS or multiple sclerosis are often confined to one area of their homes due to an inability to use existing control options for mobility. Even among users who are able to use controls well, it can be difficult to precisely navigate in tight spaces given the size and bulk of power wheelchairs.

Hospitals across the world frequently use wheelchairs pushed by porters or attendants to transport patients throughout their facilities. Close proximity between porters and patients can be a health hazard as various infections (most recently and notably, COVID-19) can be passed between them. Existing wheelchair technology in hospitals does not allow for physical distance between porter and patient that is sufficient enough to reduce risk of illness transmission. There is currently no control option that allows a power wheelchair to function autonomously to address challenges for use in the home or in a hospital setting.

The Solution: The Adventus team invented a system that enables a power wheelchair to function autonomously, and allows the user to flexibly shift between autonomous steering and traditional joystick steering. The device is retrofitted onto wheelchairs and uses mapping software to create an internal map of any space. A caretaker or hospital worker tours a given area (such as a home) with the wheelchair, allowing the device to create an internal map, and marks specific locations of interest for the wheelchair user. The device is then ready for use and the wheelchair user simply identifies their desired destination using a touchscreen.

A power wheelchair retrofitted with Adventus' technology.

The device uses long-life battery power (up to 16 hours) and algorithms to optimize routing and transport of the wheelchair user to their chosen location. The wheelchair is then able to avoid both stationary obstacles (such as furniture or a plant that has been moved) and moving obstacles (such as a person or pet in the path) by either stopping or navigating around the obstacle. The standard power wheelchair speeds allow this to occur safely.

Commercialization: Maya and Sonny are commercializing the device through Adventus Robotics, and have already established partnerships with several key research and clinical organizations in the U.S. and Canada. Partners include Canada's University Health Network, where early data suggest that implementation with existing hospital wheelchairs could save millions of dollars annually. The autonomous technology used in the retrofit kit can also be applied to a variety of other industries such as autonomous floor cleaning and sanitation.