Automatic Transport and Retrieval System for Power Wheelchairs

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Figure 2: Wheelchair in transit between van door and lift.

VISION-BASED GUIDANCE

Once the wheelchair is in the vicinity of the lift, a computer vision system guides the wheelchair onto the lift (moving from Point B to Point A in Figure 2). The small tolerances required (on the order of 2 cm in horizontal positioning) for successful docking of the chair mandate a highly accurate estimate of chair pose (position and orientation). This control problem is addressed with a visual feedback loop used to regulate the wheelchair pose. Similar techniques are often used in manufacturing applications, where a camera is used to position a robot end-effector (e.g. gripper) in proximity to a target/fixture (for grasping, manipulation, etc.)

For the ATRS, the wheelchair itself is used as the end-effector being controlled, and the target is the lift. Varying environmental and lighting conditions require a robust means for accurately estimating the pose of the wheelchair and lift. To facilitate identifying key features, two-dimensional markers are affixed to both the lift platform and wheelchair. Localizing the wheelchair and lift in the camera image can then be accomplished by locating the marker patterns, using normalized cross-correlation as a similarity metric. Normalized cross-correlation is robust to changes in scene brightness. Using this in conjunction with high-contrast markers allow the system to operate properly under varying lighting conditions.

Figure 3: Wheelchair under the guidance of the video subsystem, moving onto the lift (Point A). The oval indicates the field of view of the motor vehicle-mounted camera.

ATRS helps disabled drivers, passengers

By KIRA HILLMAN
For The Reporter

According to the Disability Statistics Center, about 1.6 million Americans use wheelchairs and one of the major issues for wheelchair users is vehicle transportation.

At Freedom Lift Corp., a division of Cook Technologies Inc. with its corporate headquarters in Green Lane, engineers began to study improvements in 2002.

What has resulted from the work is the Automated Transport and Retrieval System (ATRS).

The ATRS makes it possible for wheelchair users to transfer from their power chairs into a car seat and then, using wireless technology, automatically pack their chairs into the trunk and retrieve their chairs at the conclusion of the car ride.

The system can be modified for individual users. If the handicapped person plans to ride in the passenger seat instead of driving, the power chair can move to the right side of the vehicle instead of the left.

Bob Smith, the vice president of sales and marketing for Freedom Lift, described the realization of the system’s necessity.

“With the focus groups that we run, we found that there were tremendous burdens for handicapped people using the available lifting technology,” he said.

“It’s near impossible for an elderly couple to get their power chair out of their vehicle and then try to lift someone back into the chair,” Smith said.

“We developed this system to enable someone to be completely self-sufficient. That’s what our charter is at Freedom Lift,” he added.

Freedom Lift partnered with Carnegie Mellon University, University of Pittsburgh and Lehigh University to develop this technology that they predict will significantly impact the lives of wheelchair users.

Another goal of the technology was to cut down on modifications to the minivans. This leads to lower-cost changes for owners and the opportunity to lease their vans.

The only permanent modifications are located in the rear hatch of the van, where a camera is mounted.

Removable modifications include an ATRS touch screen, which clips onto the van near the sliding door. Also, a four-axis Freedom Seat Base attaches to the standard driver’s seat and can move outside of the car during the user’s physical transfer from their power chair.

Another benefit of this technology is the job opportunities that it will bring to the area.

In Smith’s opinion, “One of the major issues today in businesses is that a lot of manufacturing is going offshore. The charter of our parent company Cook Technology is to keep jobs here in Pennsylvania.”

The ATRS could eventually bring as many as 100 new jobs to Freedom Lift.

At the unveiling ceremony of the ATRS, state Sen. Rob Wondeker, R-24th District, delivered opening remarks to an audience of various industry leaders. The ATRS was then demonstrated in action; the entire automated unloading process took less than three minutes.

Though the unveiling occurred last month, the entire robotics system won’t be commercialized until the end of 2006. Parts of the system — the lift and seating components / will be available in October and November.

To get more information about purchasing this technology, contact Bob Smith at (800) 755-2856.