

## CCC Research Roadmap Proposal Topics

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**1. Smart Wheelchair Systems:** There are currently 2.2 million wheelchair users in the United States. According to Frost & Sullivan's North American Mobility Aids Markets report, the "mobility-challenged market will experience unparalleled growth." This view is supported by data from the U.S. Census Bureau's Survey of Income and Program Participation (SIPP), which show the number of wheelchair users has increased almost 600% over the last three decades. Since 2000, the wheelchair market size has grown at a compounded annual growth rate of 8% and the entire mobility chair market (which includes power wheelchairs and scooters) has grown at a compounded annual growth rate of 10%. This growth is due to a number of factors, including shifting demographics (the aging population), the increased social acceptance of the use of mobility devices, and the increased accessibility at home and in the community resulting from guidelines of the Americans with Disabilities Act of 1990. The use of wheelchairs and similar mobility devices is likely to accelerate given the aging of the baby boomer generation. The trend will be further accelerated by greater rates of obesity and obesity-related arthritis in the baby boomer generation according to the Beth Israel Deaconess Medical Center.

While smart wheelchair systems have been investigated in the past, the idea was in many ways ahead of its time. However, the field has evolved to the point where such systems will begin to have a societal impact. One of my current projects is entitled the Automated Transport and Retrieval System (Figure 1). It integrates a smart wheelchair with a standard vehicle. The wheelchair is able to autonomously navigate from the driver's position to the lift platform at the rear of the vehicle and back again. This eliminates the need for an attendant for a driver in a wheelchair, as well as the permanent, drastic, and very expensive modifications associated with a "handicapped van" conversion. In fact, ATRS will cost significantly *less* than a traditional van conversion. The commercialization of ATRS is being supported by an NSF Partnership for Innovation (PFI) grant. It is pending FDA approval, and is expected to go on sale this spring/summer. More details can be found on the project web site <http://vader.cse.lehigh.edu/projects/atrs/>



*Figure 1: ATRS system integrated into a traditional Chevrolet Suburban. By integrating robotics and automation technologies, the need for a van conversion is eliminated.*

Many other applications for smart wheelchair systems can be envisioned that will both enable personal mobility and independence, and enhance quality of life. The prevalence of these motorized platforms make them an ideal candidate to introduce assistive technologies for the elderly.

**2. Homecare:** Homecare is often proposed as a means to mitigate the ever increasing cost of healthcare for the elderly. The idea of “aging in place” rather than relocating residents to assisted living or nursing facilities can offer significant cost savings to individuals and government agencies alike. Studies have shown that relocation – particularly to a nursing facility – can have significant negative physiological effects on residents to include weight loss, depression, and thoughts of suicide. This can be attributed in part to the nearly complete collapse of the individual’s social network. Thus, homecare has the potential for not only significant cost savings, but also to improve the quality of life of the elderly.

I am co-organizer of the Workshop on Aging Services and Technology (WAST2008) with the Phoebe Institute on Aging (Allentown, PA). This will bring together an interdisciplinary group of caregivers, university researchers, and industry representatives with a common goal of leveraging technology to enhance care for the elderly – homecare being a primary discussion topic. The workshop will be held at Lehigh University in June 2008, and 150-200 people are expected to attend. This forum will provide a unique opportunity to interact with area domain experts from each phase of the innovation cycle, and help to identify research problems and technology needs for real-world problems faced every day in eldercare.

**3. Personal Mobility:** This is somewhat intertwined to the first two topics, as 83% of wheelchair users in the U.S. (or over 1.8 million people) use personal motor vehicles. Transportation is also critical for elderly Americans to participate fully in basic activities such as shopping, outpatient medical care, worship, recreation, and other activities of community life that most people take for granted. Increasingly, the elderly live in suburban and rural areas where public transportation services are limited, and they rely heavily on private automobiles. In these cases, loss of mobility often translates to a loss of independence. Thus, a successful homecare model relies heavily upon personal mobility.

Note that in this paradigm, personal mobility may in fact be just a smart wheelchair system for residents in more urban areas, or may be tied to a smart automobile system for rural residents.

**4. Certification Standards:** Any medical device (e.g. a wheelchair) that integrates robotics technologies will require approval by the FDA. From my personal experience trying to bring the ATRS to market, it seems that the certification requirements for such systems are not well defined. This can be expected with the introduction of any transformative technology. However, inter-agency collaboration may be in order to facilitate the introduction of robotics into the health care arena.

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