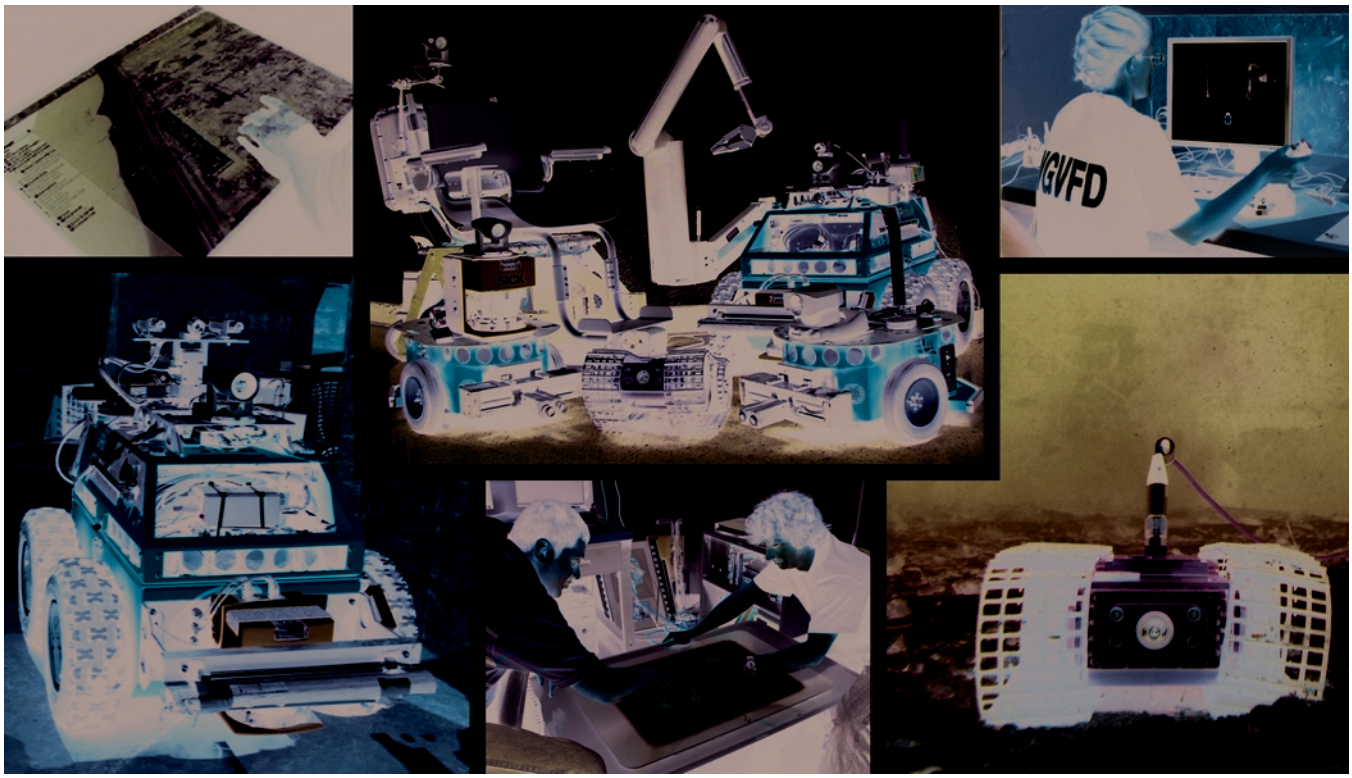
Robotics Lab @ UMass Lowell

UMass Lowell Robotics Lab
Department of Computer Science
http://robotics.cs.uml.edu



UMass Lowell Robotics Lab

Dr. Holly Yanco founded the UMass Lowell Robotics Lab in 2001. Research focuses on human-robot interaction (HRI), which includes multi-touch computing, interface design, robot autonomy, trust, and evaluation methods. Application domains include assistive technology and urban search and rescue (USAR). The Robotics Lab also has an active K-12 community partnerships program.

Urban Search and Rescue

Obtaining and maintaining situation awareness (SA) is critical to the successful operation of unmanned vehicles. We have worked to develop effective HRI techniques, design guidelines, and evaluation techniques for making human operators aware of the robot and its environment. We have also studied the impact of camera location and multi-camera fusion.

We have implemented a video-centric interface for an ATRV-JR robot. Our interface features a large video panel of the forward facing camera, a "rear-view mirror," a distance panel, a dynamically generated map, and a range of autonomy modes. Automatic Direction Reversal mode flips the front and rear camera views and remaps the drive commands to allow the user to back out of tight spaces as if driving forward. The robot can be operated with a joystick or a multi-touch device using gestures.

In addition to robot control, the multi-touch device can also be used in a command and control disaster response. For example, we have overlaid aerial photography of Biloxi, MS, after Hurricane Katrina on pre-disaster satellite imagery, providing interactive damage assessment. Multiple users can zoom and annotate the map using gestures.

Robots offer a unique view for damage assessment when structures are too unstable for human or canine personnel to safely search. Our VGTV-Extreme robot successfully cleared two buildings in Biloxi, MS, after Hurricane Katrina by providing Florida Task Force Three responder with a first-person view.

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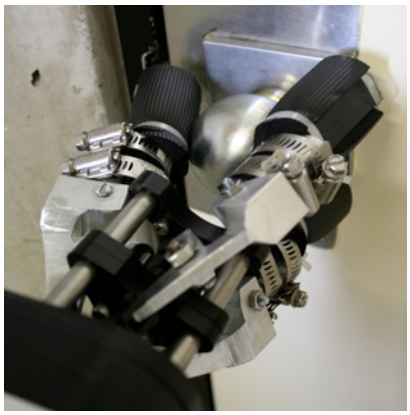
Assistive Technology

While assistive devices such as powered wheelchairs and menu-driven robot arms improve the quality of life for some, others are unable to effectively use these technologies due to their limited user-interaction methods. Users may also have cognitive impairments. Unlike other robot technologies that must be operated at a distance, assistive robots work in the same space as their user, often with the user as a rider of the technology. Our lab draws upon over fifteen years of assistive technology experience to develop assistive robot technologies with more user-friendly interaction methods.

The most frequent activity of daily living (ADL) is the "pick-and-place" task. We have developed a vision-based interface for a commercially available wheelchair mounted robot arm to bring objects back to the user. The interface displays the wheelchair occupant's view. The person selects the desired object in an "I want that" manner using a touch screen, joystick, or single switch. The system then autonomously retrieves the object.

Halo reaches for the yellow mug



DORA unlatches a door knob

Another common ADL is opening doors. We have built a low-cost door opening robot arm (DORA) specifically for this task since not all doors are ADA compliant. DORA's gripper is able to unlatch a variety of door knobs and handles in both the clockwise and counter clockwise directions using only one motor.

We are currently developing new technologies to assist with safe driving of a power wheelchair. The goal of our adaptive prompting system is to assist an inexperienced driver so that he/she is able to safely drive at an expert level. Our adaptive prompting system will help provide reminders of previously learned driving skills as needed.

Multi-Touch Command of Robot Teams

As robots become more common-place in large teams, we need to manage their actions as individuals and groups. An overhead view of the working area is similar to a map, which is well suited to multi-touch computing. The addition of robots to map-based multi-agent control creates the need to task individual robots and groups of robots.

We conducted an experiment to determine the gestures that people would naturally use. We found that the task of controlling robots exposed unique gesture sets. We are currently implementing these gesture sets for multi-robot command and control.

The high school Arbotics group showcases their "Biblotech" robotic art

Community Partnerships

The Robotics Lab is involved with a number of programs designed to stimulate interest of science and technology in students from elementary school through college, including Botball and Artbotics.

Funding and Collaborators

Research in the Robotics Lab is funded by the National Science Foundation (CNS-0540564, CNS-0837738, IIS-0308186, IIS-0415224, IIS-0534364, IIS-0546309, IIS-0905228, SES-0623083), the National Institute of Standards and Technology (70NANB3H1116, 70NANB8H8168), the U.S. Army Research Office (W911NF-07-1-0216), and Microsoft Research. Our collaborators include Carnegie Mellon University, the Crotched Mountain Rehabilitation Center, Florida Task Force Three, iRobot, Massachusetts Task Force One, the MITRE Corporation, and the University of Pennsylvania.

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