JASON DITMARS, BRIAN DUGGAN, and RONEN MINTZ
email: u27534@sdsc.edu, bduggan@sdsc.edu, u29163@sdsc.edu
April 26, 1996

The Virtual Wheelchair

The Virtual Wheelchair is a project that interfaces any wheelchair with a computer generated virtual space. The user rolls up the ramp until the wheels of the wheelchair are positioned and lowered onto two sets of rollers. Optical encoders and an interface box translate the motion of the wheels to the computer, allowing wheelchair navigation through a computer modelled environment.

The software used is Performer by Silicon Graphics, with custom navigation code developed at the San Diego Supercomputer Center by Brian Duggan. Models are created by Jason Ditmars with Alias PowerAnimator. The interface ramp -- made of steel, diamond plate, expanded metal, and electronic devices -- was constructed in Los Angeles by Ronen Mintz and Jason Ditmars. The ramp can be used by both physically challenged persons in their own variety of wheelchairs (electric or manual), as well as by others in a standard wheelchair provided on site.

Concept: The wheelchair was chosen not only for its commonly understood operation, but also for its symbolic representation. Many people find difficulty using a Trackball or 6D Tracker to navigate virtualspace, resulting in a frustrating experience. The wheelchair, by contrast, is a navigational device that everyone already understands, enabling movement through this new spatial terrain in a more familiar way. The wheelchair alone represents mobility for the physically challenged. As an interface, it becomes a metaphor for a new kind of mobility -- one in which the physical world is left behind.

By making an interface specifically for wheelchairs, the experience is accessible to the entire public. People who are bound to wheelchairs are often considered handicapped in our society. With this interface, they become the expert navigators -- able to maneuver around the space with ease. People who do not normally use a wheelchair will need to sit in a wheelchair, roll up the ramp, and navigate through the space by rotating the wheels.

Interface: The ramp consists of four main parts and is adjustable to various lengths. The full interface with a five foot front ramp, three foot middle platform, and three foot back ramp, is a total length of 11 feet, at a maximum height of 7 1/2 inches. The front ramp can be made steeper and shorter, giving a total length of 9 feet. A minimum space arrangement could be made by using the front ramp as both entrance and exit, bringing the total length down to 6 feet.

Only one person is required to assist a user in boarding the interface ramp. Once users roll up onto the middle platform, they are easily lowered into position by an extension lever. At this point, motorized wheelchairs are ready to go. Manual wheelchairs can be locked into an adjustable device that acts as weight compensation, making the wheels easier to spin. Once the experience is finished, the assistant raises and locks the wheels back to the level of the platform surface and the user can coast down the ramp.

To spice things up a bit, we added a lever/joystick that lets the user fly up into the virtual sky, affording a wonderful birds-eye-view of the buildings of various shapes and colors. Also, there is a button box that allows for selection between FAST and SLOW navigation speed. FAST is commonly used for electric wheelchairs that have more precise wheel movements, while SLOW is more representative of real-world navigation for manual wheelchairs.

Future: The next stage of the project will be to incorporate force-feedback motors into the ramp. These motors will be used to reflect real-world gravity and friction. Thus, when you are on a virtual hill, the wheels of your wheelchair begin to coast forwards. To stop yourself, you will have to brake the wheels with your hands, just as you would normally. With this system installed, we believe that the wheelchair ramp will be one of the most submersive physical interfaces to date.