

A Virtual Exercise Environment
with Immersive Panoramic
Video

Jane Mulligan

Computer Science

University of Colorado at Boulder

Virtual Reality

- A virtual reality is a computer generated world.
- Considerable progress has been made on realistic computer graphics to produce effective visual worlds.
- Immersive - typically the user's head is tracked to change the world view (goggles, CAVE's, large screen)
- Other sensory displays have been more challenging:
 - Sound
 - Smell
 - Touch (haptics)
 - Locomotion
- Requires both :
 - sophisticated computer models of the synthetic world
 - display devices which can make the user feel they are present in that world.

Virtual Exercise Systems

- NetAthalon:
www.fitcentric.com
 - Multiple machine types
 - High quality graphics
 - competition
- Espresso Spark exercise bike
www.expressofitness.com
 - TV. Music
 - Computer graphics based touring, competition
- Gamebike Pro
www.gamebike.com
 - Navigate standard computer games with pedals and handlebars



Measuring Effectiveness

- VR and Exercise machines seem a perfect match:
 - Exercise equipment provides a ready-made physical display or *locomotion interface*
- **HOWEVER:** VR exercise equipment has not (yet) been a huge success
- Integrating the many sensory aspects of a VR system to create a sense of presence remains a challenge
 - Narrow view on flat screen
 - Discomfort of head-mounted trackers and displays
- Variety in generated worlds.

Virtual Exercise Environments (VEE) for Participation and Adherence

- **Phase 1:** Exercise with no external distractions or entertainment
- **Phase 2:** Exercise with entertainment in the form of television programming
- **Phase 3:** Exercise with video monitor VEE
- **Phase 4:** Exercise with VEE goggles
- **Phase 5:** Exercise with VEE goggles with head position sensors (immersive)

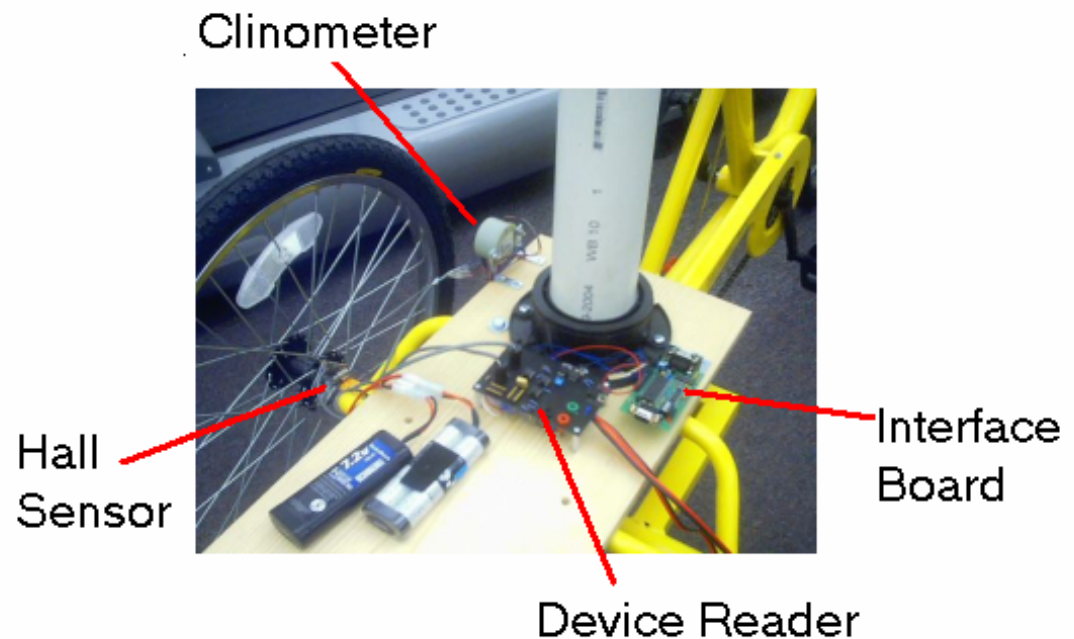
RecTech Virtual Exercise Environment

- Evaluate adherence for levels of immersion
- Virtual environments generated from images and measurements in real environments.
 - Monocular and Panoramic video
 - Simultaneous terrain recording of distance and incline.
- Playback on standard (Communications Specification for Fitness Equipment -- CSAFE compliant) exercise equipment with flat screen or immersive (goggle) display.
- Low cost

Immersive recording and playback

- Challenge: to produce high quality/low cost Virtual Exercise Environment
- Recording:
 - Record 1 to 5 images per frame at high framerate.
 - Record information about the real terrain
- Playback:
 - Blend multi-image frame into panoramic image
 - Track head mounted display (goggles) and drive displayed view according to head position.
 - Interface to exercise machine to make effort required reflect imaged terrain.

Terrain Recording System



- Special hardware and sensors mounted on recording vehicle (trike)
- Laptop interface to read incline and distance for each video frame.

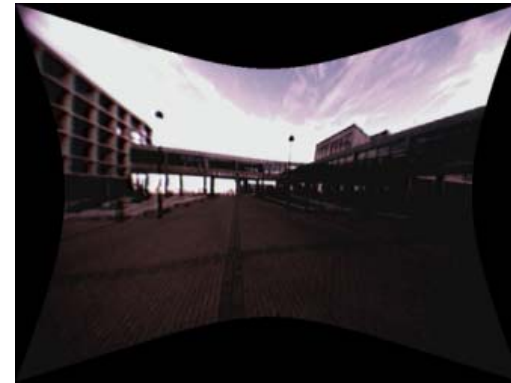
Work by John Penners

Panorama Recording System



- 5 Firewire Cameras
- Simultaneous capture
- Wide angle lens causes distortion

Building Panoramas from Multiple Views



- Undistort individual images
- Blend and project to a virtual viewing cylinder

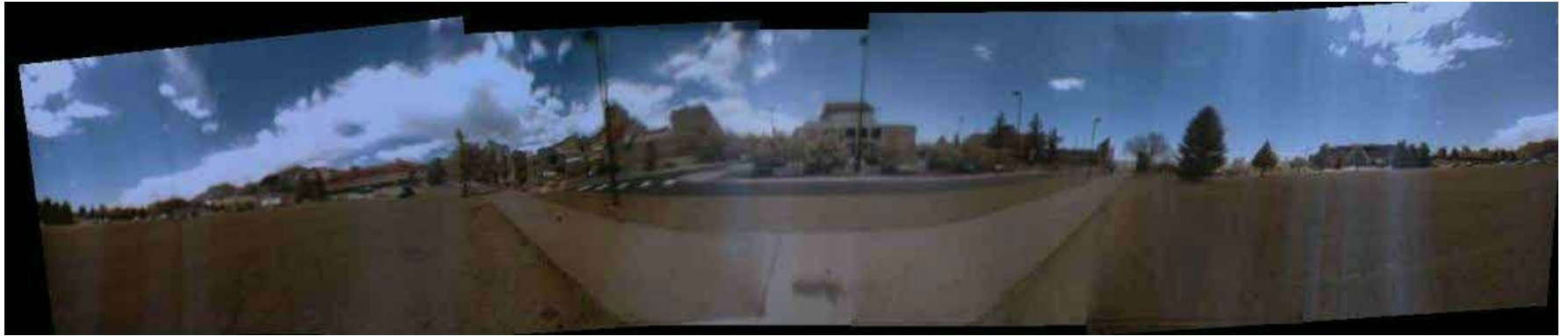
Work by Wei Xu

Playback



- Computer
- LifeFitness Stationary bike or treadmill
- Head mounted or flat panel display
- Audio display (headphones).

Panoramic Playback



- Head tracker calculates viewing angle
- Select region of panorama cylinder to display in HMD.

Challenges

- Tuning cameras to improve image quality for outdoor scenes.
- Accessible interfaces.
- Scaling intensity.
- Will users be comfortable in the Virtual environment?
- Finding exercise machines which we can control via software (CSAFE? Other?)

The Future

- Networked virtual environments
 - Remote exercise partners
 - Compete with friends
- Avatars: Who do you want to be today?
- Tease out the critical factors that affect adherence and enjoyment.

Video Playback

- Interface for display of recorded video, synchronized with the rate of travel of the user on the exercise machine.