Perspectives in Assistive Technology E110/210

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Today's Agenda

- Welcome to the Class
  - Professor Drew Nelson
- Introduction to Assistive Technology
  - David L. Jaffe, MS
- History of Assistive Technology Projects in ME113
  - Maurice LeBlanc, MSME, CP
- Sampling of Proposed Student Projects
  - David L. Jaffe, MS

Welcome to the Class
Drew Nelson

- Welcome to students and community
- How this course came about
- Why it is being offered
- Caveats for this first time being taught
- Expected student workload
- Administrative items
- Introduce Alex Tung – Public Service Coordinator
- Introduce Dave Jaffe

Introduction to Assistive Technology

- Course purpose, goal, and content
- Definitions
- Broad overview
- What is a disability?
- Range of disabilities
- People involved - demographics and numbers
- Goal of rehabilitation
- Needs of people with disabilities
- Perception of people with disabilities
- Examples of assistive technology products and devices
- Phraseology, semantics, and social correctness

Class Goals

- Provide knowledge background and interaction with professionals, clinicians, and potential users during the Winter Quarter so that in the Spring Quarter ME113 students would better be able to develop a prototype, conduct user testing with that prototype, and iterate the design to develop a second prototype

- Introduce engineering students to concepts of effective design that go beyond the technical aspects

- Provide information to the greater Stanford community

Student Experience

- Gain an appreciation for the psychosocial, medical, and technical challenges in developing assistive technologies,
- Learn about ethical issues in technology development, including intellectual property rights as well as best practices in community relationships, and
- Engage in a comprehensive design experience that includes working with real users of assistive technology to identify needs, prototype solutions, perform device testing, and practice iterative design

Class Structure

- A weekly seminar with lectures on many of the different perspectives surrounding assistive technology by experts including entrepreneurs, clinicians, and persons with disabilities

Scheduled Seminars

- Introduction to Assistive Technology
- Research Engineer Perspectives
- Universal Design and Designing for Accessibility
- Perspective of Companies and Intellectual Property Issues
- Perspectives in Job Accommodation, Blindness and Low Vision, and Students with Disabilities
- Personal Perspectives of Jim Fruchterman
- Personal Perspectives of Peter Axelson
- Multidisciplinary Partnerships in Rehabilitation Research and Development
- Clinical Occupational Therapy Perspectives and Perspectives of People with Disabilities

Credit Options

- **1-unit option:**
  - attend the E110/210 seminars, no participation in a project, no continuation in the Spring Quarter

- **2-unit options:**
  - take E110/210 seminar, participate in a project, continue with ME113 in the Spring Quarter

  - take E110/210 seminar and participate in a project, continue with independent study credit in the Spring Quarter

  - take E110/210 seminar and participate in a project, no continuation in the Spring Quarter

E110/210 Activities

- Review project offerings
- Select a project
- Form a team
- Investigate project needs
- Evaluate the needs and further define the project
- Gather relevant background information for the project, including any prior design approaches
- Prepare and present a design proposal giving background, design criteria, and some initial design concepts from brainstorming

ME113 Activities

- Complete brainstorming of possible design approaches
- Evaluate the approaches and select the most promising approach to pursue
- Prepare an updated design proposal
- Perform detailed design and analysis
- Prepare a midway report
- Build a first cut prototype to demonstrate design feasibility
- Test the prototype and get feedback from users
- Re-design as necessary
- Construct a second, improved prototype
- Pursue re-testing and get feedback
- Prepare a final report documenting the results of a project and suggesting steps to further develop the design

E110/210 Class Assignments

- Submit a Problem Identification Report
- Submit a Design Proposal Abstract
- Submit and Present a Design Proposal
- Reflect on the class experience

Definitions

- Assistive Technology
- Disability
- Rehabilitation
- Rehabilitation Engineering

Assistive Technology

- Assistive Technology (AT) is a generic term that includes both a description of devices and a process that makes them available to people with disabilities.
- An AT device is one that has a diagnostic, functional, adaptive, or rehabilitative benefit.
- Engineers employ an AT process to specify, design, develop, test, and bring to market new devices.

Assistive Technology

- Other professionals are involved in evaluating the need for Assistive Technology devices, supplying them, and assessing their benefit.
- AT devices promote greater independence, increased opportunities and participation, and an improved quality of life for people with disabilities by enabling them to perform tasks that they were formerly unable to accomplish (or had great difficulty accomplishing, or required assistance) through enhanced or alternate methods of interacting with the world around them.
- New AT devices incorporating novel designs and emerging technologies have the potential to further improve the lives of people with disabilities.

Disability – Work Based

- Persons with a disability are those who have a “health problem or disability which prevents them from working or which limits the kind or amount of work they can do”. – Current Population Survey

- Cornell University Disability Statistics

Disability – Activity-Based

- Disability is defined in terms of limitations in a person's activities due to a health condition or impairment.

- "Activities" is broad enough to include working, doing housework, taking care of personal and household needs, and other age-appropriate activities. - National Health Interview Survey

- UCSF Disability Statistics Center

Rehabilitation

- **Medical model**: Restoration of function despite physical disability – through therapy and retraining

- **Engineering model**: Includes Assistive Technology

Rehabilitation Engineering

- Assist people who have a functional impairment by engaging in:
  - Device design
  - Research and Development
  - Technology Transfer
  - Marketing
  - Provision
  - Education

Facets of Rehabilitation Engineering

- Personal Transportation
- Augmentative & Alternative Communication
- Dysphagia: Eating, Swallowing & Saliva Control
- Quantitative Assessment
- Technology Transfer
- Sensory Loss & Technology
- Wheeled Mobility & Seating
- Electrical Stimulation

Facets of Rehabilitation Engineering

- Computer Applications
- Rural Rehabilitation
- Assistive Robotics & Mechatronics
- Job Accommodation
- Gerontology - Technology for Successful Aging
- International Appropriate Technology
- Universal Access

Disability in the US

- 43 million citizens are disabled, about 17% of 250 million
  - Some reports cite 49 to 78 million
- 24.1 million individuals have a severe disability
- 11 million children have a disability
- Disability is the largest minority group
- 15 million are 65 or older
- 10 million people with vision impairments
  - 1.3 million are legally blind
- 24 million people with hearing impairments
  - 2 million are deaf
- 1 million wheelchair users
- 6 million people who are mentally retarded
- Less than 5 percent were born with their disability

Disability in the US

- Disability rates vary by age, sex, race, and ethnicity
- Disabilities result in a reduced chance for employment
- Disability is associated with differences in income
- As the nation ages, the number of people experiencing limitations will certainly increase.

Disability Types

- Congenital
- Physical
  - Sensory
  - Functional
- Psychological / neurological

Goals

- Goal of Rehabilitation
  - Restore function
- Goals of Assistive Technology
  - Increase independence
  - Improve quality of life

Needs of People with Disabilities

- Regain function
- Perform tasks independently
- Improve quality of life
- Take full advantage of all opportunities
  - Educational
  - Vocational
  - Recreational
  - Activities of daily living

Perceptions of Disabilities

- In the US:
  - A diminishing stigma
  - Mainstreaming
  - ADA
- In other countries:
  - Taken care of, but often hidden away
  - Pursue a technology solution

Assistive Technology Market

- Many people with a disability – in US and world-wide
- Every consumer is unique
- Largest homogeneous group in the US is wheelchair users
- Lack of mass market means that companies are small and products are expensive

Example Assistive Technology Devices

- **My Spoon** feeding device
- **RIC** robotic prosthetic arm
- **iBot** wheelchair
- **Kangan Roo** wheelchair
- **Lokomat** walking retrainer
- VA RR&D assistive robots
- **Ralph** fingerspelling hand

My Spoon Feeding Device

- Engineers at SECOM in Tokyo have developed the **My Spoon** robot, designed to help feed patients unable to feed themselves. Requiring minimum setup from an outside source, such as preparing food into bite-sized pieces on the provided tray, **My Spoon** can be used with almost any kind of food.

- The device can be tailored for different degrees of disability. The robot is designed for safety: the manipulator, tipped with a spoon and fork, is designed so as not to hurt the user, and its position is set at the beginning of each meal.

RIC Robotic Prosthetic Arm

- The **RIC** neuro-controlled Bionic Arm allows an amputee to move his or her prosthetic arm as if it is a real limb simply by thinking.

- The arm also empowers patients with more natural movement, greater range of motion and restores lost function.

- **RIC** = Rehabilitation Institute of Chicago

iBot Wheelchair

- The **Balance Function** elevates the user to move around at eye level and to reach high places independently. In this function, the front wheels rotate up and over the back wheels, while the user remains seated at an elevated position.

- The **Stair Function** enables the user to safely climb up and down stairs, with or without assistance, giving them accessibility to previously inaccessible places.

- The **4-Wheel Function** enables the user to climb curbs as high as five inches and to travel over a variety of uneven terrain, such as sand, gravel, grass, thick carpet and other surfaces.

- Johnson & Johnson Independence Technology

Kangan Roo Wheelchair

- Built by engineering students and staff at Kangan Batman TAFE (Institute of Technical and Further Education), the 'Kangan Roo' is built of aluminum and has a radical frame design that allows the chair to be adjusted in wheelbase length while in use. The frame can be shortened for indoor tight maneuvering and lengthened for outdoor cruising speeds of up to 10 km/h.
- Combined with the lightweight aluminium frame, the Kangan Roo weighs only 42 kg (including batteries) - amazing considering that most lightweight electric wheelchair weigh on average between 80 – 120 kgs.
- http://www.kangan.edu.au/kanganroo/

Lokomat Walking Retrainer

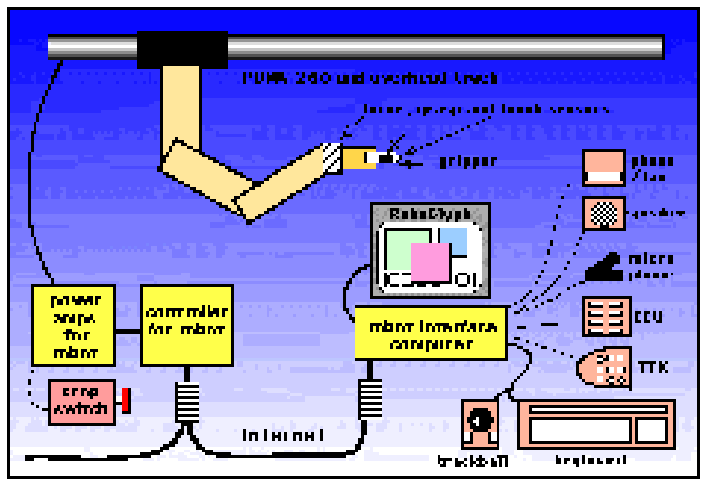
- The Hocoma **Lokomat** Robotic Ambulation System for body weight supported treadmill training is an effective therapy for persons with spinal cord injuries.

- Research indicates that spinal and cortical nervous systems have the ability to recall the walking process from repeated walking therapy.

VA RR&D Assistive Robots

- The **ProVAR** (Professional Vocational Assistant Robot) system is an assistive robot that enables individuals with a physical disability such as high-level tetraplegia to manipulate physical objects in a semi-structured office workstation environment.

- **ProVAR** allows its users to create and execute Activities of Daily Living (ADLs) and vocational support tasks that are complex yet robust.



Ralph Fingerspelling Hand

- **Ralph** offers individuals who are deaf-blind improved access to computers and communication devices in addition to person-to-person conversations.

- Enhancements in this design include better intelligibility, smaller size, and the ability to optimize hand positions.

Social and Political Correctness

- Put the person rather than the condition first:
  - Individuals or people with a disability
- Focus on capabilities rather than disabilities
  - Wheelchair user
- Refer to the person rather than the disability group
  - The Blind, the Disabled, the Deaf

Social and Political Correctness

- Shorthand terms:
  - Para, Quad
- Derogatory terms:
  - Gimp, Crip, Spaz
- Use of terms:
  - “Patient”, “User”, “Subject”, “Consumer”
  - “Suffering” and “Afflicted”
  - “Diagnosed with”, “Living with”, “Survivor of”

Robert Van Etten

- Dwarf
- Midget
- Shorty
- Little person
- Munchkin
- Elf
- Leprechaun
- Vertically challenged

Top Ten Reasons to Work in Assistive Technology

- 10 – It makes you feel good

Top Ten Reasons to Work in Assistive Technology

- 9 – The big bucks

Top Ten Reasons to Work in Assistive Technology

- 8 – The fame, glory, and recognition

Top Ten Reasons to Work in Assistive Technology

- 7 – You want to make a difference in people's lives

Top Ten Reasons to Work in Assistive Technology

- 6 – It is challenging

Top Ten Reasons to Work in Assistive Technology

- 5 – It is non-traditional

Top Ten Reasons to Work in Assistive Technology

- 4 – You know someone who would benefit

Top Ten Reasons to Work in Assistive Technology

- 3 – Someday you will need the technology

Top Ten Reasons to Work in Assistive Technology

- 2 – You have a good idea

The Number One Reason to Work in Assistive Technology

- Your mother always wanted you to be a doctor - working in Assistive Technology is close enough

History of Assistive Technology Projects in ME113

Maurice LeBlanc

- Example projects from last year
- Student experiences

Page Turner

- Microcontroller-based prototype page turner to allow a man with ALS, a neuromuscular disorder, to independently read a book

Standing Aid

- Device to assist a young male wheelchair user to stand while urinating, without assistance

Wheelchair Lift

- Portable wheelchair lift to facilitate the transfer of a patient to/from bed / wheelchair

Student Experiences

Projects Ideas

- Weight Management System for Wheelchair Users
- IV Pole for Wheelchair Users
- Kitty Litterbox Lifter for Wheelchair Users
- Accessible Interactive Model of the National Mall in Washington DC
- Sensors for Monitoring Body Position

Projects Ideas

- Fiberoptic WristAlert System
- Wheelchairs for a Therapy Pool
- Accessible Office Equipment
- Alternate Interface for an Office Telephone System for a Employee who is Blind
- Gesture Recognition for a TrackerPro Head Tracker

Projects Ideas

- Aid for Donning an Artificial Leg
- Rain Protection Device for a Wheelchair User
- Bicycle Navigation Device for Visually Impaired Riders
- Device to Facilitate Moving Elderly Individuals around Their Home

Projects Ideas

- EnableMart:
  - Accessible Fishing Pole
  - Go Anywhere Walker
  - CD-ROM/DVD Changer for a Computer
  - Amplified Answering Machine
  - Accessible Video Game Control

Projects Ideas

- Further Work on Last Year's Projects:
  - Page Turner
  - Standing Aid
  - Wheelchair Lift

Projects Ideas

- Accessible Interfaces for:
  - iPods and MP3 Players
  - Cellphones
  - Gameboxes
  - Remote Controls
- Projects Listed in the NSF Guidebook
- Student-defined Projects

Contact Information

- Websites:
  - http://www.stanford.edu/class/engr110/
  - http://www.stanford.edu/class/me113/

- Telephone numbers and email addresses:
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  - Alex Tung – 650/723-1642
    - tungsten@stanford.edu

Questions?

Next Week

Research Engineer Perspectives

Engineers from the VA RR&D

- Douglas F. Schwandt, MS
  - Mechanical engineer, designer, consultant
- Machiel Van der Loos, PhD
  - Mechanical engineer, researcher
- Eric E. Sabelman, PhD
  - Researcher
  - *Supporting, Lifting, and Moving Fragile Patients*
- David L Jaffe, MS
  - Electrical engineer, researcher
  - *A Robotic Fingerspelling Hand*

Adjourn