A Novel Interdisciplinary Course in Gerontechnology for Disseminating Computational Thinking

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Interdisciplinary Teamwork

• It’s there… on the screen
• Stereotypical nerds without social skills
• We trained students to collect and analyze data, but never asked for real solutions
• A booming ring

Plus, we try to disseminate non-CS major students computational thinking
Urgent Issue of Aging

Iowa has the highest percentage of people age 85 or older in the U.S. (2.1% 1996 to 3.1% 2025)
Cost of Senior Care

- Nursing homes (50,000/annual, 115/day)
- Home health care (85/visit, 100/day)
- Assisted living facilities or retirement housing (1000-5000/month, 12000-60000/annual, average 72/day)
- Adult day care (10 – 50/day depend on the kind of care)

Other senior care services
- Geriatric care manager (40 – 100/hour)
- Emergency response service (35 – 100/month)
- Medication reminder service (20/month)
- Meal delivery service (2 – 5/meal)
- Transportation service (50-100/round trip)
- Senior Center

By 2050, the overall cost of senior care will be in the range of 600 billion USD annually.
Background

• ComS/Geron 415x Gerontechnology in Smart Home Environments

• Pre-requisite:
  – for ComS 415x: Programming I/Intro to OOP
  – For Geron 415x: Aging and the Family

• Objective

To train next generation of gerontechnologists (scientists, engineers and designers) that can identify opportunities, assess options and create new solutions which utilize technology to improve older users’ real needs

• Challenge
  – New area: very few courses have been offered, no suitable textbook, and very little precedence to guide the course development
  – Must be developed collaboratively by an interdisciplinary team of faculty, since no one has enough expertise to develop new course materials in all areas
Course Development Process

1. Brainstorming
2. Identify cross-cutting themes
3. Learning module design
4. Integration and scheduling
5. Refinement
6. Variation
Interdisciplinary Collaboration

- HCI/Design
- Gerontechnology
- Computer Science
- Gerontology
Design Guideline for Seniors

Assistant Tech System Modeling & SOA

Software Engineering

System Modeling & SOA

User Study and Ethics

Aging Process

Assistive Tech

Direct Instruction

Guided Discovery

Inquiry

Computational Thinking (CT)

Interdisciplinary Teamwork

Social Pedagogy

Universal Design (UD)

Pedagogy

Inquiry

Direct Instruction

Guided Discovery

Inquiry

Direct Instruction

Guided Discovery
Learning Activities

- **Guided Discovery**
- **Direct Instruction**
- **Inquiry**

**Social Pedagogy**
- Lectures
- Term Projects
- Student In-Class Presentations
- Critique Session
- Field Trip
- Group Discussions
- Peer Review
- Hands-on Workshop
- Mentorship
- Crash-course
- Competition
- Joint Lectures
Student Project
REACH Platform

- Remote Access to Smart Home Facility Based Computer Science Laboratory

High-level Objectives:
- Hands-on experience
- Generate observable, physical effects in a familiar environment
- Real outcome with real use
- Underscore the critical computational thinking (CT)
REACH (pedagogically speaking)

• Computer Laboratory for new and cross-disciplinary students
• Support asynchronous distance education
• Enable usability and user studies
• Enable interdisciplinary group work
• Promote interests in computer science in female/minority students by
  – Putting computer system in a real-world context (e.g. senior care or home automation)
  – Align lab activities with students’ majors and prior interests, experience and knowledge
REACH (technically speaking)

• Virtualization
  – Packed lab kits (middleware, software tools, libraries, collaboration tools, manuals and useful links to references)
  – Individually customized environment and suspend-resume
  – Encourage trial and error → disposable images (sandboxes)

• Remote observation and intervention
  – Web cam/Sensor logs/ web-service interface to Actuators

• Scalable Solution
  – Encourage self-exploration via well defined API and well-structured programmers’ manual with step-by-step lab instruction
  – Separated development and experimental environments
  – Maximize utilization of the smart home lab facility
  – Minimize interference between different projects

• Service-oriented development environment
  – Improved flexibility and reduced complexity
  – Allows students to focus on logical composition using existing services rather than detailed implementation
### Fundamental bundles

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<th>OSGi Framework: Knopflerfish</th>
<th>IDE: Eclipse + plug-ins</th>
<th>Version control: SVN</th>
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- **Guest OS**: Windows Server 2008
- **Virtualization**: VMware Server 2.0
- **Host OS**: Windows Server 2008

- **SHADE image**
- **Binding and switching**

![Diagram of sensor setup](image)
Remote Observation and Intervention
Support for the Students

• Smart Home Programmer’s Manual
• CPATH server using Redmine
  – Project Repository
  – Collaborative tools
• New development lab
  – Three new workstations
  – REACH (VM, remote observation and intervention)
• Hardware checkout program
  – New inventory management allows students to checkout sensors and actuators for development and testing
  – Expanded number and diversity of sensors and actuators
• Mentorship and technical support
Protocol of User Study

• Use of IRB-approved 37-question 5-point Likert scale survey instrument
• Focus on self-reported confidence, knowledge level and attitude towards various aspects of computational thinking, interdisciplinary teamwork and gerontology
• Students in ComS 415x (fall 2010) are invited to voluntarily participate in the study. Those participated took the survey in the second and the last lectures of the semester
• The delta of pre- and post-test data from the same participant is used to measure the effectiveness of the course
Student Demographics

Student Gender Distribution

Male: 6
Female: 5

Ethnicity Distribution

Caucasian: 6
Asian: 3
Hispanic: 1
Others: 1
Interdisciplinary Teamwork

- Comfortable with Interdisciplinary Collaboration: 0.14
- Communicate with tech domain experts: 1.00
- Communicate with non-tech domain experts: 0.57
- Communicate with end-users: 0.57

Δ 5-pt Likert Scale
Future Plan

Focus group

Open research facilities for collaboration and experimentations

Distance education opportunities
Conclusion

• Interdisciplinary teamwork and computational thinking are critical skills for successful professionals in the 21st century

• Through careful, collaborative, and innovative course design, ComS 415x shows great results in enhancing both skills in its first offering while reaching underrepresented student demographic

• REACH platform, developed as a pedagogical supporting project, enables us to support more students, offer distance education and encourage interdisciplinary collaborations in research and student projects
Thank you
• Computational Thinking/Service computing
• Gerontology and Aging
• Assistive Technology
• Design Principles
• Software Engineering
• Product Evaluation and User Study
3 Cross-cutting Themes

- Interdisciplinary Collaboration
- Computational Thinking
- Universal Design
- Gerontechnology
Pedagogies

• Social Pedagogy
• Direct Instruction
• Guided Discovery
• Inquiry
Data Analysis III

• Findings of interest: uniformed response across the board
• Recruitment