CMP3202 Human Computer Interaction

Period per Week			Contact Hour per Semester	Weighted Total Mark	Weighted Exam Mark	Weighted Continuous Assessment Mark	Credit Units
LH	PH	TH	CH	WTM	WEM	WCM	CU
45	30	00	60	100	60	40	4

Rationale

The design and development of displays, alarms, and interfaces for small or large screens is an activity captured in the study of the human computer interface and in a study of human computer interaction. This discipline is increasingly software based and design needs require guidance by insights from psychology and informed by an appreciation of human diversity including matters such as colored blindness and deafness; in these circumstances, multimedia approaches often have a role to play. It is important to note that in certain applications there are crucial requirements for reliability and other kinds of performance that have implications for matters such as safety and security. Emphasis is placed on understanding human reactions to displays of various kinds and on human behavior in the context of interactive objects. Based on these, students need to understand the principles associated with the evaluation of interfaces including those that embody interaction. Students need to know the principles and guidelines that reflect best practice in the design, development, and maintenance of interfaces for multiple types of systems.

Objectives

By covering the course in Human Computer Interaction (HCI), the student will be able to:

- Identify some contributors to human-computer interaction and relate their achievements to the knowledge area, define HCI, explain the reasons for proper HCI designs in engineering, provide a good reason for having a small-screen graphical user interface, provide a good reason for having a large-screen graphical user interface, give an example on how one might evaluate an engineering design using some principles of HCI and describe how computer engineering uses or benefits from human-computer interaction.

- Develop a conceptual vocabulary for analyzing human interaction with software: to include terms such as affordance, conceptual model, and feedback, summarize the basic science of psychological and social interaction relevant to the development of human computer interfaces, differentiate between the role of hypotheses and experimental results recognizing the role of correlations, distinguish between the different interpretations that a given icon, symbol, word, or color can have in (a) different human cultures and (b) in the context of human diversity, and create and conduct a simple usability test for an existing software application, taking into account human diversity.
- Identify several fundamental principles for effective GUI design relevant for different applications in computer engineering, use a GUI toolkit to create a simple application that supports a graphical user interface, illustrate the effect of fundamental design principles on the structure of a graphical user interface, and conduct a simple usability test for each instance and compare the results.
- Recognize contexts in which to deploy the various technologies associated with intelligent systems and demonstrate an awareness of the capabilities as well as the limitations of the available techniques and technologies.
- For a range of contexts in which intelligent systems are deployed in a computer engineering context, identify the technical implications for devices, for computing power and for software, identify the potential for the use of intelligent systems in a range of computer engineering equipment, discuss the professional, legal and ethical implications of deploying intelligent systems in a range of computer engineering situations, describe situations from computer engineering applications when intelligent systems can be relied upon to deliver a required response, describe situations in which intelligent systems may or may not be reliable enough to deliver a required response, giving reasons for the answer, explain the necessity for heuristics in the general context of intelligent systems, and differentiate between the concepts of: optimal reasoning and human-like reasoning; of optimal behavior and human-like behavior.
- Discuss the full range of evaluation criteria appropriate for one of a range of computer engineering applications, conduct a walkthrough and a Keystroke Level Model analysis, summarize the features of the major guidelines and standards associated with human-centered software evaluation, and evaluate one of a range of existing interactive system with appropriate human-centered criteria and usability, giving reasons for selection of techniques.
- Explain the basic types and features of human-centered software development, indicate three functional and three usability requirements that may be useful in developing human-centered software, specify an interactive object using one of the common methods as well as appropriate standards or guidelines, and demonstrate the application of guidelines and fundamental principles in developing one of a range of possible computer engineering applications that rely on a human computer interface.

- Summarize common interaction styles, explain good design principles of each of the following: common widgets; sequenced screen presentations; simple error-trap dialog; a user manual, design, prototype, and evaluate a simple 2D GUI, and discuss the challenges that exist in moving from 2D to 3D interaction.
- Compare the event-driven paradigm with more traditional procedural control for the user interface, identify common differences as well as similarities in cross-platform user interface design, and demonstrate an ability to outline an approach to interface design for a computer engineering application that utilizes an appropriately chosen selection of technologies from event management, widgets, geometry management, and GUI builders.

- Understand the nature of graphical design and implement a simple graphical activity using a standard software package, appreciate the role of visualization technologies and demonstrate them through the development of a simple application, appreciate the benefits of virtual reality and the nature of the advantages this offers, and demonstrate a simple application of computer vision technology in a computer engineering context.
- Select system components which are suitable for the realization of multi-media interfaces of high quality, and design and develop a multi-media interface for a simple computer engineering application.

Subject Content

1. History and Overview of HCI

- Indicate some reasons for studying human-computer interaction
- Highlight some people that influenced or contributed to the area of human-computer interaction
- Indicate some important HCI considerations such as foundational elements, ergonomic designs, and graphical interfaces
- Contrast ways in which engineering design should reflect human interaction
- Mention some advantages of small-screen designs versus large-screen designs
- Describe how one would evaluate an engineering design vis-à-vis HCI compatibility
- Explore some additional resources associated with human-computer interaction
- Explain the purpose and role of human-computer interaction in computer engineering

2. Foundations of Human-Computer Interaction

- Motivation: the importance of the human interface in computer engineering; issues of small screens and larger screens
- The range of possibilities: text-based systems, use of graphics, sound, animation, video; the possibilities of multimedia Strengths and weaknesses of individual approaches
- The web as an example of an interface
- Human-centered development and evaluation
- Human performance models: perception, movement, and cognition; culture, communication, and organizations

- Accommodating human diversity; the role of multimedia
- Principles of good human computer interaction design in the context of computer engineering; engineering tradeoffs
- Introduction to usability testing
- The role of and use of a range of tools

3. Graphical User Interface

- Illustrations of developments of graphical user interfaces including: textual displays; interfaces that include alarms; displays that exhibit motion; displays that exhibit interaction
- Principles of design using graphical user interfaces (GUIs); principles associated with interaction including fault tolerance
- GUI toolkits
- Principles associated with use of sound and multimedia in different contexts; use of relevant tools
- Principles of design for web interfaces; web interfaces for small screen and mobile devices
- Use of relevant tools

4. I/O Technologies

- The range of technologies and techniques that can be deployed in intelligent systems: vision, speech processing, specialized sensors
- Technologies for location aware computing, the role of geographical positioning systems, other possibilities
- Overview of the technologies involved: their strengths and the limitations
- Availability of software support and of relevant tools

5. Intelligent Systems

- Illustrations of the deployment of intelligent systems in a computer engineering context
- The nature of intelligence deployed and the implications for sensors, for software (the nature of the software, the reliability of the software, the reasoning, the speed of response)
- The special case of mobile systems and location aware devices; illustrations of applications and benefits
- The problems associated with control passing to an agent and a user losing control as in a safety context
- Ethical issues
- History of artificial intelligence
- Philosophical questions about the nature of intelligence: the Turing test; Searle's "Chinese Room" thought experiment
- Ethical issues in artificial intelligence; the concepts of the computable and the incomputable
- Fundamental definitions: Optimal vs. human-like reasoning, optimal vs. human-like behavior
- The nature of knowledge and knowledge based systems; consistency and completeness concerns; what is possible
- The issues associated with the ordering of information, the fundamental role of technologies such as search, inference, and the role of heuristics
- Modeling the world; guidance on effective approaches

6. Human-Centered Software Evaluation

- Setting goals for evaluation
- The range of evaluation criteria including learning time, task time, completion time, acceptability; the strengths and weaknesses of the different criteria
- Evaluation without users: walkthroughs, Keystroke Level Model (KLM), guidelines, and standards
- Evaluation with users: usability testing, interview, survey, experiment

7. Human-Centered Software Development

- General guidelines associated with the structure of large systems that embody significant HCI code; separation of concerns, issues of maintenance; differing development life cycles
- Approaches, characteristics, and overview of processes associated with human centered software; systems that offer interfaces in different natural languages
- Functionality and usability: task analysis, interviews, surveys
- Specifying presentation and interaction; techniques and approaches; software support
- Prototyping techniques and tools: Paper storyboards; inheritance and dynamic dispatch; prototyping languages and GUI builders
- Quality considerations
- Standards and guidelines

8. Interactive Graphical User-Interface Design

- Choosing interaction styles and interaction techniques appropriate to applications
- HCI aspects of common widgets
- HCI aspects of screen design: layout, color, fonts, and labeling
- Handling human failure
- Beyond simple screen design: visualization, representation, metaphor
- Interfaces for computer engineering tools that utilize databases
- Multi-modal interaction: graphics, sound, and haptics
- 3D interaction and virtual reality

9. Graphical User-Interface Programming

- User interface management systems: different approaches; responsibilities of the application and of the application
- Kernel based and client server models for the user interface
- Dialogue independence and levels of analysis, Seeheim model
- Widget classes; aggregation of widgets
- Event management and user interaction
- Geometry management, constraint based approaches
- GUI builders and user interface programming environments; callbacks and their role in GUI builders
- Cross-platform design

10. Graphics and Visualization

- Computer graphics: Design of models that represent information and support the creation and viewing of images; possibilities to include two dimensions, three dimensions, shading, animation; graphical display devices; packages that support graphical design

- Visualization: Nature of computer visualization; the role of visualization in communicating information in a dataset to an interested party; use of tools to accomplish this
- Virtual reality: Nature of and benefit of virtual reality; its limitations; components of a typical virtual reality situation, e.g. graphics, sound; the nature of interaction with a user; virtual environments
- Computer vision: Role in deducing properties and the structure of a three dimensional world from one or more two dimensional images; tools used for this and their role in computer engineering

11. Multimedia Systems

- The use of multi-media in computer engineering applications; the benefit, especially in reinforcement and in a context of human diversity
- The implications of performance requirements associated with multi-media for the hardware, the software and communications aspects of computer based systems
- Considerations resulting from interaction of various kinds
- Design concerns associated with the development of multi-media interfaces
- Implementation issues; synchronization aspects, tools
- Quality considerations
- Guidelines and standards

Recommended and Reference Books

[1] Alan J. Dix, Janet E. Finlay, Gregory D. Abowd, Russell Beale, and Janet E. Finley, 1998. *Human-Computer Interaction*. 2nd Edition. Prentice Hall. ISBN-10: 0132398648, ISBN-13: 978-0132398640

[2] Dov Te'eni, Jane Carey, and Ping Zhang, 2006. *Human Computer Interaction: Developing Effective Organizational Information Systems*. John Wiley & Sons. ISBN 0471677655

[3] Helen Sharp, Yvonne Rogers, Jennifer Preece, and Jenny Preece, 2007. *Interaction Design: Beyond Human-computer Interaction*. Wiley. ISBN 0470018666

[4] Andrew Sears, and Julie A. Jacko2008. *The Human-Computer Interaction Handbook*. Lawrence Erlbaum Associates. ISBN 0805858709