TENTATIVE SYLLABUS - ICS 452 – Software Design for Robotics

Software Design Programming for Robotics is a specialized area of programming involving the integrated knowledge of both hardware and software into a working robotic system. Current technology has made robotic hardware relatively inexpensive and so trivial that engineers have turned their attention to robotic devices that can operate in hazardous or exotic environments. The potential of robotics operating in normal environments is limited by the computer science profession, more specifically, computer science professionals adept in both the software and hardware of robotics.

This course is the first undergraduate course specifically focusing on software design for robotics at the UH. The “Software Design for Robotics” course complements related courses offered by the Information and Computer Sciences department such as: Computer Vision, Multi-Agent Systems, Machine Learning and Artificial Intelligence.

The purpose and objective of this course is to fill this gap by providing information and computer science students with knowledge of and hands-on experience with both robotic hardware and advance software tools used in robotics.

By the end of the course, students will have achieved the following learning objectives:

- Students will have completed several programming assignments and will also have implemented a project so that they can acquire experience in software design for robotics.
- Students will understand basic hardware aspects of robotics and how programming is influences by robotic hardware issues.
- Students will understand the design principles and implement dataflow programming for robotics.
- Students will understand the programming issues of robotic programming for individual robots as well as multiple cooperating robots.
- Students will be proficient at programming both semi-autonomous and autonomous robotic systems.
- Students will learn to add robustness to their software to compensate for sensor and actuator problems.

Required Computer and Webcam:
You need to have a Windows based computer that you can download Roborealm (Primary software), Microsoft Robotics Studio and supporting software such as Visual Studio. A laptop would be best since you'll need to download programs via a USB port to robots. For system requirements see: http://msdn.microsoft.com/en-us/robotics/
Webcam – Some type of video input, preferably not built in to the laptop.

Required Software
Roborealm Academic (approx. $40) http://www.roborealm.com/
Text

Prerequisite
The prerequisite for this course is 2 ICS 300 courses. ICS 331 (Logic Design and Microprocessors) and ICS313 (Programming Language Theory) are highly recommended classes.

The tentative syllabus is likely to change to better follow the text.

Tentative 16-Week Syllabus:

Week 1: Introduction (Chapter 1, 11 & 12)
- What is Robotics
- What Types of Software Platforms are Used to Control Robots

Week 2: Robotics Hardware (Chapter 3 & 4)
- Introduction to Robotics Using Lego Mindstorms Robots
- Sensors, Actuators and Control Processors
- Programming Assignment #1

Week 3: Robotics Hardware/Software Issues and the Programming Platform (Chapter 5 & 6)
- Programming Assignment #2

Week 4: Movement planning (Chapter 7 & 8)
- Software Control Architectures, Localization, Navigation, Sensing, Planning, and Uncertainty

Week 5: Movement planning (Chapter 9 & 10)
- Mapping
- Robot Collectives

Week 6: Robust Software
- Data Flow Programming
- Agent Based Systems
- Programming Assignment #3
- Designing Robust Software to Compensate for Sensor and Actuator Problems.

Week 7: Signal Processing Algorithms
- Sampling Theory
- Fourier Transform and other Signal Processing Methods
- Programming Assignment #4

Week 8: Computer Vision Primer
- Object Segmentation
- Object Recognition and Representation

Week 9: Computer Vision and Robotics
- Sequential Image Analysis
- Current Computer Vision Systems
- Programming Assignment #5

Week 10: AI Paradigms of Machine Learning for Robotics
- Expert Systems, Case Based Reasoning, Bayes Network, Behavior Based AI

Week 11: Paradigms of Machine Learning
- Neural Networks
- Programming Assignment #6

Week 12: Robots Interfacing to Humans
- Human-Computer Interaction Aspect of Robotics

Week 13: Advance Robotic Topics

Week 14: Advance Robotic Topics

Week 15-16: Student Robotic Programming Project Presentations and Discussion
- Robotic Software Project Presentations