

Proposal for a new course

Spring 2017

24-662: Special Topics - Robotic Systems and Internet of Things

12 units

Tue and Thu 3:00pm - 4:50pm

Class size: ~ 40 students

This course presents an overview of Robotic Systems (RS) and Internet of Things (IoT), and how these two systems can be integrated into a larger framework, Internet of Robotic Things (IoRT). In the first half of the semester, students gain knowledge and skills related to RS and IoT through lectures and hands-on problem sets that introduce to students how RS and IoT components work and how they can be linked. The hands-on problem sets use common RS/IoT components such as industrial robot manipulators, mobile robots, vision sensors, online databases, and mobile devices. Building on the general knowledge and skills thus gained, students' work in the second half of the semester is project-focused. Student teams of 4-5 members design, build, test and demonstrate either a component or a system of IoRT. Teams meet with the course instructors regularly to incrementally extend and improve their IoRT component/system. This course is intended for graduate and upper class undergraduate students who have already learned at least one of the technical skills related to RS (for example: mechanism design, kinematics, dynamics, mechatronics, sensors, control, and machine learning).

Pre-requisite: A course in at least one procedural programming language such as C, C++, Java, JavaScript, or Python.

Course educational objectives

By taking this course, students will:

- learn the basic principles and practical applications of robotic systems (RS), internet of things (IoT) systems, and internet of robotic things (IoRT) systems,
- acquire design and development skills on RS, IoT and IoRT through a series of problem sets on RS, IoT, and IoRT, and
- reinforce knowledge and skills on designing and prototyping RS/IoT/IoRT systems through a team-based, seven-week hands-on project.

Target audience(s)

- MSR and MSC
- Seniors

Target departments

- ME
- Other CIT departments

Unmet ME needs that course would meet

- Understanding recent trends on the integration of robotic systems and IoT
- Exposure to industrial robots and their applications

Potential overlap with other courses. Indicate percent overlap or specific topics

No significant overlaps with other MechE courses currently offered

Prerequisite/co-requisite courses and/or expected prior knowledge

Students are expected to have basic knowledge and skills of at least one of the technical skills related to RS, for example:

- mechanism design
- kinematics and dynamics
- mechatronics and sensors
- dynamics and control
- machine learning

Students should also be familiar with at least one procedural programming language such as:

- C, C++, C#
- Python
- Java
- JavaScript

Number of units

12 units

Faculty who could teach the course

Kenji Shimada, Tomotake Furuhata (Researcher in Shimada's CERLAB), and other faculty members who are familiar with robotic systems and IoT.

Frequency with which course might be offered

Once a year (usually offered in spring)

Expected enrollment

30-50 students

General course plan

Topics

- Three components of robotic systems (actuators, sensors, controller/planners)
- Mobile robots
- Industrial robots
- Sensors (cameras, proximity sensors, range sensors)
- Cloud computing
- Mobile computing
- IoT examples
- IoRT examples

Problem sets and course project

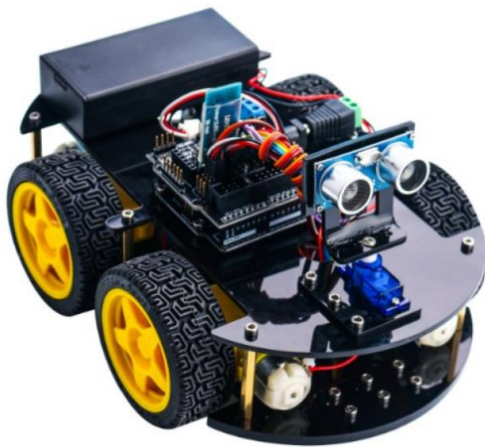
- 6 problem sets (in the first half of semester)
 - PS1: Mobile robots
 - PS2: Industrial robots
 - PS3: Sensors
 - PS4: Cloud computing
 - PS5: Mobile computing
 - PS6: IoT
- RS/IoT/IoRT system designing and prototyping project (in the second half of semester)
 - Conceptual design presentation of the proposed IoRT system
 - Detailed design presentation of the IoRT system to be prototyped
 - Demo and final presentation of the prototyped IoRT system

Textbook(s) to be used

No designated textbooks

Anticipated resources

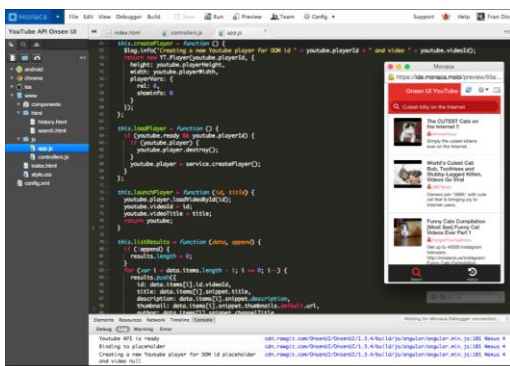
- 2 TAs and 2 Graders
- Two server computers
- 6-10 sets of mobile robots, cameras, proximity sensors, Arduino, and Raspberry Pi (new purchase in the first year)
- Industrial robots (We will use Denso Wave robots in Shimada's CERLAB.)
- Machine shop
- Lab space for design, fabrication and testing of IoRT system prototypes



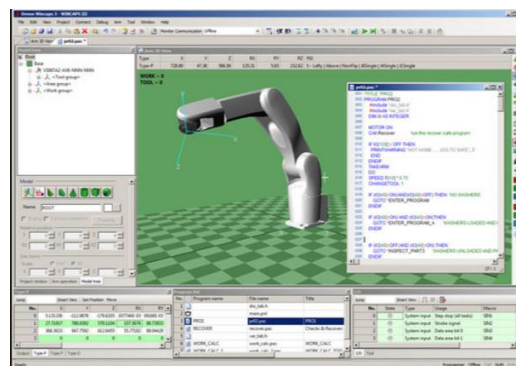
Mobile robot with a proximity sensor, camera, and Arduino



Industrial robot and motion-teaching pendant



IoT/IoRT system prototyping for mobile devices



Off-line motion programming and simulation system