**IoT Course Project 1**

IoT system development

- **Project**
  - Develop a small IoT system from IoT sensors and actuators using an IoT platform

- **Objective**
  - Learn about IoT platforms and how to use them for constructing IoT systems
  - Learn how to program on Raspberry Pi
  - Consider the design of more complex IoT systems

- **IoT system design and implementation**
  - Define the goal of the system you would like to construct
    - Design an IoT system using available sensors, actuators, and Raspberry Pi
      - You can add your own devices if desirable
  - Design the workflow to realize the goal
    - What will be the input events?
    - Define the actions to be performed for each input event
    - Define the overall system policies to ensure the proper operation of the system
  - Implement the workflow under the IoT platform
    - Understand how to use the hardware
    - Program Raspberry Pi to control the hardware
    - Use an IoT platform to implement the workflow of your system
  - Implement the policies under the IoT platform, if possible

- **IoT Platforms for constructing an IoT system**
  - Study a few IoT middleware
    - Open source middleware: OpenIoT, Kaa, Node-RED, ThingsBoard
    - Cloud and Edge based commercial IoT middleware: AWS IoT, AWS Greengrass, Microsoft’s Azure IoT Hub, Samsung’s SmartThings, ThingWorx
  - Choose one IoT platform and use it for constructing your project

- **An example IoT system for your project**
  - **System objective**
    - Home lighting management
  - **Devices**
    - Sensors: PIR, sound, luminance, etc. sensors
    - Actuators: light bulbs
  - **Automated lighting control**
    - Get sensor inputs
      - Get sound sensor input event
      - Get PIR sensor input event
      - Read light sensor input
    - Activities
      - Upon PIR event, read light sensor, switch on one of the lights if the luminance is lower than a user pre-specified level
        - E.g., if it is day time, the room is anyway luminated, no need to switch the light on (use lab lights to simulate daylights)
        - Depending on the required lighting level, switch on the appropriate bulb(s)
      - After a duration without PIR event
        - Turn off the lights
Voice command based lighting control
- Upon sound event:
  - Use Google speech recognition to determine which case the speech is about
    - A. not relevant, B. light 1 on, C. light 2 on, D. all lights on, E. all lights off
  - Voice response regarding the status of lighting

Policy
- Energy conservation policy: When there is sufficient lighting (user specified level based on the system design or the user voice commands), no lights will be turned on
- Further design the project to make it more interesting

Design of a more complex IoT system
- When designing your IoT system, first consider a large-scale system that is useful in real life
  - Try to pay more attention to multi-tenant IoT systems
  - Try to consider more interesting policies that requires more complex analysis
- For example
  - UTD campus management
    - Entry control using facial recognition
    - Track the individuals, providing on-demand transportation services, lighting control and AC control of individualized zones in buildings, customized information resources to be displayed on the available screens, …
    - Energy conservation policies for the buildings
    - Safety and security policies for the campus
    - Access control to rooms, facilities, equipment, information resources, …
- After designing a large-scale IoT system, scale it down to implement a small part of the system
- If you construct the large-scale IoT system you have designed, what features are needed but not exist in some of the IoT platforms

Submission
- Report
  - Survey different IoT platforms
    - Discuss compare common features in all platforms
    - Discuss special features in some of the platforms you have explored and why they are good to have in what types of IoT applications
  - Your system design and implementation
  - Efforts of the members
    - Discuss which member worked on which part of the project
  - Vision
    - Based on the project, assume that you can scale the small project up, what would be the large-scale IoT system you would like to construct
      - Try to pay more attention to multi-tenant IoT systems
      - Try to consider more interesting policies that requires more complex analysis
    - If you construct such an IoT system, what features are needed but not exist in some of the IoT platforms
  - Demo
    - Discuss the system you designed and show it actually works
      - Goal of the system, middleware used, workflow realized in the middleware
    - Discuss the contributions of each group member
    - Discuss your vision of an extension to a large-scale IoT system