EE409: Automation and Robotics Laboratory

Syllabus 2019-2020

(Modifications to this syllabus may be required)

1. Laboratory Catalog Description

This laboratory includes Two parts:

a. Part 1: Embedded Systems (Arduino) and PLC.
b. Part 2: Robotics.

The overall goal is to provide students with hands-on experience in embedded controllers, PLCs and Robotics through several experiments for each part.

2. Objectives and Expected Learning Outcomes

Objectives for Part 1

a. Students are familiar with the installation of the embedded controller (Arduino) and the PLC.
b. Students can install integrated development environment (IDE), as well as program the board's firmware.
c. Students can access the pins of the Arduino and the PLC, as well as they can distinguish between digital and analog pin.
d. Students are familiar with variety of devices, commonly found in industry, which the embedded controllers and PLCs can interact with them.
e. Students realize how and when to use the different types of sensors and how to connect them to the Arduino or to the PLC.

Objectives for Part 2

a. Students understand the kinematics and coordinate transformation of robot by implementing and analyzing 3-degree-of-freedom manipulator.
b. Students can design appropriate simple robotic systems to accomplish a specific task.
c. Students can differentiate between open-loop and feedback control for motion (position and velocity) for the robot.
d. Students know how to follow the guidelines for accessing to the microcontroller of the robot and program it for a desired task.

3. Experiments

Part 1

a. Hello World
b. Controlling a Relay
c. LED Bar Graph Display
d. Playing Music
e. Simple Counter
f. Controlling a Servo
g. Measuring Temperature by Thermistor
h. IR Remote Controller
i. 3-axis Accelerometer
j. 4x4 Matrix Keypad
k. Controlling DC motor
l. Controlling Stepper Motor

Part 2

a. 3-DOF Manipulator Kinematic Diagram and Coordinate Transformation
b. DC motors Torque/Speed Control
c. Control the Velocity of the Joints
d. Open-Loop and Feedback Control to Set the Position of the End Effector
e. Speed, Stability, and Accuracy in a Control Algorithm of Robot

4. Grading

Discussion	10%
First Exam	30%
Final Exam	60%

5. How the Laboratory Works

Sessions

a. The class will be split into two groups, every group has to attend the LAB according to the schedule.
b. Each group will be divided into four subgroups of two/three students.

c. After explaining the theory and the procedure of the experiment by the lecturer, the subgroups have to implement it using the available materials in the LAB and show the results.
d. The results for each subgroup are checked by the T.A.
e. For every session, students are discussed separately by the lecturer about the results of the last experiment.
f. The average grades of the discussion are calculated and recorded by the lecturer at the end of the semester.

Exams

There are two exams for this LAB, each exam has a theoretical and a practical part. The theoretical part is an on-paper exam taken in-LAB and it is 40 percent of the grade. For the practical part, the students have to draw the design, implement it and show the results. This part is 60 percent of the grade.

6. Lecturers and T.A. Contact Information

a.

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