MCE 449 - Mechatronics Components and Instrumentation

Course Prospectus

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Instructor & Teaching Assistant

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- Office : A-525
- Office Hours : By appointment
- Lab. : DB-426

Unfortunately we do not have any official TAs. However you can visit DB-426 and ask for assistance from my MSc. and PhD. students.

You are encouraged to use the laboratory and the equipment therein *as long as one of my grad. students is also in the lab to supervise you.*

Course Objectives

This class aims to expose the student to basic concepts of mechatronics such as

- sensing
- actuation
- transducers
- embedded programming
- digital control
- low-level communication
- design and manufacturing

At the end of the semester students are expected to be able to

- design basic algorithms
- implement sensor-actuator feedback systems.

Who Should Take This Course?

This course is designed for students interested in applying their mechanical and electronic engineering skills on mechatronics systems.

This requires the students to be exposed to basic concepts of

- mechanical engineering
- electrical and electronic engineering
- computer science (basic algorithm design and data structures)

The student should be interested in practical applications such as

- sensor interfacing
- actuator control
- low-level micro-controller - computer communication
- design and manufacturing electromechanical systems

References

This course does not have an official text book. In preparation of the course material I benefited from the following references.

1. Bolton, William. *Mechatronics: Electronic Control Systems In Mechanical And Electrical Engineering*. Pearson Education, 2003.
2. Shetty, Devdas, and Richard A. Kolk. *Mechatronics System Design*. Cengage Learning, 2010.
3. Alciatore, David G. *Introduction To Mechatronics And Measurement Systems*. McGraw-Hill Education, 2007.
4. Jouaneh, Musa. *Fundamentals of Mechatronics*. Cengage Learning, 2012.
5. Çetinkunt, Sabri, *Mechatronics*. John Wiley & Sons, 2006.

Mini Projects

You will be given a 3 mini projects each of which is continuation of the previous ones.

At the end of the semester, you are expected to present a fully-functioning linear sliding stage.



Mini Project Phases

This mini project series consists of 3 phases

1. Production and assembly
2. Open-loop position and speed control
3. Closed-loop position and speed control

Mini Project Phase #1

Production and assembly :
The sliding stage requires

- a stepper motor,
- motor coupling,
- lead screw and nut,
- bearings,
- linear rail shaft,
- nuts, bolts, washers etc.

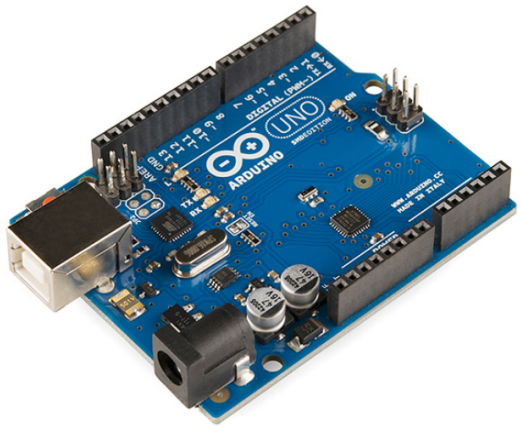
Mini Project Phase #2

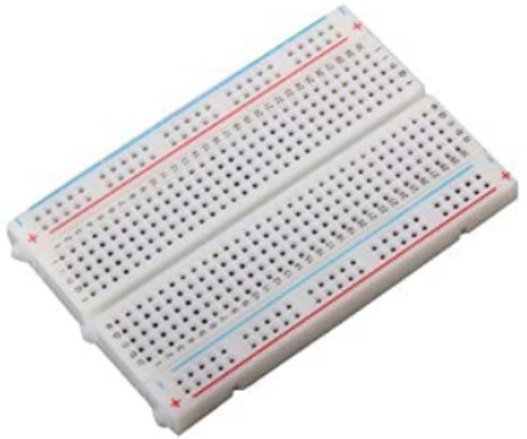
Open-loop position and speed control :

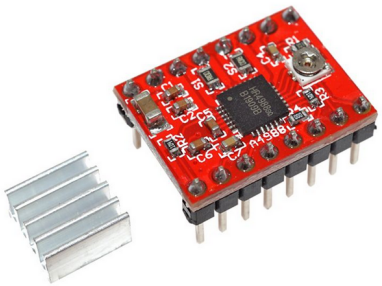
You will add the following to your design

- arduino micro-controller,
- breadboard,
- stepper-motor driver,
- data and signal cables,
- limit switch

and implement an open-loop controller on Arduino











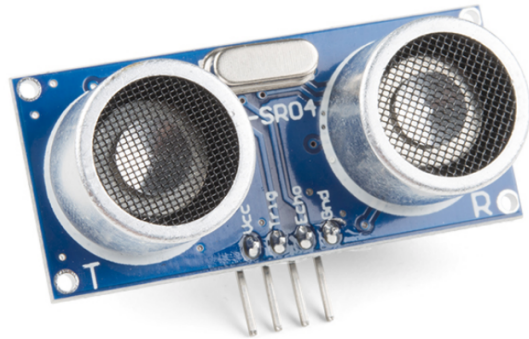
Mini Project Phase #3

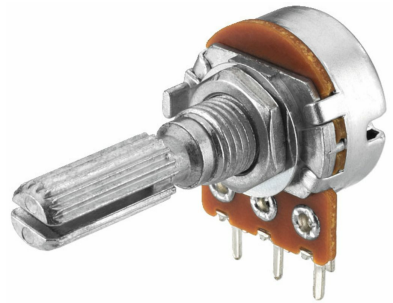
Closed-loop position and speed control :

You will add the following to your design

- ultra-sound distance sensor
- potentiometers

and implement a closed-loop controller on Arduino





Shopping List

You will need to purchase these components. Cost could go as high as 1000 TL. We have 3D printers and filaments at DB-426, and you are encouraged to use these for your projects.

You can form groups of 2-3, and share the expenses.

Looking for sponsors!







Midterm & Final Exam

The midterm will be in-class, and include Arduino programming questions.

You will attend the midterm with your laptops and basic Arduino equipment required to implement and test programming questions.

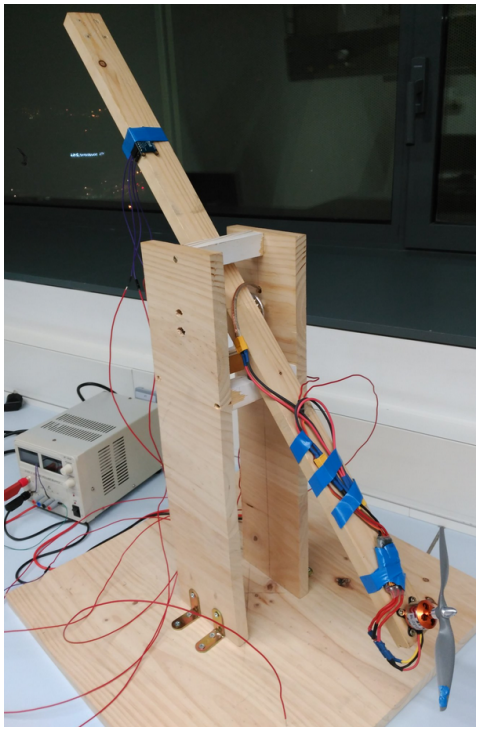
No group work, no internet access. You're on your own!

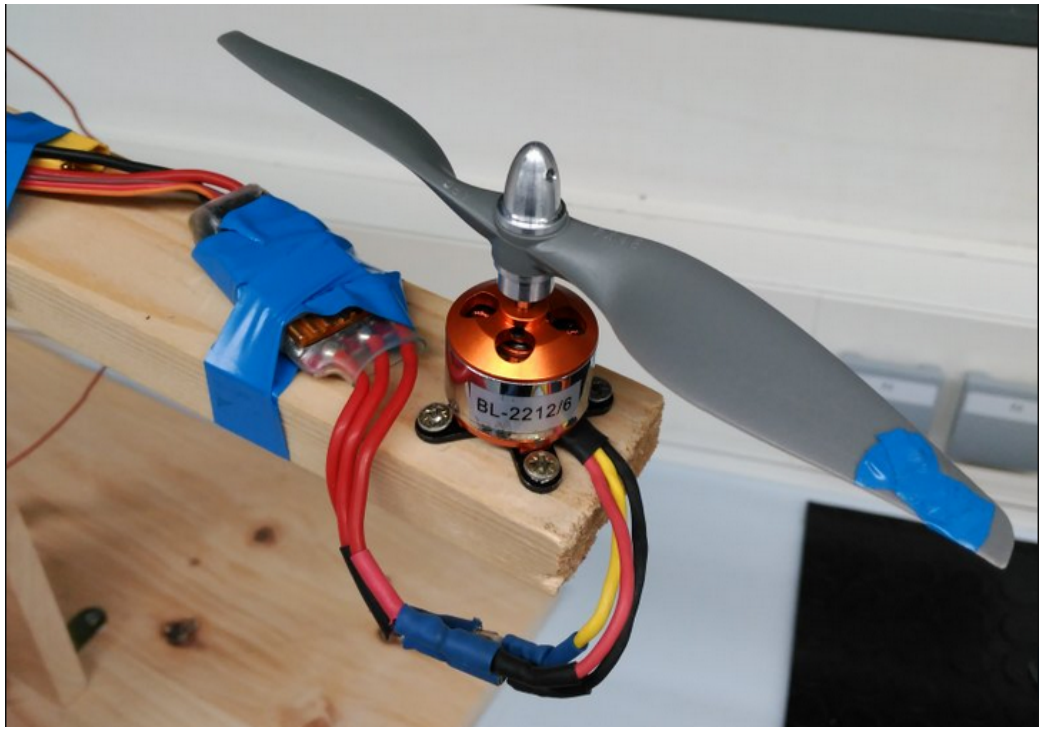
Final exam will be similar to the midterm.

(note : depending on the decision by YÖK, I may employ final project in place of final exam.)

Term Project

Design and manufacture single axis seesaw attitude control system using a motor, a propeller and an angle/attitude sensor.





Tentative Course Plan

Week	Subjects
1	Course introduction, mechatronic systems, design process
2	Introduction to microprocessors (Arduino)
3-5	Embedded C programming: development IDE, variables, arrays, functions, basic algorithm design
6	Electrical components, circuit theory overview
7	Signal conditioning & processing, ADC, DAC, PWM
8	Low-level communication, SPI, I2C, RS232
9	Midterm Exam
10	Sensor types, sensor interfacing and data acquisition
11	Motor types, various actuators and motor control
12	Mechanical components, dynamics and mechanisms overview
13	System modeling and controller design
14	GUI design, communication with ROS
15	Kalman filter

Assessment

	Count	Total Cont. (%)
Midterm Exam(s)	1	15
Quiz(zes)	5	10
Mini Project(s)	3	30
Term Project	1	25
Final Exam	1	20

(note : percentages may change, see note on page #12)