ME 456 Mechatronics – Spring 2025

Workshop Assignment #1: Ultrasonic Distance Measurement

11.03.2025

Goal:

The first assignment is about familiarizing with ultrasonic sensor and Arduino programming. A simple code to move robot on a square path and reading ultrasonic sensor distance will be implemented.

Prelab:

- Obtain one of the suggested sumo robot kits. Make sure you have at least one HC-SR04 sensors.
- Assemble robot parts by following instructions.
- Follow the instructions and complete an introductory example on interfacing HC-SR04 ultrasonic sensor at: https://projecthub.arduino.cc/Isaac100/7cabe1ec-70a7-4bf8-a239-325b49b53cd4. Another tutorial at: https://howtomechatronics.com/tutorials/arduino/ultrasonic-sensor-hc-sr04/.
- Follow an Arduino motor control tutorial: https://www.youtube.com/watch?v=YkfBtjs8uWg
- Each group bring your kits and one notebook computer with necessary programs installed at the Workshop to be held during the class time.

Workshop Tasks [12 pts]:

1. [+4 pts]. Write an Arduino program to read ultrasonic sensor data and display it continuously on serial monitor window.
2. [+4 pts]. Add your code to move forward while reading ultrasonic sensor distance. Stop your robot when distance (to obstacle) drops below 20 cm.
3. [+4 pts] Now program your robot to follow a square shaped path, as follows:
    i. Go forward for one second,
    ii. Make a 90 degree left turn,
    iii. Go to step (i).
    iv. Stop after four turns.

1

Hint:

Your codes will call the following functions:

- Serial.println() function sends text data which can be seen at "Serial Monitor". Use 115200 baud transfer speed.
- You can define separate functions for forward, backward, left and right turns.

Homework and Reporting [13 pts]:

1. [+4 pts]. Add to lab task 3 the following function. Robot follows the square shape again but this time measures the distance to obstacle. If it detects an obstacle within 10 cm then instruct the robot to follow an obstacle avoidance move. Obstacle avoidance will be to move backwards for one second and then make a 180 degree turn. Your code must be composed of functions. Set values should be defined as variables.

2. [+5 pts]. Ultrasonic sensor has a limited accuracy. Obtain a "calibration chart" of the ultrasonic distance sensor. Using a tape measure, put the robot in front a wall at distances from 5 to 250 cm. Use the distance increments in the table below. Record the actual (by tape measure) and the value given by the sensor. Plot a "calibration curve" and find a best-fit polynomial. Assess the overall accuracy of the sensor (non-linearity error).

From distance (cm)	To distance (cm)	Increment (cm)	Total measurements
5	20	1	16
25	100	5	16
110	250	10	15

3. [+4 pts] Prepare a short report (2-4 pages) explaining your codes, calibration chart and results. Give a discussion on robot's performance. Also record and submit a video of your robot performing the assigned tasks. Submit your reports within one week of the workshop.