ME461 Final Project

You and your lab partner (partners for the groups of three) will pick a project that uses either the three wheeled (one is the caster) robot car or the two wheeled balancing Segbot. In addition to using the F28379D (red board) to control you chosen robot, you need to include in your project at least one more processor or processor board. Two examples are a Raspberry Pi 4 board or the MyRIO board from National Instruments. I will list more choices later in this document. Third, you will pick the sensors (and possibly more actuators) you will use to have your robot sense the world. These can be the ones already given to you: microphone, MPU-9250, optical encoders, joystick, real-time clock chip, RC servo, DC geared motors attached to wheels, buzzer, LEDs. There are also other sensors (listed below) that I have in the lab that you can use in your project, but they will need to be returned at the end of the semester. One very important part in your group's decision on what type of project to choose is that each partner needs to be in charge of one portion of the project. Partners will of course help each other on all parts of the project but the part you are in charge of will be what I base a good portion of your project grade. Each partner needs to have an important role in the project's success. One of the goals of semester project #4 is for your group and I to sit down and make sure each of you have an important role in your project. Below I give project ideas but I am also interested in hearing project ideas you come up with.

Additional sensors/items I have in the lab that you can use for your project. Most of these you will need to return at the end of the semester.

1. USB camera. To use a USB camera you will need to either use your own Raspberry Pi or one of the labs Raspberry Pis or Orange Pis. In addition you could use the MyRIO board programmed in LabVIEW.

2. IR distance sensors excellent for wall following and obstacle avoidance.

3. I have only 6 total LIDARs. Talk to me quickly about these if you want to use on for your project, but know the LIDAR will add some difficulty to your project.

4. Switches you could use as feeler switches. I have some switches but you can also make your own with bendable music wire.

5. Ultrasonic sensor. This sensor would require you to use the eCAP peripheral of the F28379D processor.

6. ESP8266 UART to WIFI board. This would give your robot WIFI communication. Not very fast, but fast enough for most things you would be communicating to your robot. A Raspberry Pi would also give your robot Wifi.

7. There is a spot for a relay and two spots for higher current transistors on your green board that could be used for turning on and off a higher current device like a two position solenoid.

8. I have only two ReSpeaker mic arrays https://www.seeedstudio.com/ReSpeaker-USB-Mic-Array-p-4247.html. The ReSpeaker can detect direction of sound source and also (with some work) voice recognition.

9. Your MPU-9250 also has a Compass that we did not read in Lab 5.

10. You can also purchase other sensors and actuators but make sure I approve the item before you purchase it.

11. I may have more sensors in the lab that your project ideas may jog my memory to remember.

List of Processors and Processor boards to choose from for your project.

1. Raspberry Pi 4. I have 12 of these boards.

2. MyRIO. I have 10 of these boards.

3. Orange Pi, (raspberry pi knock offs). Pretty similar to a Raspberry Pi 3. I have quite a few of them.

4. Work with the second processor, CPU2, of the F28379D dual core processor.

List of ideas for PARTS of your project. An entire project would include a few of these or other items you come up with.

- Play with MPU-9250 registers and Compass. If you want to play with the Compass I suggest you pick the robot car since it lays flat.
- Play with eQEP and unit time capture (an extra feature of the eQEP) and use it to balance the Segbot. You would need to come up with something for the Segbot to accomplish.
- Play more with microphone. Use TI's FFT library to detect different notes and make the Segbot receive commands by playing notes. Here you could look into the DMA of the F28379D processor.
- Play with I2C more by writing code to overcome errors when the I2C communication runs into faults. Also look into using the receive and transmit interrupts of I2C.
- Change the code on the F28027 (DAN28027) chip so that it can be used for the PWM of the robot's geared DC motors. I would like to figure out a fix so that the DAN28027 chip does not need to use a SPI TXDLY of 16 clocks. Also if the DAN28027 is not communicated with in say .25 seconds the PWM channels would be set to zero.
- Make the Segbot do something. Make a gripper with a RC servo to hold something. Take it somewhere and drop it off.

- Also remember you have two robot cars. So you could perform tasks using both of your robots. The only limit for using two robots is the amount of equipment/processor boards/sensors I have to give out to all the groups.
- Play with a cheap ultrasonic sensor to measure distance using the eCAP peripheral of the F28379D. Add it to Segbot or to robot car.
- Make the robot car or Segbot wall follow and avoid obstacles as it is commanded to go from one XY point to another XY point on the floor.
- Make segbot or robot car dance to beat of a song.
- Add bump switches feelers, to Segbot or robot car so it can recognize if it needs to backup and turn.
- I do not have any Bluetooth modules but Adafruit has a nice UART to Bluetooth module that you could purchase and add wireless to your robot that way.
- Have the Segbot or robot car go towards certain colors and perform different tasks when close to these colors.
- Research the capabilities of the OpenCV (Computer Vision) library and have the Raspberry Pi or Orange Pi perform other tasks than just color following.
- Write a PC program in LabVIEW (or another package if you want) to display where your Segbot or robot car travels XY on the floor. This could be done with a Raspberry Pi or an Orange Pi and also with the ESP8266.
- Run your control algorithm in the CLA (Control Law Accelerator) which is close to a third core in the F28379D processor.

Project Submission and Demonstration Day:

Demonstration Day is Thursday December 16th 1:30pm to 4:30pm. I will bring donuts.

I would like you to submit your project to the http://hackster.io website. When you sign up for an account at hackster.io make sure to use you U of I email account. I will be showing your projects to a few TI representatives to show all the hard work you performed with their F28379D processor. The hackster.io website submission is due Friday December 17th midnight.

Items (minimum) that must be posted at your Hackster.io site:

- Videos of your project working.
- Video of you explaining what sensors and actuators you used for the project and how they are connected to the Launchpad. Make sure to plug TI and the F28379D Launchpad board.
- Entire source code and Code Composer project files. Make a zip of your project directory in your workspace.
- Number of paragraphs explaining your project.

- If any algorithms used, make sure to explain how they were used and have links to websites or papers that explain the algorithm.
- If you added any sensors, maybe a video of how you soldered and interfaced with the sensor.

If you have trouble submitting your project to hackster.io first talk to fellow students to see if they can help. If you keep on having trouble talk to me.