Week 5 homework

Due date reminder

Please email your completed assignment to the course TAs (mch6@illinois.edu and jjc11@illinois.edu cc rlongo@illinois.edu, subject: '[PHYS371]: Week 5 Homework, Your Group Number) by Thursday, 5 pm of week 5 (02/23/2023). Homework that includes only group work should be submitted by one group member, rigorously copying all the other members, the instructor and the TAs.

Each day of delay in turning in the assignment will result in a grade reduction of 10%. We will not grade anything submitted more than one week late. The use of the wildcard should be communicated to the instructor and the TAs before the deadline to turn in the homework, and it does not apply to homework that includes group work only.

Quote the main authors of different parts of the code you develop. **Keep the code up-to-date on the GitLab repository.**

Please compress all the material related to the homework into a .zip or .tar file. If you have questions or points you need to address, please do not wait for the last day to ask for office hours since it may not be possible to accommodate all the requests on short notice.

Problem 1

Each group will have to address specific items that are instrumental for the successful assembly of their project on the breadboard and provide a sketch that will allow us to start outlining the PCB. These are the other per-group tasks, discussed during the informal discussion during Friday's class:

Group 1: Make a robust training set using computer generated data. Revert the setup to an Arduino Mega board. Benchmark the usage of the camera with the mega and attach HD pictures acquired with it. Finish rudimentary housing for the camera.

Group 2: Investigate a mechanism to simultaneously shoot the two pucks and elaborate more on the launch system itself. Determine if the camera DAQ speed is sufficient to pair with ML techniques or whether a second camera would help in this process. Determine whether the tracking with Machine Learning will work with the existing setup. Start working on the camera support system.

Group 3: Integrate the new camera into the setup. Work out the DAQ with the new setup and send new material with a video of data acquisition and an example full data package. Provide details about the implication of dead time of the camera in the measurement. After solving Problem 2, adapt the Frog design to house the sketched PCB.

Group 4: Carry out simultaneous measurement with the two Plantowers, and double-check one vs the other. Do the same exercise together with Group 7 sensors. Analyze the correlation between particles of different sizes detected by the Plantower. Progress on the design of the housing after solving Problem 2.

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Group 5: Carry out a feasibility test with the sensors and inform the instructor and the TAs as soon as the results are available. Test the new rubber band (to be picked up from Loomis 481). Evaluate the length and number of ribbon cables needed.

Group 6: Test the BME on I2C again, this time connecting the SDO pin to the ground to change the address of the device. Implement capacitors in the design. Provide a calibration curve of the ultrasonic sensor (distance measured with a ruler vs measured with the sensor). Test the BME against another BME to study the bias observed while measuring vs the TMP.

Group 7: Test readout of the anemometer when connected on an external power source. Carry out simultaneous measurements with the two Plantowers, and double-check one vs the other. Do the same exercise together with Group 4 sensors.

Group 8: Compare flows from different sensors. Test the Arduino Uno for the pressure sensor. Investigate whether daily data for the water tower filling level are available.

Problem 2

Provide a 2D schematic representing how you want your board and sensors laid out on the PCB. The schematic should show blocks realistically representing the size of each device, as well as clear labelling for the pin connections. Please attach a document with a justification for each positioning choice and design request. If your breadboard layout is final (e.g. no components have to be added and everything is working as expected), receiving this input before Thursday would be extremely helpful in streamlining the PCB design process.

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