Phase III Project Description

INTRODUCTION

One of the fundamental activities of scientists and engineers is recording, processing, analyzing, and presenting real-world data. This is true whether you are measuring muscle activity or metrological events. The work of the final phase of the class will be a team-based project which will bring together the earlier programming concepts and combine them with data analysis and processing techniques. Over the course of this phase, you will design, develop, and implement a graphical user interface (GUI) that can 1) record data from an Arduino microcontroller 2) analyze and graphically present the data, 3) save the data to a file, and 4) analyze and remove unwanted noise in the recorded signal. You will accomplish this by prototyping each component as separate lab exercise and then combining the functionality into a unified final program.

This will be a team activity and you are encouraged to break the effort into separate pieces. Each lab exercise representing a prototype of the final functions of the project will be due in stages as per **ENGR 131 21S-IN-001-04-Z (Course Calendar).** Later lab exercises will likely build upon earlier ones and include the previous functionality developed (ex. Streaming data from the Arduino to Matlab introduced in Phase 2 Lab 1 will be a part of all later labs). For complete details of each lab, please see the pertinent document listed.

PROJECT PROTOTYPE LAB EXERCISES SUMMARY

- Phase II Lab 1
  - ENGR 131 21S-IN-030-21-X (Arduino Basics)
  - Record light levels (analog voltage) using the Arduino
  - Stream data to Matlab and record a pre-set length of data
- Phase III Lab 1
  - ENGR 131 21S-IN-030-31-X (Statistical Analysis)
  - Perform statistical analysis on recorded data
- Phase III Lab 2
  - ENGR 131 21S-IN-030-32-X (GUIs)
  - Use the Arduino to record data using the Elegoo temperature & humidity sensor
  - Implement a GUI to display the recorded data
  - Save the data to an Excel file
- Phase III Lab 3
  - ENGR 131 21S-IN-030-33-X (Frequency Analysis)
  - Control a servo motor to move to random positions
  - Perform frequency analysis on recorded data
  - Implement filters to remove unwanted noise

The concepts you develop in these lab exercises will then be implemented in a final GUI incorporating everything into a single system. This is a bit more than cutting and pasting, but the core logic you worked out in the labs should transfer over. The exact appearance of the GUI, the types of controls you use, and its overall operation are yours to develop, but it must be capable of performing the following functions:

FINAL REQUIRED FUNCTIONALITY:

- Fully functional GUI
- Move a servo motor connected to an Arduino to a random location
- Read in light, temperature, and humidity data from an Arduino via serial communication
- Graphically display the recorded data (in any combination of temperature, humidity, and light level)
- Display the statistics (mean, standard deviation, min, and max) of the recorded data
- Perform frequency analysis (FFT) of the recorded light level data
- Use controls (your choice) to set the filter parameters and filter the light level data
- Save raw data to an Excel compatible file
- Load raw data from an Excel file

You will be permitted to revise and resubmit each deliverable **once** for improved credit with the exception of the final, functional project.

HINTS:

- Remember that the temperature and humidity data are MUCH slower than the speed of the loop() function. You'll want to revise the conditional statement where the temperature and humidity are measured so that that all the data is output via serial at the same time in the main loop.
- To use a GUI table for the statistics, set up the column and row name in the Property Inspector in Design View mode. In one of your callbacks, compute the stats and place them in an array as in Phase III Lab 1. Assign this array to app.<Table Name>.Data and your table will populate with the computed stats.

TEAM-BASED LEARNING

To prepare you for a career in engineering you will be conducting your design project in teams of three students. Teams will be assigned using CATME, a validated team building and evaluation system. Students will use this system to perform peer-reviews of their teammates in order to assess participation. The outcome of this peer review will scale your final design project grade by 80% to 120%

Revision	Description	Date
A	Original Document	3/30/2021
B	Revised to remove controlling servo speed, include loading from an Excel file, and added some hints.	4/21/2021