Class Project

ENG 10 (Spring 2021)

Project description:

The goal of the class project is to apply the concepts from the class to an engineering problem. Your team will identify a problem that has an engineering solution, propose a solution, and develop a prototype proof-of-concept. All projects will involve measuring physical quantities using sensors (e.g. noise levels using sounds sensors, for example) and Arduino microcontrollers, and then reacting to the measurements (e.g. flashing LEDs when a loud noise is detected, for example). For this quarter, we will be using the Adafruit Circuit Playground Express as the microcontroller.

Below we've provided example past scenarios, which can act as the basis for your projects. You may propose other projects, but you purposefully constrained by the hardware available (see below). Also, all projects must:

1. Use 1 or 2 **sensors** to quantify a physical phenomenon (e.g. temperature or sound).
2. Perform **computation** on an Arduino microcontroller using the sensor data as input.
3. **Control** a reactive device (e.g. LEDs or a vibrating motor) based on the stimuli from the sensors and results of the computation.
4. Have a **3D prototype** of some part produced by Fusion 360.

Example 1: Acoustical noise monitoring

Excessive noise can have many negative effects, including, but not limited to, decreased concentration levels, low quality sleep and increased stress levels. This is especially important when students are studying for exams. To prevent excessive noise, you have been tasked with creating a device that can be installed in study areas (e.g. Geisel library) to autonomously monitor noise levels and provide a non-verbal (i.e. visual) notification to students when noise levels exceed a specified threshold.

Example 2: Fall detection

Those with limited mobility can be at risk for fall-related injuries, particularly when they are in situations where their fall is not easily witnessed (e.g. inside a bathroom) or are living by themselves. Detecting falls accurately and quickly can have major impacts on the health of the user, as well as enabling additional independence. You have been tasked with creating a wearable device that can detect falls and provide notifications to others nearby that the user requires assistance.

Deliverables

All project teams must complete the following:

- **Design proposal**: Justify your design problem choice and propose a solution.
- **Proof-of-concept**: Prove that your prototype can work.
- **Final presentation**: Show off your finalized prototype.

Further information (including submission requirements for the design requirements and proposal) will be provided in a separate document.

Team names

All teams must come up with a name for their team and/or project. You should take pride in your work, and details such as a name (and possibly a logo) show that you are approaching your work as professional engineers.

Grading

Grading of the project (worth 40% of your course grade) will be based on:

- **Design Proposal**: Due **Week 5 (April 28th);** see the Design Proposal document for more info.
- **Proof-of-concept**: Due **Week 9 (May 26th)**; demonstrate a working prototype. Must have both: An actual working prototype **AND** a movie demonstrating this.
- **Final presentation**: In-class (**Week 10, June 2nd**), 10-15 min. per team (plus Q&A session).

Hardware

Every team will be provided with:

- (1) Adafruit Circuit Playground Express: https://www.adafruit.com/product/3333
- (1) USB cable
- Servo motor
- Misc. parts (resistors, wires, etc.)

Each team may select one or two of the sensors built into the Circuit Playground Express:

- Sound sensor
- Light sensor
- Temperature sensor
- Motion sensor (triple-axis accelerometer)

- Proximity sensor (an extra part)

More info on the Circuit Playground Express can be found here:

- https://www.adafruit.com/product/3333
- https://learn.adafruit.com/circuit-playground-lesson-number-0/take-a-tour

And one of the following part types for the output portion of their project (use as examples):

- Circuit Playground's built-in NeoPixel LEDs (10 total, RGB controllable)
- Circuit Playground's built-in speaker/buzzer
- (1) servo motor (for rotational motion): https://www.adafruit.com/products/169
- (1) vibrating motor (for haptic feedback): https://www.adafruit.com/product/1201

General suggestions:

- Creativity will be rewarded, but straight-forward projects will not be penalized. In other words, you can still achieve a high score with a "simple" solution that is well-executed.
- **Start early!!!**
- Take advantage of office hours.
- Use free tools to help coordinate and delegate work (e.g. Doodle polls for scheduling and Google Docs for shared document writing).
- Focus on getting the proof-of-concept system to work first, rather than spending all your time on polishing. The point is **to create a working solution**, not the world's most beautiful 3D printed part.
- Manage your time. This **project should not negatively impact** your other responsibilities (going to classes, studying, eating, sleeping, etc.).

Links (for inspiration):

- Sound-reactive LED array: https://youtu.be/c3DFLFITaG0
- Sound-reactive LED peace pendant: https://youtu.be/0NRY9WaExDg
- Sound-reactive servo motor: https://youtu.be/wk4SfIBNFKU
- Circular LED array: https://youtu.be/-3L8Nao3dus

Also, look for inspiration for different aspects of the project from other resources, e.g., YouTube and projects on the Adafruit website (https://learn.adafruit.com/).