Electronics Project (Engn 208, winter 2021): Detailed Project Proposal

Due: Tues, 16 Feb 2021, noon

System Overview: Aims, Objectives, Constraints

1. Describe the **aim** of your project. What are you building and what real world problem does it address?

2. Describe at least 2 **related designs**. Detail (at least) one novel element of your design.

2. What are **constraints** of your system? For instance, you might need to design an electronics system that fits multiple sensors within a 2x2x1 inch case affixed to a person's wrist.

4. What are **objectives** of your system design? These are attributes you want to maximize or minimize. These could be cost, power consumption, etc.

Electronics System Design considerations

1. **Sensors**: What physical quantities or attributes must your system sense? What sensors/instruments will you integrate into your design (e.g., temperature, resistivity/salinity, , acceleration, etc.)? How many of each sensor will you need? Identify potential parts/devices you can incorporate (recommend digging through the wonderful treasure trove of parts on Sparkfun and Adafruit)

2. **Actuators**: What actuators do you need? These could be speakers,motors, lights (LED strips), OLED/TFT displays, water pumps etc. Identify actuators you will need for your project.

3. **Data acquisition requirements**: What is the nature of the data that you need to record? How fast do you need to sample these signals? For instance, maybe you need to sample temperature and salinity every 30 min. Or maybe you need to sample 3 axes of linear acceleration plus 3 axes or rotational motion at 100 Hz (sampling period of 10 ms). Or maybe you need to record 1 megapixel images at intervals of 5 ms. Choose an appropriate microcontroller that is fast enough to accommodate your data acquisition requirements.

4. **Computational Demands**: Do you need to take running averages (relatively low computational overhead)? How about signal processing of multiple stream of data in real time (relatively high computation overhead)?

5. **Communication Protocols**: How will the various sensors and actuators be connected to the main microcontroller unit: analog readings? Digital transmission with SPI or I2C? Make sure the MCU you choose has a sufficient amount of each.

6. **Data storage requirements**: Do you need to log data for off-line analysis? If so, how much data do you have to store in units of bytes? If so, you'll need to log data using a microSD card or possibly in real time via a wireless connection.

7. **User interaction**: How does your user interface with the design? How do they reset the device or program it into different modes? Does the user need to see data in real-time? If so, how will they view it (on a pc via Bluetooth or LoRa)? On a small OLED/TFT display?

8. **Microcontroller Unit (MCU)/DevBoard**: Identify a microcontroller that has sufficient computation speed, communication protocols, and I/O ports to connect to your sensors and actuators. Strongly suggest Teensy (over Arduino); Adafruit Feather boards (integrates MCU + wireless communication all in one); ESP8266 thing (if you need wifi); Particle Photon (mesh networking); RasPi (if you need heavy duty computational power).

8. **Power Requirements/Source**: What are power requirements of your system, and how will the system be powered? Perhaps you have steppers motors that need a beefy power source (plug into the ac mains or a car battery?); or maybe you need a tiny coin cell that won't explode if water leaks in. How long must your system stay powered at bare minimum? What is the max current draw (units of mA)? What is the charge capacity of a battery to keep your system appropriately powered?

System summary overview: block diagram/circuit schematic

Given your responses above, provide a block diagram showing the system overview clearly indicating inputs (what is sensed or measured) and outputs (what motors rotate, what lights turn on or off, etc). It should specify the **individual components**, and detail how they are to be **integrated into the overall electronics system**. This is the 30,000 ft overview.

Bill of Materials

What individual parts will you need? Complete the table below for a Bill of Materials (BoM). An example is shown to help get you started. Be sure to LINK the part and specify part number (makes it easy to quickly load up carts and place orders). For Adafruit, look for "Product ID: xxxx". Note the total below. Please be mindful of your team's (initial) budget of $150. We will likely receive a bit more from the department, but be economical as you can.

Component Type	Use in system?	Vendor/Part # Linked URL	Quantity	Cost per unit ($) [nearest dollar]	Subtotal ($) [nearest dollar]
Pressure Sensor	Detect variations in water level and velocity	Sparkfun SEN-12909	2	60	120
Inertial Measurement unit	Measure linear and rotational acceleration	Sparkfun SEN-13762	1	15	30
Adafruit Feather LoRa radio	MCU + wireless dev board for sensor readings and wireless communication	Adafruit: 3178	1	35	35
LiPo Battery (3.7V; 2000 mAh)	System Power	Adafruit 2011	1	13	13
8 GB microSD card	Data logging	Bestbuy 4656701	1	5	5
TOTAL					203