UAF EE444/645, Spring 2023
Homework #1
Due *2/28/2023 (**Tuesday**) by 11:15 am*

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1. Starting from the project description (requirements) created by a virtual customer (you), prepare an informal team project proposal presentation (Power Point or compatible). The main purpose of this exercise is to formulate initial specifications for the project and to start a discussion that will lead to a final proposal. In your presentations and a short write-up, please address the following issues:
   - General project requirements (follow the guidelines given in the Design Process document).
   - General project specifications (follow the guidelines given in the Design Process document).
   - Existing solutions and their potential disadvantages in the context of this project.
   - Initial components selection (for example, which sensors you think would be suitable for this application).
   - Tentative timing (Gantt chart) – will be refined later.
   - Work distribution among partners.
   - What are the major obstacles to success that you have identified so far?
   - Briefly present each sensor that you are planning on using.
   - Interfacing issues – if you have enough information, try to address the types of interfaces that will be used by components (wireless, SPI, I2C, etc.), voltages, currents, etc.

The presentations should be informal, and since we have 4 groups, your presentation should not be longer than 15 minutes, to allow for transitions and some time for questions/discussion. You should take turns presenting. Each student should try to present the portion of the project that they will be responsible for. Obviously, nothing is set in stone yet, and changes are possible. **After each group presents, we will have a short discussion in a form of a Q/A session and brainstorming**.

One person from the group should bring their own laptop to present from. Please make sure that your presentations go smoothly. Test the equipment before the presentations begin.

2. Prepare a team draft project proposal (2 pages or so) following the formatting and content guidelines given in this assignment (Page 2). Your proposal should be in a MS Word format.

Dress code: ***casual***

Send me (draskovic@alaska.edu) your presentation, proposal, and, if applicable, the link(s) to the datasheet or website describing each sensor/component you selected.

Your email messages to me **must** contain **EE444 or EE645** in the subject.

Reverse Bop-It

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Overview

Our embedded system is named the "Reverse Bop-It" because rather than being told what to do and acting on that instruction we use multiple different sensors to provoke a response from the system. At a basic level, the user will tilt the microcontroller and a message will be output on the LCD screen acknowledging the change in positioning. This message will be output in either white or black lettering depending on the amount of light in the room similar to that of a smartwatch or fitness device.

Requirements and Specifications

The Reverse Bop-It is an embedded system with the capability to display a message on the LCD corresponding to inputs such as pushing a button, tilting the board, and shaking the board. The LCD board should be able to display "Don't poke me!" when the button is pressed. It should also be able to display "Put me down!" when the board/three-axis accelerometer is tilted or when the accelerometer senses the change in g-force on the sensor. It will display "Stop shaking me!" when the board/three-axis accelerometer is shaken due to it sensing the change in forces.

The inputs consist of the button and the analog data from the accelerometer; the accelerometer would be measuring at a specific sampling rate the change in g-force of the sensor when the device is tilted and the threshold will be determined by the corresponding calculated angle of the tilt. While "shaking" the device both the g force and the rate at which it changes will be measured at a specific rate. For all input the LCD board will display the corresponding message (digital). The LCD display has a resolution of 138 x 110, 4-level grayscale pixels and a built-in backlight driver that can be controlled by a PWM signal from the MSP430F5438. For the performance of the system it needs to be capable of being in sleep mode when not moving or when the button is not pressed. Once the button is pressed it needs to display the message on the LCD board for approximately 30 seconds before it goes back to sleep. Once the LCD board is moved, it needs to stall for a bit to determine whether or not it's reaching the required thresholds for either being tilted or shaken, then it should display the corresponding message again for roughly 30 seconds while ignoring other interrupts during that time and going into sleep mode after performing the singular interrupt until the next interrupt occurs.

The components for the embedded system will consist of only devices that are available to us in the lab so there will be no additional cost to the components. The device will likely be powered by the computer but we may consider using a battery if the cord connecting the board to the computer gets in the way of moving the board around. If batteries are used the amount of power will have to be determined by measuring the current draw from the MSP430 and calculating the power needed.

Components and System Design

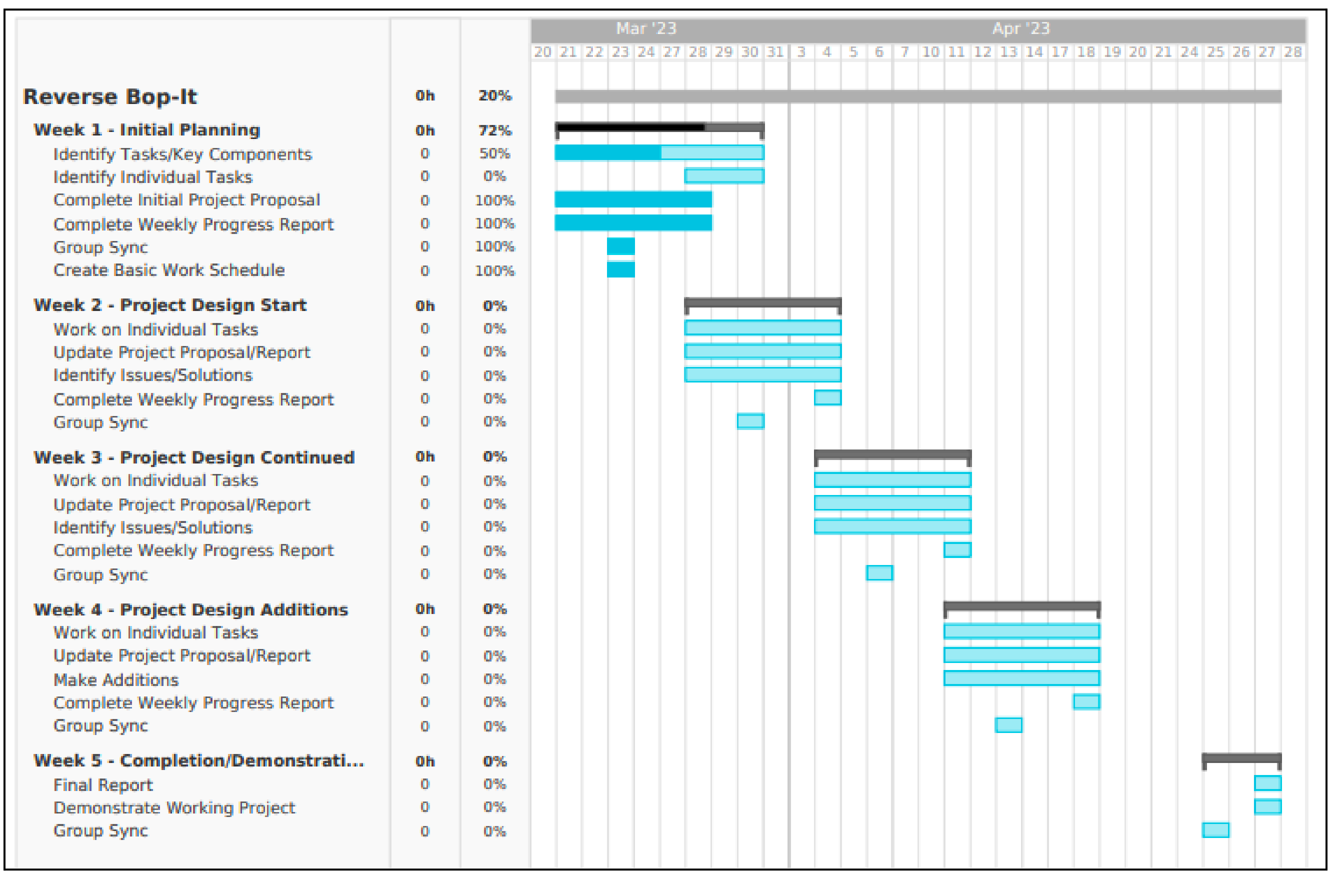
- Mini Photocell
- Triple Axis Accelerometer Breakout Board - MMA8452
- MSP430F5438A Experimenter Board

- CrossStudio for MSP430
- TeraTerm

Difficulties

We are planning to incorporate many different components which may make time a difficult constraint. To overcome this we have designed a base idea which requires fewer components but can easily be built upon and added to if time permits. Additionally, some of the components such as the triple-axis sensors will need to move according to the microcontroller, requiring a way to attach them so the readings and resultant outputs are accurate. All members of the team have busy and conflicting schedules so finding time to have group syncs will also be difficult. To overcome this we will utilize the overlapping lab and class time available to go over updates, ideas, and issues. There also may be issues with ensuring the program performs the correct outputs for the corresponding inputs. This includes concerns over whether the accelerometer can differentiate between the “tilting” and “shaking” actions and ensuring that even though multiple inputs can occur at once, only one output (LCD screen message) can occur at a time.

Project Plan



References (in the IEEE format, examples given below)

[1] E. A. Lee, “What’s Ahead for Embedded Software?” *IEEE Computer*, vol. 33, num. 9, pp. 18-26, Sep. 2000.

[2] A. S. Guy. (2012, Jan). AP23XM13 3D Smell Detector. Sensor Company, CA. [Online]. Available: http://sensorcompany.com/doc/smelldetector.html

[3] Texas Instruments Inc. (2010, Oct). MSP430F5438 Datasheet, Rev. B. [Online]. Available: http://www.ti.com/lit/gpn/msp430f5438a