Project Charter

Project Overview

The goal of our project is to test out different underwater sensor designs to get an idea of what works best. The sensors will be placed on coral reefs by divers, and will collect information about the depth at which it is placed. It will be able to display this data to divers in real time, and also store the information to be transferred later.

Our project falls within the greater context of the 100 Island Challenge, headed by the Scripps Institute of Oceanography. The 100 Island Challenge is a project that is collecting photographic, geographic, and oceanographic data in order to build models of coral reef communities around the world, and track their changes in structure and growth over time. Long term, they are seeking a sensor that collects many different types of data - not just depth. For now, we will be focusing on just a basic depth sensor and try out different components so we can see how they perform. Scripps will test out our basic models of the sensor and give feedback to the full time team working on the project.

Project Approach

Team Members:

- Samuel Givens, Software Developer
- Xuanyi Yu, Hardware Designer
- Liren Chen, Hardware Assembler

The approach falls into three main steps. First, we will design a hardware platform which integrates depth sensor, microcontroller, LEDs/e-ink and other necessary modules. Second, we will program the microcontroller. After that, we simulate the program and then test it on our board. Third, we pot the whole device and make it waterproof. We will follow this flow for 2-3 iterations and see which version works best. For the first iteration, we make sure that the very basic function is available, including depth/heading measurement and display. Then for the second/third iteration, it will integrate more modules that meet other requirements, such as wireless data transformation and data storage.

Project Objectives, Milestones and Major Deliverables

For this quarter, our main objective is to develop 2-3 fast iterations of different design that can meet the minimum requirements:

- Waterproof
- Measure the depth/heading and display it
- Ability to turn on/off
- Rechargeable
- Reprogrammable

- Average the depth over a longer period to eliminate the influence of noise
- Detect when to start/stop averaging the depth

As for the potential longer term, a more robust version needs to be developed with some additional requirements:
- Ability to collect multiple types of data
- Ability to save the depth data for backup

Major Deliverables
- By the end of week 5, we will finish the first iteration which is able to measure the depth/heading, display the data.
- By the end of week 7, we will finish the second iteration which is able to turn on/off and rechargeable.
- By the end of week 9, we will finish the third iteration which is able to save and transfer the data.

Constraints:
- Cost: The device should be cheap enough(less than $100) to be able to widely distribute to our collaborators.
- Time: We must complete our project by the end of the quarter.
- Reusability: The device must be rechargeable and reprogrammable
- Working Conditions: The device must be waterproof, durable, and have enough battery life to last an entire day

Risks:
- The biggest risk is that we run out of time. We have set an ambitious goal of 2-3 prototypes within one quarter. To avoid the risk of running out of time and to make our goals more feasible, we have stripped much of the functionality of the sensor tile down to a very basic model that should be easier to produce
- There is a risk that we cover the depth sensor with epoxy when waterproofing it. If this happens, we will have to take it apart and install a new depth sensor and get a new batch of epoxy ready. In order to avoid this mistake, we will be extremely careful when waterproofing the device

Group Management

Among the 3 of us, decisions will be made by consensus. However, we will likely defer judgment to whoever has the most expertise on the subject of the question. All of our decisions will be in compliance with the direction and decisions of Eric Lo, the staff engineer. We will schedule our meetings via text, and collaborate on projects in person in CSE common spaces using Git and Google Docs. We have set a schedule for our milestones and broken them down into smaller pieces, so we will know that we are off schedule if we deviate from that plan. If we fall behind our schedule, we will have to assess whether our reason for falling behind is a one-off or if it is because our schedule is too ambitious. If we find that we have set an unrealistic schedule, we can modify it. However, for one-off slips, we can get back on schedule by putting extra hours in for the project. All 3 of us rely on each other to complete the milestones given our different areas of knowledge, so we will all be responsible for their on-time delivery.

Project Development

1. Hardware Development
    a. MCU: We choose Arduino board (with STM32 chip) as our micro-controller. These two platforms have a large community. There are lots of Arduino-compatible breakout boards and codes for us to speed up the development process.
    b. We will build our first prototype with breadboard and breakout boards. These boards are highly modularized and easy to plug-in. We can build this prototype in a few days and develop our code on this platform.
    c. In parallel with the breadboard prototype. We will build 1 to 2 models in each iteration. These models are sealed in epoxy and highly water-proof. These models should be ready for underwater tests.
2. Software Development
    a. As our board is compatible with both Arduino and STM32, we could choose either for software development. We will use Keil MDK IDE and STM32 tool kit for writing and loading the code.

Project Schedule

1. Iteration 1: Week 3 to Week 5
    a. In the first iteration, we will get familiar with the whole working pipeline. We will build 1 or 2 models in parallel. These two models are built based on breakout boards.
    b. The first iteration will integrate depth sensor, magnetometer(for headings), display and leave socket outside for power.
    c. Week 3: List all materials for the prototype and buy them.
    d. Week 4: Assemble hardware (soldering, sealing with epoxy) and develop software in parallel.
    e. Week 5: Download the software into the hardware and test them all.

2. Iteration 2: Week 6 to Week 7
    a. In the second iteration, we would integrate the power module into the tile, including a waterproof switch mechanism and a wireless charging module. Printing PCB is needed for the second iteration.
    b. Week 6: Assemble hardware.
    c. Week 7: Hardware+software debug.

3. Iteration 3: Week 8 to Week 9
    a. In the third iteration, we would integrate storage module (SD/EEPROM), RTC module and wireless transmission module.
    b. Week 8: Assemble hardware.
    c. Week 9: Hardware+software debug.