Prince William Sound Profiler Communication Module

ECE 4873 Senior Design Project
Aquanuats

Introduction

- 1989 Exxon Valdez oil spill caused environmental damage
- Since 2013 an autonomous moored profiler (AMP) has collected data on PWS recovery
- Profiler needs modifications/updates
- Goal: design new communication module for existing profiler
- Module can send data from profiler sensors to scientists
- Centralized data storage in module
- Requesting $400, preliminary cost estimate is $183.78
    - PCB printing cost, other components, and shipping will increase cost

Project Description and Goals

- 2 main customer requirements, 2 auxiliary requirements:
  - Higher data transfer volume and speed (M)
  - Longer battery life (M)
  - Updated central memory and processing (A)
  - Improved profiling ability (A)
- How we will address each:
  - Revamp comms utilizing the nearby 3G cell tower and updated data transfer rates. Current - 9600 baud, proposed 56,000 to 114,000 baud (Arduino GSM shield specs)
  - One main sensor module operating on separate winch. This will accomplish two things:
    - Better battery life - reduce use of larger anchoring winch by only surfacing the sensor module for comms
    - Ability to profile on the way down by preventing water wash through profiler
  - Updated memory and processing unit to replace outdated/no longer manufactured Persistor

Technical Specification

Table 3. Technical Specifications

Specification	Min	Max
Functional Temperature	-5 C (** Datasheet says 0)	30 C
Functional Depth	N/A	100m
Total Power Consumption	9 Vdc, 1.01 A (** Missing min amp info for RBR Brevio)	14 Vdc, 1.67 A (**Missing max amp info for RBR Brevio)
Communication Range (Approx)	100m (Operating depth + realistic estimate of surface buoy distance)	8000m (Nearest cell tower, approximately 5 mi.)
Communication Frequency	GSM 850 MHz for remote 3G compatibility (869.2 – 893.8 MHz) **Other available frequencies**: E-GSM 1900 MHz, DCS 1800 MHz, PCS 1900 MHz	

Design Approach and Details

- Smaller Module
  - Design
    - Connected to power supply via a long cable
    - Aquanauts focus is on technology inside module and not the enclosure
  - Pros
    - Will save battery life
    - Safer than using a buoy
  - Cons
    - May not surface properly to send signals
- Centralized sensors
  - Design
    - Currently using outdated persistor
    - New microcontroller- Arduino Mega
  - Pros
    - Update older sensor
      - Allow for replacement
  - Cons
    - Added Cost

Design Approach and Details Cont'd

- Data Transmission
  - Design
    - Considered Satellite and Radio
    - Nearby 3G cell tower
    - Arduino GSM 1400 Cellular Kit
  - Pros
    - Currently in use
    - Easier to test
  - Cons
    - Doesn't work if module doesn't surface

Codes and Standards

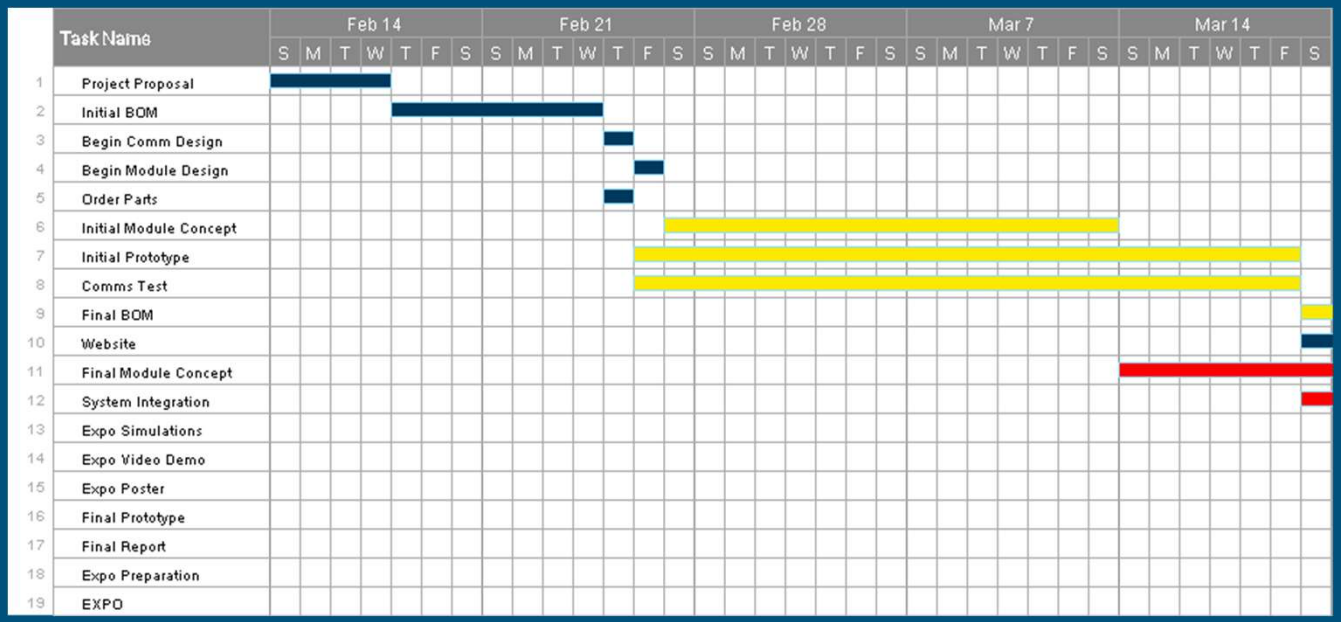
- IP69K: Ingress Protection rating that states that the device will be dust-tight and will be protected against complete, continuous submersion.
- The Research Vessel Safety Standards (RVSS) states that the tension in the rope must be monitored at the operator’s station with a resolution of a certain frequency depending on the factor of safety.
- 802.15.4-2020 - IEEE Standard for Low-Rate Wireless Networks: The standard provides for ultra low complexity, ultra low cost, ultra low power consumption, and low data rate wireless connectivity among inexpensive devices.

Project Demonstration

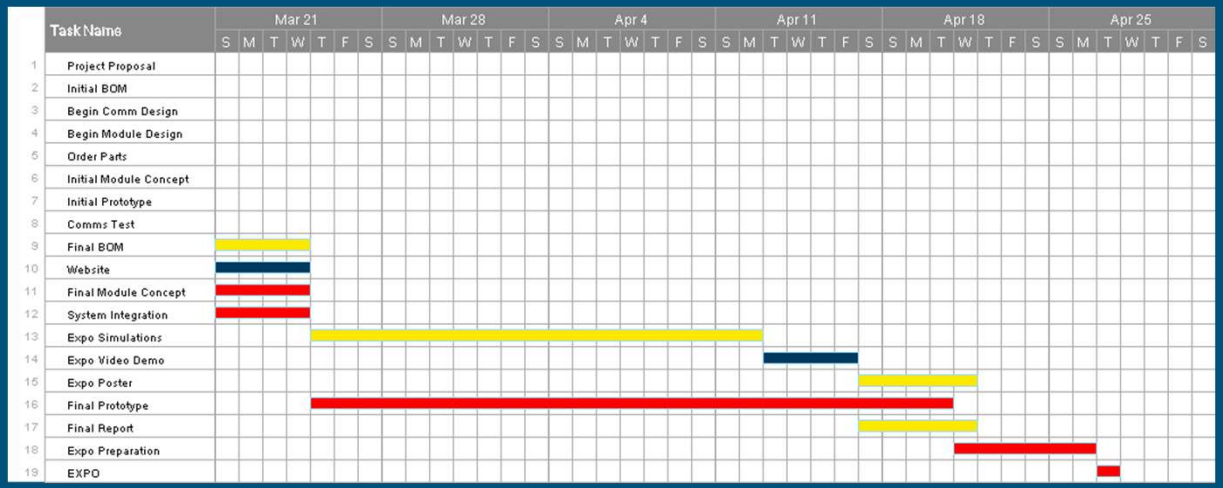
- Verification and Validation
  - Software simulation and physical testing with the final prototype (Inspect, Demonstrate, Test)

- Expo
  - Poster, Video, Prototype Demo
    - Present simulation results in a descriptive manner
    - Video demo for features not easily demonstrated during the Expo
    - Physical prototype

Schedule, Tasks, and Milestones Pt. 1



Schedule, Tasks, and Milestones Pt. 2



Chance of Success: 95%

Marketing and Cost Analysis

Some similar products on market

- DSPComm underwater acoustic modem
  - Used underwater
  - Transmit signal 3 km away
- MarineLabs CoastScout
  - Long range communication buoy
  - 5 MB wirelessly
  - Use of buoy isn't optimal due to boat traffic and weather conditions

Preliminary BOM

Part	Quantity	Manufacturer	Retailer	Price per Item	Total
Arduino Mega 2560	1	Arduino	Arduino	$40.30	$40.30
Arduino Slm MKR GSM 1400 Cellular Kit	1	Arduino	Newegg	$119.69	$119.69
PRO Plus SD Card 32GB	1	Samsung	Amazon	$9.99	$9.99
MKR SD Proto Shield	1	Arduino	Arduino	$13.80	$13.80

Current Status

a. Designing a new centralized storage component for data - IN PROGRESS
b. Designing a system that will send data to the research facility over a cellular connection - IN PROGRESS
c. Designing software programs for components listed above - INCOMPLETE
d. Creating a full BOM - IN PROGRESS
    i. Order parts - INCOMPLETE

Leadership Roles

- Group Leader: Jim O’Donnell
- Expo Coordinator: Shayna Seidel
- Financial Advisor: Seungju Jason Lee
- Webmaster: Ruben Quiros
- Documentation Coordinator: Timothy Pierce
- Tech lead: Shelby Crisp