Divide and Conquer

February 14, 2020

Bottom Feeder

Fig 1: Florida aquatic scene

A remotely operated underwater vehicle that de-risks aquatic exploration and assists in locating and recovering personal effects.

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Group 2

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2.0 Project Narrative

Living in Florida, our lives are deeply entwined with the water. Many of our hobbies, our recreations, our professions, and our stories touch the waves at some point or another. Florida's key location at the southeast point of the nation, and it's peninsular geography combine to create an environment that draws visitors from around the globe for reasons spanning business and pleasure.

Our motivation in creating a submersible robot is to alleviate some of the drawbacks to our watery way of life. Jewelry, keys, and keepsakes are liable to be lost at beaches. Repair and maintenance of boats and submerged structures can be delayed if a tool or critical component slips out of a technician's hand and buries itself in the silt below. We are creating an ROV capable of finding and recovering objects from sandy bottomed waterways. This will be achieved through the use of a metal detector and vacuum assisted shovel for an aquatic robotics platform.

Control and interaction with the device will be facilitated by a camera system linked with a head mounted display. With a low-latency connection, users will be able to look around from the robot's perspective, independent of machine orientation. The machine will be aware of its orientation and position and actively stabilize itself with thrusters. The operator will be able to use an off the shelf gaming controller to direct the general movement of the machine, while the operating system will manage the motors to accomplish that locomotion. The systems will also support headlights.

In addition to metal detection, the ROV will be equipped with other sensors to improve its functionality as well as helping gather information about the surrounding waters. Functional sensors would include those that would enable our bot to maintain proper orientation, depths, and speeds while it traverses through the water. Information gathering sensors will collect pH, conductivity, radiation, and temperature measurements to better monitor the encompassing body of water's health.

The ROV will have an array of thrusters for movement. The controller on board the submersible will be able to use motion sensors to stabilize itself, allowing the operator to control the machine behind a layer of abstraction. Through a controller, the operator will command the machine to perform translation and rotation operations. Within the submersible, it will manage whichever thrusters may have to work together to perform those operations faithfully.

In general, not only is it much safer to deploy an unmanned vehicle under water but, given that ROV's can stay underwater longer than your average diver, it's also more time efficient. Our vision is to eliminate the need for human divers to enter our waterways to retrieve lost valuables and gather information, making for much more effective subaquatic exploration.

3.0 Requirements Specifications

Stereo camera:

- Provide 180 degree visual feedback to an operator above water
- 1080p video resolution for real time video feedback and video recording

Battery:

- 1 hour lifetime
- Easily accessed by customer

Metal detector:

- Has a maximum detection range of at least 6 inches
- Has a maximum depth rating of 30 meters

VR Headset:

- Capable of displaying 1080 video feed from cameras underwater
- Able to look around in 180 degrees
- Shows feedback from onboard sensors
- Battery charge displayed

Handheld controller:

- Controls all horizontal translational, vertical translation, and rotational movement.

Onboard Controller:

- Receives input instruction from handheld controller and sends power to the appropriate thrusters and ballast tank.
- Receives data from inertial measurement unit and other sensors
- Transmits sensor data to headset
- Emergency float system in case cable disconnects from ROV

Sensors:

- 3 axis gyroscope with ±2000 degrees per second dynamic range
- 3 axis accelerometer with ±4g acceleration range
- 3 axis magnetometer ±1000μT magnetic field range
- Depth gauge accurate to 5mm
- Total Dissolved Solids with a range of 0-1000 parts per million
- Temperature sensor accurate to 0.1 degrees F
- pH sensor accurate to 8 bits
- Geiger counter accurate to ±20%

Collection Device:

- Can collect an item under 6”x6”x6” and under 5 pounds

Housing:

- Water resistant up to maximum depth of 30 meters

Motors:

- Capable of moving the ROV at 5 knots forwards and backwards
- Can turn the ROV completely around in 3 seconds
- Can change the pitch by 30 degrees in 1 second

Constraints:

- All electrical components need to be in an airtight enclosure to avoid contact with water
- Outside components need to be corrosion-resistant
- Size of the body or function of the vacuum/metal detector/appendage that picks items up needs to account for narrower areas
- Metal detector must be able to work in both fresh and saltwater
- Metal detector must not interfere with ROV's electrical or metal components
- A tangible, cost-efficient product must be made in two semesters

4.0 Block Diagram and Illustration

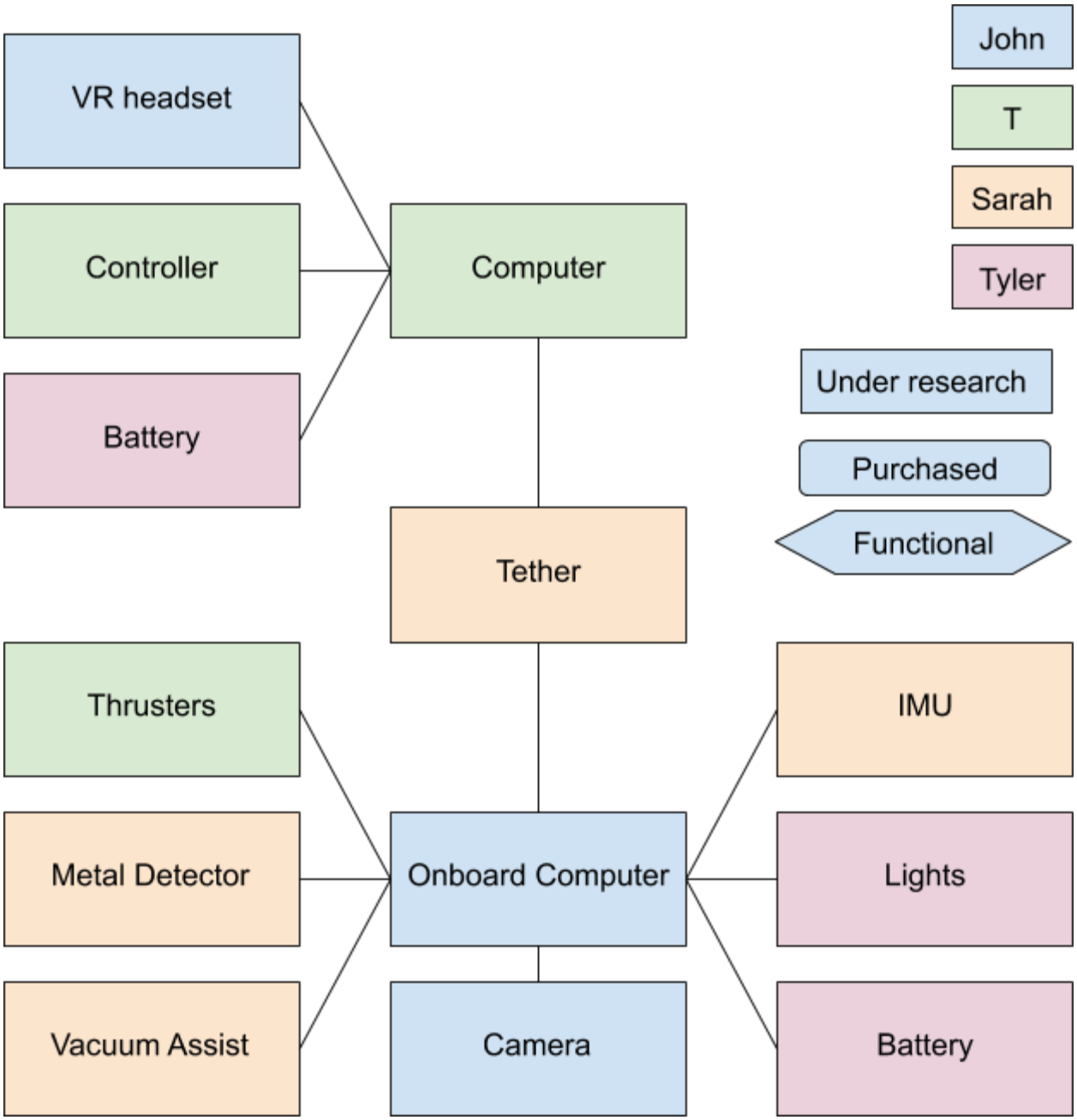

Fig 2: Block Diagram of system with task assignments

5.0 Estimated Project Budget and Financing

Item	Cost
Camera	$125
Raspberry Pi (2)	$80
Microcontroller	$30
Battery	$30
Handheld Controller	$40
Inertial Measurement Unit	$30
Motors	$100
Metal Detector	$100
Tether	$100
FPV Headset	$120
Frame	$50
Printed Circuit Board	$30
Electronics Enclosure	$20
Total	$855

Table 1: Project budget

6.0 Project Milestones

Spring Semester	
Task	Deadline
Divide & Conquer 1.0	01/31/20
Divide & Conquer 2.0	02/14/20
Milestone 1 - Finalize Project Idea & Requirement Specifications	
Order Parts	02/21/20
60 Page Draft	03/09/20
Parts Tested	03/20/20
Order PCB	03/27/20
100 Page Draft	04/02/20
Order New Parts If Needed	04/10/20
Final Document	04/13/20
Milestone 2 - Finished Research & Produced Final Document	
Summer Semester	
Task	Deadline
Final Parts Check	05/15/20
Order Parts If Needed	05/22/20
Build Prototype	TBD
Test Prototype	TBD
Milestone 3 - Working Prototype	
Final Presentation	TBD
Milestone 4 - Graduation	

Table 2: Project milestones

7.0 House of Quality

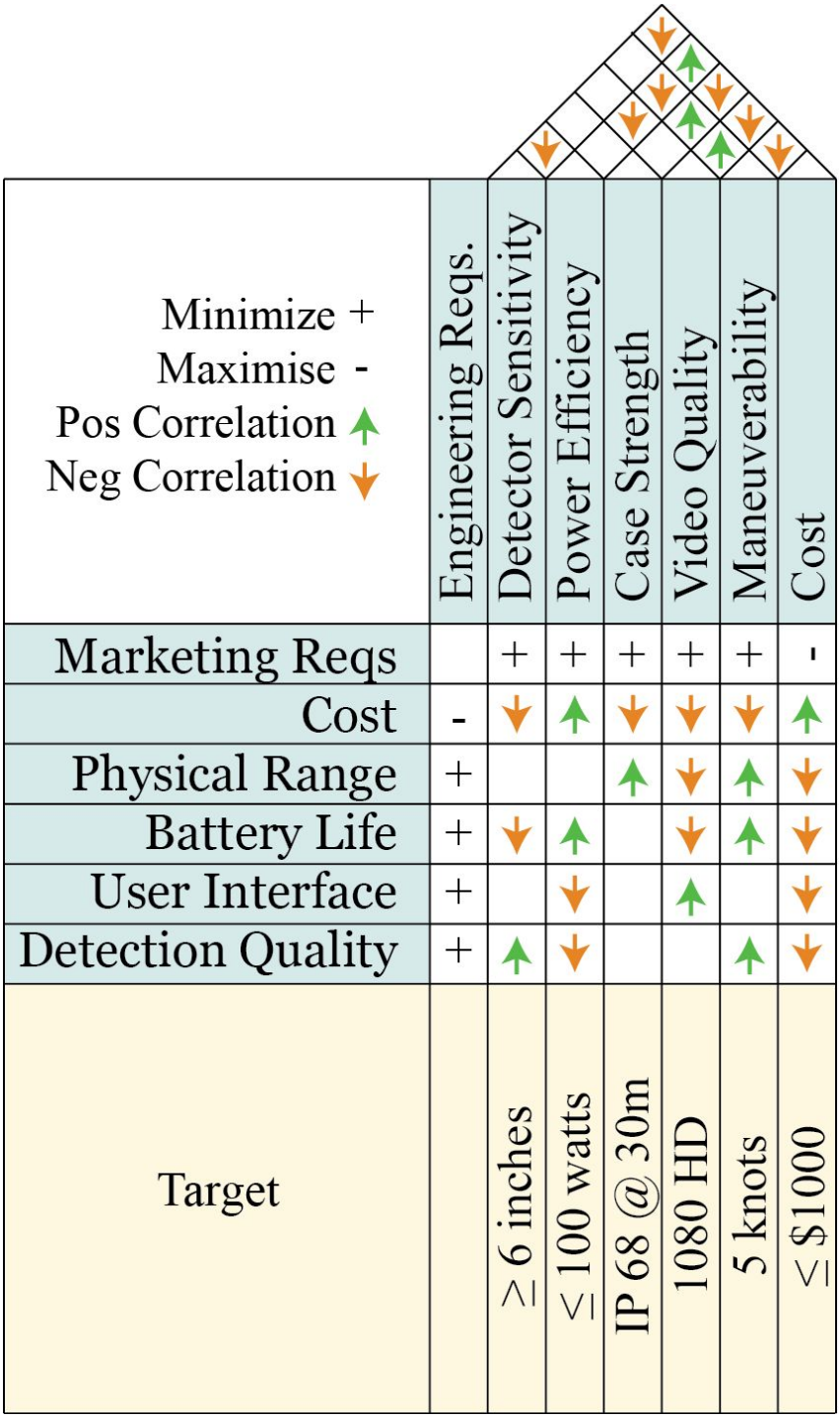

Fig 3: House of quality