R/C Water Quality Buoy Bot

Initial Documentation

Fall 2013

UCF
50
YEARS
1963—2013

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I. Personnel

Group Members	Sponsors/Significant Contributors

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	To be determined.

II. Project Description

The state of Florida is not only surrounded by water on three side, but also contains more than 30,000 lakes that cover a little more than 3 million acres of land. Water is an essential requirement of life for many different species. Unlike other species, humans also use water for recreational and leisurely activities. There are many water sports, competitive races and other activities that exist in today's society. Of course, humans do not have complete control over the water and they must share with the other natural inhabitants. Most of these other inhabitants can be relatively harmless but some can be very dangerous to the human body. Perhaps the most frightening of all is the brain-eating amoeba. This amoeba is particularly dangerous to smaller children.

On August 3rd, 2013 a little 12 year old boy contracted a deadly amoeba called Naegleria Fowleri, by swimming in a closed freshwater body of water. This amoeba thrives in warm waters and hot springs, often leaving people weary and discouraged about swimming in freshwater lakes and fully enjoying their warm weather summer. However, by precisely measuring the water temperature we are able to take the proper preventative measures in tracking this amoeba. When the temperature reaches near 25 °C/77F the amoeba becomes active and begins to reproduce.

The goal of this senior design project is to make it easier for any outdoor enthusiast to test the water for safe and comfortable conditions. We will achieve this by measuring the water temperature, as well as pH levels, conductivity, dissolved oxygen and the oxygen reduction potential of the water. The user of the Buoy Bot will be able to stay safely on shore while using a RC controller to maneuver the Buoy Bot to take samples in different areas of the fresh water body. The Buoy Bot will then wirelessly transmit the gathered data to a portable display the user has on shore. Creating this system will help scientists and outdoor enthusiasts gather precise data on anybody of freshwater.
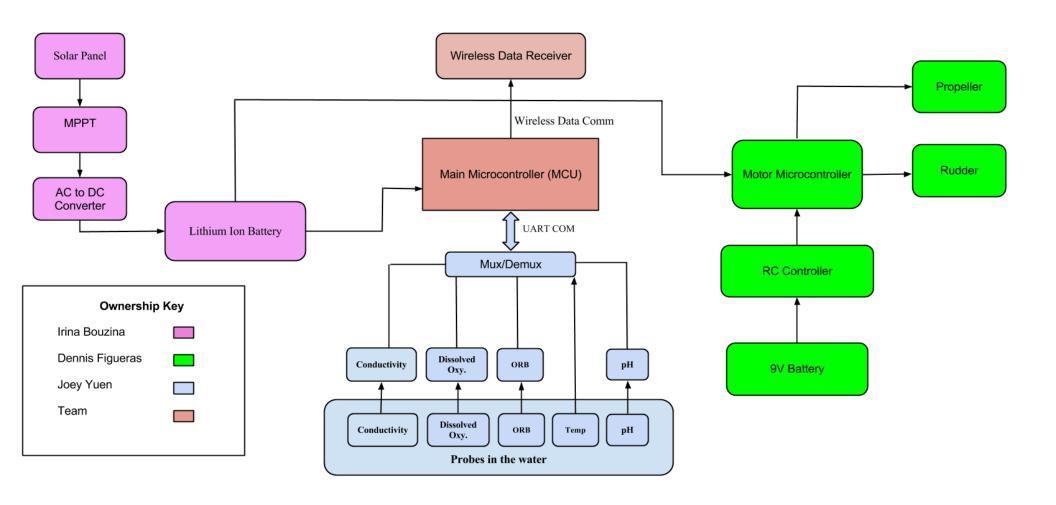
Instead of having people go in the water and find out that it is unsafe or uncomfortable for use when it is too late, our project will sample the water numerous times throughout the day. With each sample the system will check for temperature, pH levels, dissolved oxygen, ORP (oxidation reduction potential) , and conductivity of the water. The temperature of the water is important for any human who wants to go and enter the water. If the water is too cold or hot, the sudden change in temperature could negatively affect the human body. pH levels could also negatively affect humans. If the pH levels are too acidic and someone accidently digests the water, organs can be damaged and muscle soreness may occur. When there are too many bacteria

or aquatic animal in the area, they may overpopulate, using dissolved oxygen in great amounts. In order for water to be able to conduct, minerals and salts must be dissolved in the water, as the concentration of dissolved solids increase so does the conductivity of the liquid, thus conductivity can be used to measure the purity of the water. ORP is a measure of the cleanliness of the water and its ability to break down contaminants.

III. Specifications & Requirements

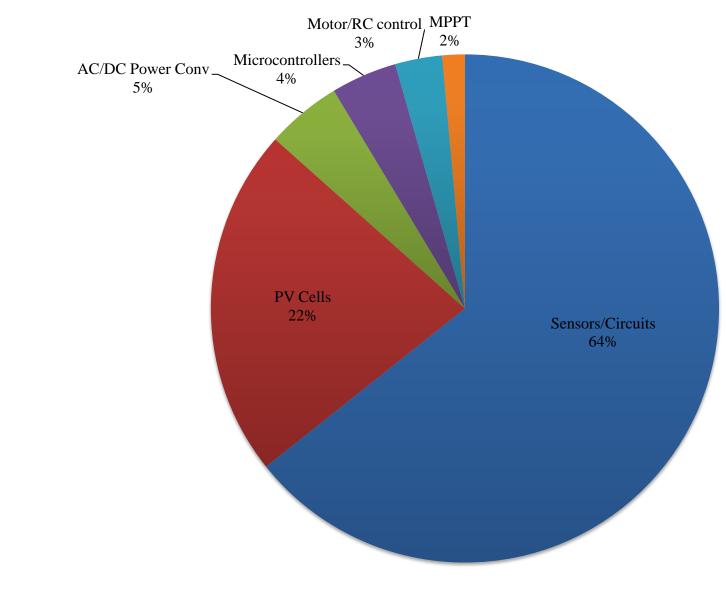| Req. ID	Requirement Text
BB-001	The Buoy Bot shall operate within 150 meters of the main receiver tower.
BB-002	The BB microcontrollers shall operate off lithium ion batteries which are connected to solar panels.
BB-003	The BB probes shall operate off lithium ion batteries which are connected to solar panels.
BB-004	The BB navigation system shall operate off lithium ion batteries which are connected to solar panels.
BB-005	The BB remote control shall run off 9V alkaline batteries.
BB-006	The BB shall measure water temperature with an error no greater than ± 1°C.
BB-007	The BB shall measure dissolved oxygen with a range 20 mg/L.
BB-008	The BB shall measure pH levels of freshwater on a scale of 0-14.
BB-009	The BB shall measure Oxidation Reduction Potential with a range of ± 2000 mV.
BB-010	The BB shall measure Water Conductivity in microsiemens.
BB-011	The dimension of the BB shall be at most 1x1x1 ft.
BB-012	The sensors on the BB shall be connected to one microcontroller.
BB-013	The BB shall wirelessly transmit data to a device on shore.
BB-014	The BB shall have one main microcontroller to gather all data for transmission.
BB-015	The BB shall be able to stay in water indefinitely.
BB-016	The BB shall be optimized for freshwater use only.

IV. Project Block Diagram

V. Project Budget and Financing

The cost of parts will be split evenly between the group.

Part	Cost Per Unit	Quantity	Total Cost
Scientific Grade Silver / Silver chloride pH Sensor ------------------------------- Circuit	$60 ------------------------------- $28	1	$60
Field Ready Temperature Sensor	$18	1	$18
Dissolved Oxygen Sensor ----------------- Circuit	$160 ----------------- $33.00	1	$193
ORP Sensor ------------------------------- Circuit	$90.00 ------------------------------- $28.00	1	$118.00
Conductivity Sensor ------------------------------- Circuit	$105.00 ----------------------------- $43	1	$148.00
MSP430 Ultra Low Power Microcontroller	$9.99	3	$29.97
Diode	Free*	4	$0
PV Cells	$146.00 + $40(Shipping)	1	$186
Lithium-Ion Battery	$45.00	1	$45
MPPT	$12.00	1	$12.00
AC to DC Power Converter	$40.00	1	$40.00
RC Control	$15.00	1	$15.00
Motor Microcontroller	$5.00	1	$5.00
Rudder**	$.0.00	1	$0.00
Propeller	$5.00	1	$5.00
Motor	$10.00	1	$10.00

*Free samples offered by TI.
** Handcrafted.

Project Budget and Finance

- Sensors/Circuits 64%
- PV Cells 22%
- AC/DC Power Conv 5%
- Microcontrollers 4%
- Motor/RC control 3%
- MPPT 2%

VI. Project Milestones

	ⓘ	Task Mode	Task Name	Duration	Start	Finish
0			◢ **Senior Design Project Plan**	**157 days**	**Mon 9/23/13**	**Tue 4/29/14**
1		📌	Research PV Cells and Wireless transmission	7 days	Mon 9/23/13	Tue 10/1/13
2	🧍	📌	Research Microcontrollers/Motor	7 days	Mon 9/23/13	Tue 10/1/13
3	🧍	📌	Research Water Quality Probes	7 days	Mon 9/23/13	Tue 10/1/13
4		📌	Meeting to consolidate research/outline Design Paper/Sponsors	1 day	Wed 10/2/13	Wed 10/2/13
5		📌	Begin Design Paper/Continue Research	7 days	Thu 10/3/13	Fri 10/11/13
6		📌	Meeting for Design Paper	1 day	Sat 10/12/13	Sat 10/12/13
7		📌	Continuation of Design Paper/Research	7 days	Sun 10/13/13	Mon 10/21/13
8		📌	Learn Eagle PCB Software	7 days	Mon 10/14/13	Tue 10/22/13
9		📌	Design Solar Panel/Power Management	21 days	Sat 10/19/13	Fri 11/15/13
10		📌	Design Navigation/Control system	21 days	Sat 10/19/13	Fri 11/15/13
11		📌	Design Water Quality System	21 days	Sat 10/19/13	Fri 11/15/13
12		📌	Finish and refine Design Paper	7 days	Sat 11/16/13	Sat 11/23/13
13		📌	Finalize Parts list and order parts for SD2	2 days	Mon 11/25/13	Tue 11/26/13
14						
15		📌	Winter Break	19 days	Wed 12/11/13	Sat 1/4/14
16						
17		📌	Begin SD2/Take inventory of ordered parts	1 day	Mon 1/6/14	Mon 1/6/14
18		📌	Design Software/Test	21 days	Tue 1/7/14	Tue 2/4/14
19		📌	Prototype Solar Panel	14 days	Fri 1/24/14	Wed 2/12/14
20		📌	Prototype Navigation/Control System	14 days	Fri 1/24/14	Wed 2/12/14
21		📌	Prototype Water Quality System	14 days	Fri 1/24/14	Wed 2/12/14
22		📌	Test/Debug Solar Panel	21 days	Thu 2/13/14	Thu 3/13/14
23		📌	Test/Debug Navigation/Control System	21 days	Thu 2/13/14	Thu 3/13/14
24		📌	Test/Debug Water Quality System	21 days	Thu 2/13/14	Thu 3/13/14
25		📌	Integrate whole system	14 days	Sat 3/15/14	Wed 4/2/14
26		📌	Test whole system	15 days	Thu 4/3/14	Wed 4/23/14
27		📌	Finalize Documentation/Presentation	9 days	Sat 4/12/14	Wed 4/23/14
28		📌	Presentation	5 days	Wed 4/23/14	Tue 4/29/14