FAMU-FSU College of Engineering
Department of Mechanical Engineering

UPDATED SCOPE AND PROJECT PLAN
and
UPDATED PROJECT REPORT

EEL4914C/EML4512C– ECE/ME Senior Design Project II

Project title: FAMU-FSU RoboSub

Team #: 21

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Project Executive Summary

The main objective of the FAMU-FSU 2012 RoboSub Team is to participate in the AUVSI Foundation and ONR's 15th International RoboSub Competition. The competition is held in the TRANSDEC pool in San Diego, California and consists of a practice round, a first round, and a final round. The judges will also check that the AUV is within the size, weight and density restrictions that have been set forth. Once the AUV has been cleared by the judges it will then be allowed to compete in the competition.

In each competition round, the AUVs will be expected to follow paths, identify and pass through underwater gates, bump into colored buoys, pick up objects, fire torpedoes at specific objects, breach at specific points, and other things. All these activities will be performed while completely submerged unless permitted or required by the competition rules. The AUV is to be completely autonomous and may not have any communication with the team or any other source during the competition.

The first semester of the project was spent redesigning the robot to be more usable in the upcoming competition. Attention was giving to the accessibility of the interior electronic components, the lack of which hampered progress by last year's team. The entire hull and frame were redesigned and submitted to the machine shop for manufacture by mid-December.

In addition, a number of electronic components have been replaced, redesigned, or added. The power system was redesigned to be more stable and minimize potential damage to sensitive electronics. An additional Arduino was added to improve control capabilities. Time was also spent coordinating how these various components would communicate with each other and process data. In addition, preliminary tests were performed to verify that all components functioned as expected and satisfied requirements.

The spring semester will focus on extensive testing and programming of intelligence and behavior. Early on, the newly manufactured hull and lid will undergo waterproofing tests. Concurrently, progress will be made on object and color recognition, actuator control, and IMU data interpretation. After the subsystems have a sufficient level of functionality, they will be combined to put the AUV through practical testing. At this point, the group will be working to refining the behavior, stabilizing the AUV in water, and debugging other possible issues.

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1 Scope

This project deals extensively with mechanical, electrical, and computer areas of engineering. The design of the hull dealt with the consideration of materials and forces acting on the Robosub to ensure its operationality. Electrical and computer engineering are needed to connect, power, and communicate the software and operating mechanism that are required to complete the tasks. Overall this a large project to undertake considering the need to redesign the operating system and hull design of the Robosub.

2 Goals and Objectives

This semester, the team's primary goals are to improve the product produced by last year's Robosub team. To this end, the team aims to manufacture a device which is able to complete as many of the AUVSI competition tasks as are feasible.

Please note that these requirements have been updated since the previous version of the project report to reflect the recently released 2013 competition guidelines. The current course tasks, released by the AUVSI Foundation on Sunday, January 13, 2013, are summarized as follows (tasks are from last year unless stated otherwise):

1. Path following
2. Bumping colored buoys upon receipt of signal
    - AUV will now wait for visual signal to perform this task
3. Dropping markers in bins
4. Firing torpedoes through colored shapes
5. Object manipulation
    - New, the AUV will now have to perform a different manipulation as well: turning a spoked wheel and pulling a lever
    - From last year: picking up and transporting a wreath

6. Locating a pinger

The team has tentatively recognized that fully realizing all of these tasks is likely to be an overly ambitious undertaking. Historically, very few teams, if any, have been able to complete the entire AUVSI course; as such, the team expects to be able to perform admirably in this year's competition without completing the course guidelines. The team presently aims to complete as many of the tasks as possible, and is focusing on creating a stable foundation for the AUV to support future teams in continuing the project.

3 Updated Technical Plan

The technical plan includes an aluminum hull which will contain the electronics and computer to control the mechanisms of the Robosub. Eight holes with water proof Seacon connectors will be used to connect the mechanisms to the electronics. A downward and front facing camera, two torpedoes, four thrusters, a beacon dropper, hydrophones, and claw will be attached to the 80-20 aluminum frame which is bolted to the hull of the Robosub. The claw and torpedoes will be powered by compressed air via an actuator which will trigger when required.

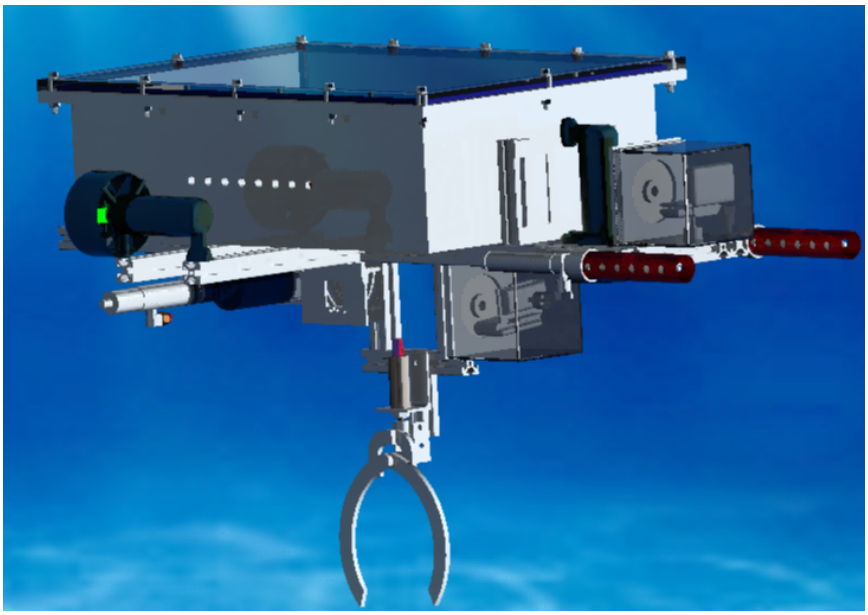

Figure 1. CAD of RoboSub

The electrical systems will be controlled by a main CPU. Data from the front and downward facing cameras, hydrophone, and depth sensor will be collected by the main CPU. Processing the data, orders

will be given to the components when they are required to perform an action via an Arduino UNO and Arduino Mega. The figure below gives a graphic representation of how the system will perform.

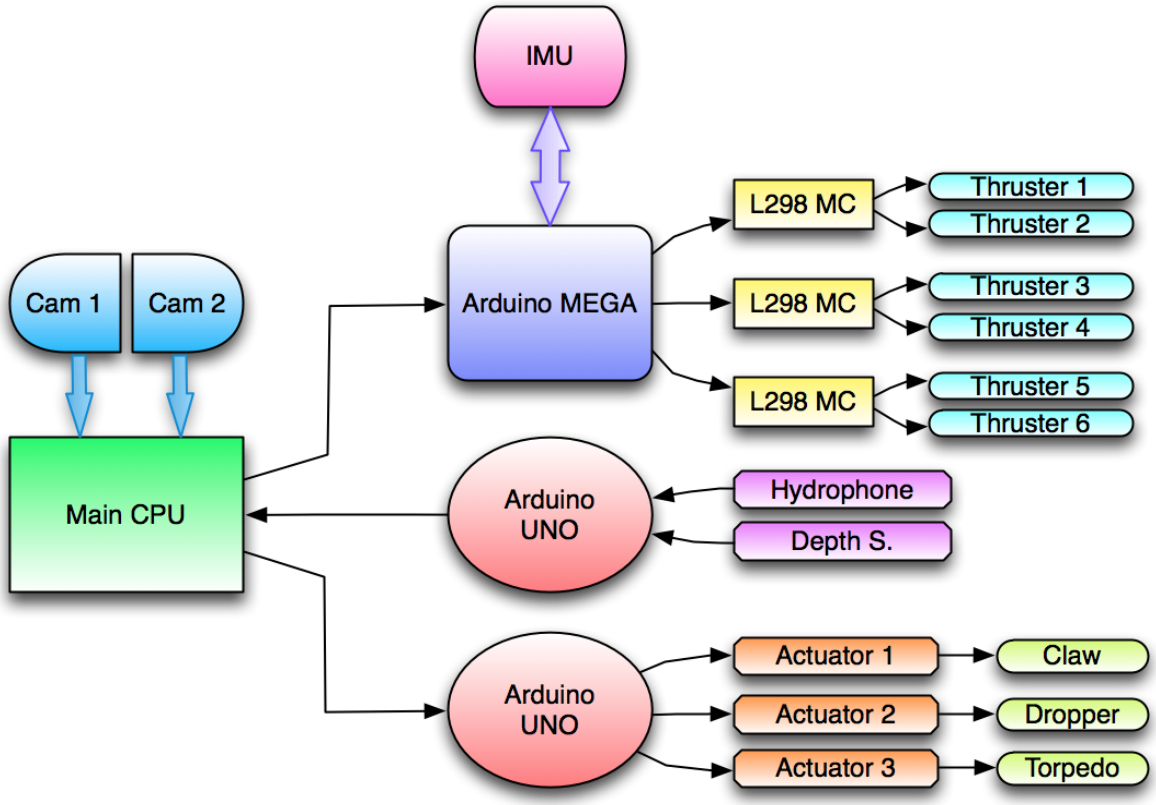

Figure 2. Flow chart of how the electrical systems interact

The initial design for the electronics has carried over from the first ideas, however a couple changes have been made throughout the process. The addition of the Arduino mega to offload CPU power is the main advancements from previous designs. The largest problem that has yet to be solved is the communication to each controller. The arduinos' are intended to control a device, and they themselves are going to be controlled via the main controller. This is an issue because the data transmission between each device is more complicated than just having them connected together, it's causes an overload of data, and also each controller has a limited amount of transmission ports to send and receive data.

The power system has changed slightly as well, where in the first iteration it was intended to use two batteries to power the thrusters, we have cut one of the batteries finding it unnecessary to provide enough power to move the AUV. However we may come to find that once all of the thrusters are consuming a full load that the second battery may need to be added in parallel. This should not be an issue in any

regard.

In a previous iteration of the software design, a top-level controller was to be included to handle communication between the movement controller and the vision module. The team has since decided to focus on the vision module and decentralize the processing intended by this module. However, the same information will still be sent between modules.

Potential pitfalls that exist for the project are many. Currently the air regulator that controls the airflow used to power the torpedo and claw system is nonfunctional and is at the moment being troubleshooted. The contingency plan for this is to purchase a new regulator with our limited budget. Mishaps on the planned arduino hardware connections may be a possibility due to the limited ports and capabilities of the devices, but at the moment are also being troubleshooted. If they fail to meet our needs, more hardware would be have to be ordered or a redesign of the system will have to be done. As the hull is nearing completion, water tightness is of absolute importance. During testing if the water seal fails, then minor or perhaps even major fixes will have to done to the design, this would include water sealant added or maybe a whole redesign.

4 Budget Report

Expense Report		
Purchases	EE	
	Z-box	331.70
	Arduinos	50.00
	Batteries	185.90
	RAM	35.97
	IMU	124.95
	Arduino Mega	58.95
	ME	
	Al-panels	15.40
	Orings/clamps/acryli	90.98
	Al-panels	20.11
	Hull materials	417.31
Funds Left	868.73	

Table 1. A breakdown of expenditures as of January 17, 2013

At the beginning of fall, the team was allotted $2,200 for the project. At this point, the remaining funds for the team are $868. All major purchases have been made as far as the robosub goes, but once testing begins, more purchases will have to be made to create an accurate testing environment.

5 Scheduling

The included Gantt chart shows the proposed schedule for the spring semester. The schedule has been heavily modified since last semester to allow for changes in in scheduling and task management as well as better estimates of task duration. The newly proposed schedule still allows the team a sufficient buffer in case some tasks take longer than expected. While some of the design milestones planned last semester were not reached, sufficient time was given such that the rescheduling did not have significant adverse effects on project completion. The proposed schedule is expected to get the AUV to a sufficient level of competence at a majority of the tasks, putting us in a better position to make it to competition this year. Any additional time will be spent refining behavior and adding additional functionality to maximize the number of points that can be earned.

6 References

1. AUVSI Foundation Website - 2013 Mission and Rules
http://higherlogicdownload.s3.amazonaws.com/AUVSI/fb9a8da0-2ac8-42d1-a11e-d58c1e158347/UploadedImages/2013%20RoboSub/RoboSub_PreliminaryMission_2013.pdf

2. AUVSI Foundation Website - 2012 Mission and Rules
http://higherlogicdownload.s3.amazonaws.com/AUVSI/fb9a8da0-2ac8-42d1-a11e-d58c1e158347/UploadedImages/PDFs/RoboSub_Mission_Final_2012.pdf

3. McMaster-Carr http://www.mcmaster.com

4. Amazon
http://www.amazon.com/Zotac-i3-2330M-2-2GHz-Barebone-ZBOXHD-ID82-U/dp/B008G9WB1I/ref=sr_1_1?s=electronics&ie=UTF8&qid=1349295946&sr=1-1&keywords=ZOTAC+ZBOX+ID82

5. Pololu http://www.pololu.com/catalog/product/2110

For additional information and references, please see the team website. http://coeRoboSub.wordpress.com