EEL 4924 Electrical Engineering Design
(Senior Design)

Preliminary Design Report

31 January 2011

Project Title:
Mutli-Function Pontoon (MFP)

Team Members:

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Name: **Sheng-Po Fang**

Project Abstract:

Our project consists of creating a remote controlled sensor boat. The boat will be covered in sensors that will test temperature, ph and distance. The information that will be received by the boat will then be sent to a touch screen that will display all of the information. This touch screen will possibly display the signal strength, speed and a compass. Also, if the data received is in the dangerous levels the boat alarms will immediately sound.

The boat will be controlled remotely by our personally designed motor controller. The motors will be two mounted fans on the rear of the boat. The remote control will send out a wireless signal to the microprocessor (MSP-430) which then sends a signal to a stepper motor than will control the directions of the fan.

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Figures and Tables:

Introduction:

The MFP a user controlled water surface vehicle. It will test the water quality of a system and send it back to the main display. If it decides that the water quality is not within safe levels it will start an alarm. This device was made especially for environmental management and control. The MFP will be useful in locating areas of high pollution or overly rich areas of water especially for people with low incomes. It will be a lot cheaper to test several meters of water using an RC boat than chartering a boat and doing the testing manually.

All of the wireless messages—both the motor controller and the data—will be sent using two pairs of Xbee's. The biggest difference between this and any similar projects or adding sensors to a RC toy boat is the user interface. This interface will be able to display all of the data in a timely manner on the touchscreen LCD screen. The cost of a "good" RC boat is approximately $60; however, we expect ours to cost closer to $400 dollars. This is mainly due to the fact that the graphical LCD will cost close to $40 dollars. The boats frame will cost anywhere between $50-$150 dollars according to the modifications that we are going to make. The remaining sensors and PCB's will account for the remainder.

Overall, when this project is completed the final result will be wireless and user controlled boat that will be able to take various water readings and send it back to a display and or warn the user when the readings are not safe.

<u>Project Features/Objectives:</u>

The main objective of our project is to design a system test water quality

- Remote controlled boat.
- User friendly, touch screen interface.
- Depth and collision detectors.
- Accurate data acquisition from sensors
- Completely wireless communication

<u>Technical Concepts/Technology Selection:</u>

To make all of these features possible there are several key objectives that must be achieved.

<u>Boat Frame Design</u>

This is probably the most important step in project. The boat will have to be designed in such a way to protect all of the electrical components from water and support the weight of the PCB, motors and power source .We are going to buy the frame of the boat and then modify it. The main modifications are the two floatation devices that will be added to both sides of the boat. This add-on is incredibly important because not only does it decrease the like-hood of the boat sinking—by increasing the buoyancy, the boat will be able to support more weight; especially because some of the components—motors, battery will be heavy.

Figure 1: Floating devices on the side of the boat.

Motor Controller

Currently, there are two main designs for the how we are going to actually going to move the boat. The main design is having two fans over each float on the boat. The fan speed will be controlled directly from the motor controller. The direction of the fans will be controlled by stepper motors. The stepper motor takes the signal from the controller and turns the fans accordingly. This design is especially useful because we will be able to make the boat move in more directions easier by controlling each fan separately. The second design was an easier, cheaper design which only had one dc motor submerged in the water and a stepper motor controlling rudders on the side of the boat. One of the biggest obstacles in designing this motor controller system the power source. The power source that we add will need to be very specific. It will have to be able to fit within the constraints of the frame and will have to be light enough to not affect the boats movement. The fans will be made using a basic DC motors and a fan blade will be attached.

Wireless Interfacing

We are going to use two pairs of wireless XBee's (Max-Stream XB24AWI-001-ND). One Xbee pair will control the motor controller. The transmitter will be on the remote control and the receiver will be on the main circuit board; which will then control the motor. The second Xbee pair will be for the user interfacing. The transmitter will be on the main circuit board, and the data received from the sensors will be sent directly to the receiver connected to the LCD screen. We choose this Xbee because it is one of the cheaper Xbee's on digikey and it also has antennae which mean we have the antennae out of the enclosure and the rest of the circuit in the enclosure without affecting the signal.

PDR: MFP

Figure 2: XB24AWI-001-ND Xbee

LCD screen

We are going to use a 2.3" LCD touchscreen. This touchscreen was chosen because it was one of the cheaper ones ($40). It has 18 bit color with a 4 white LED backlight. It also comes with a breakout board to ease the programming.

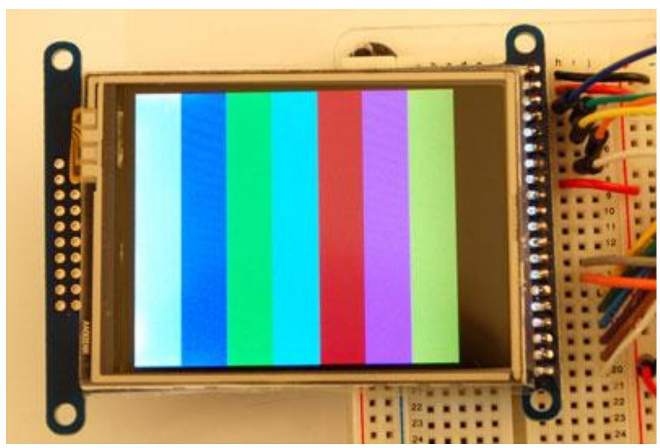

Figure 3: Touch Screen LCD

Microprocessor

We choose an MSP-430 with 64 pins to all of the operations. Specifically, we chose the MSP-430F2471TPM because it should have enough pins to control the motors and the LCD; also, it was ultra-cheap and low power like most MSP-430 microprocessors. Both of us have more experience working with this microprocessor than others.

Figure 4: Basic MSP-430 processor

Sensors

The sensors account for the main analog component of this experiment. We are using three main sensors for our project—temperature, distance/depth and PH sensors. All of the sensors will be placed on the base of the boat. We are choosing a $10 water-proof temperature sensor because while there are definitely cheaper ones on the market this one is already water-proof. The ph sensor that we are going to choose is expensive. Most ph-sensors that we can find cost around $60-$70 dollars and we are researching other methods to measure Ph. We are choosing a sonic distance sensor over an IR because we do not believe the IR sensors will be accurate enough to measure distance under the water.

Figure 5: Water-Proof Temperature sensor

Miscellaneous

There are also costs that will be added to the project apart from the main components. Overall should cost around $50.

- **Enclosure**: We need three enclosures for the project. All of these enclosures will protect the circuit from leakage.
- **Fans**: We need 2 fan blades to attach to the DC motor component.
- **Water Proofing** : Polymer will be used to make the sensors water-proof and still usable
- **Power-Source:** Specific to the power consumption of the motors normally costs around $30 dollars
- **Circuitry:** We will need all of the most of the basic circuit components**.** Such as speakers, LED's, switches etc.

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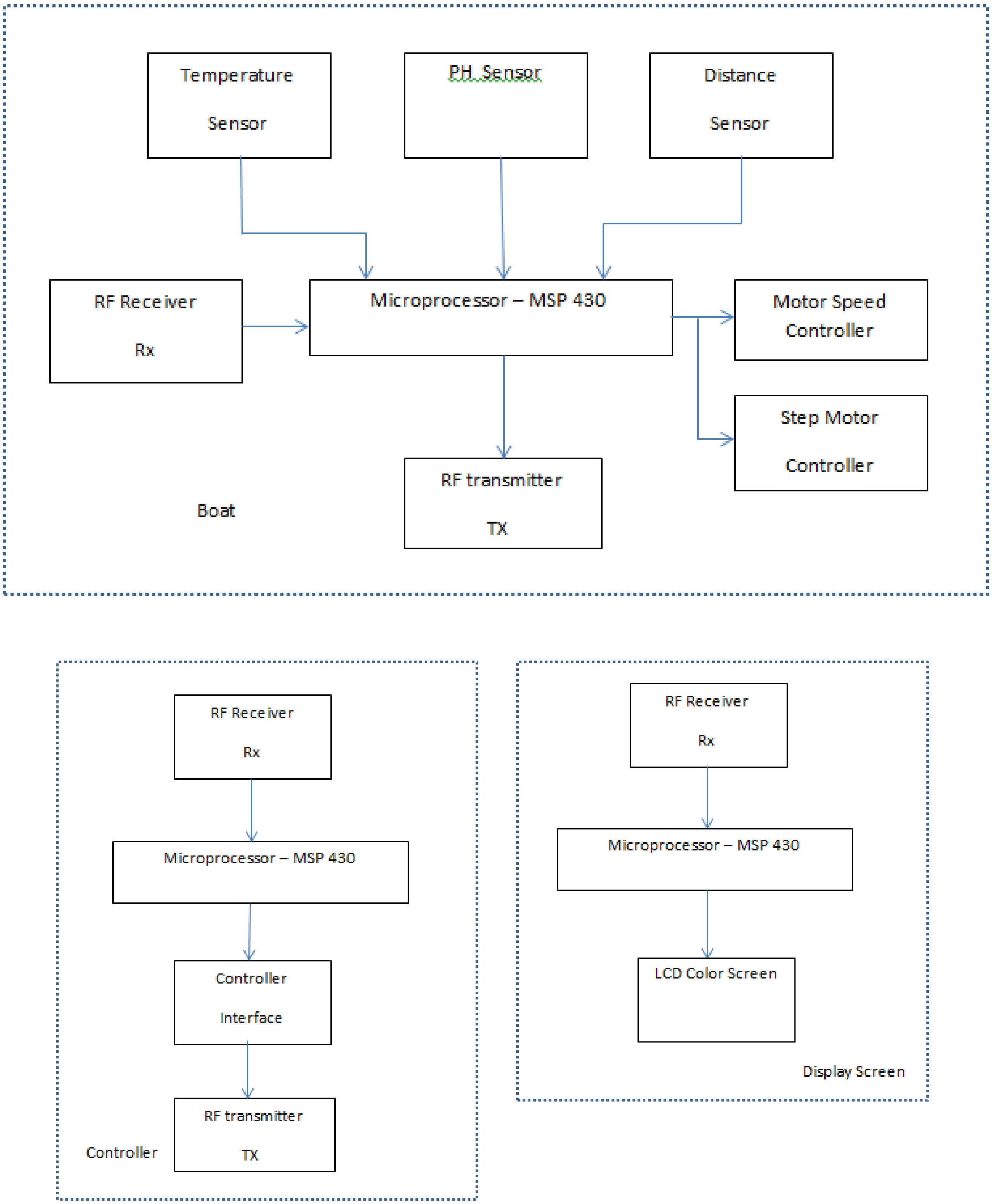

Figure 6: Hardware Flow-Chart

Cost Objectives:

Parts List	Quantity	Price	Total
TouchScreen	1	40	40
Temperature Sensor	1	9.95	9.95
PH sensor(tentative)	1	70	70
Distance sensor	1	15	10
Motors	4	12	48
MPS-430	2	7	14
XB24AWI-001-ND Xbees	2	19	38
Enclosures	3	10	30
Boat Core	1	40	40
Miscellaneous	1	50	50
Total			344.95

Table 1: Showing Parts List

Distribution of Labor:

Task	Mikkel	Sheng-Po
Research	50	50
Create motor controller	80	20
Create LCD interface	20	80
Create wireless system	50	50
Frame creation	50	50
Create and Debug PCB's	50	50

Table 2: Showing division of Labor

Gantt Chart:

PDR: MFP

Task Name		Planned	Extension	Down time	
Introduction (team)	0	1	2	0	3
Research/project proposal (team)	0	4	0	0	4
Create motor contoller	3	2	1	0	6
Create LCD interface	4	2	0	0	6
Create wireless system	5	2	1	0	8
Frame and Field Testing	6	1	1	0	8
Create and Debugg PCB's	6	2	0	1	9
Frame and Field Testing and Debuggin	9	2	0	0	11
Packaging and Extra Stuff	11	2	0	1	14
Demo (team)	14	2	0	0	16