EEL 4914 Electrical Engineering Design
(Senior Design)

Preliminary Design Report

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Project Title: Human Powered Submarine Control System

Team Name: Swamp Thing

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Project Abstract:

This project will control four separate servos that will move four individual control surfaces, two rudders and two elevators, on the exterior of the UF Human Powered Submarine (UFHPS). The submarine is powered by a single propeller; the rotation of the propeller causes a right rolling motion that needs to be compensated for. This roll will be detected and all four servos will be moved to counteract the roll. At the same time the pilot will be able to maneuver the sub with the elevators and rudders. Additionally the depth will be displayed on an LCD so that the pilot can maintain constant depth. Time permitting an attempt will be made to make the controls hands free so that the sub will travel a constant course and depth.

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Objectives:

Our project will provide three axis control of the UF Human Powered Submarine similar to a fly by wire control system used in civil and military aircraft. The following is a list of features.

- Interface a potentiometer joystick to the microprocessor to provide an input from the pilot. This will be used to determine the desired direction of movement.
- Provide a roll indication using a gyro/accelerometer. Given these joystick and roll commands the microprocessor will give a single command to each of the four servos, roll and rudder to each rudder and roll and pitch to each elevator.
- A fifth servo will release a “Dead Man” buoy if a momentary switch is released by the pilot.
- Using a pressure sensor report the depth to the pilot
- Using the same pressure sensor, have the microprocessor provide automatic depth control(time permitting)

Components:

Servos: standard servos only provide about 50 oz-in of torque. This will not be meet the needs required. A hi-torque servo is needed, a HS-755MG has 150-200 oz-in torque, and HiTec RCD has agreed to donate five.

Microcontroller: five PWM channels are needed. An Atmel 256 should work fine, lots of people have a great deal of experience with it and cost should be minimal. An Atmel 324p will be used for prototyping and waterproof testing.

Sensors: a pressure, gyro/accelerometers are needed. I currently have accelerometers and pressure sensors from Freescale on hand. A gyro from Analog Devices may also be used. Further test and evaluation will determine which sensors will be used.

Joystick: There are no waterproof joysticks commercially available. Our joystick will probably be made from a "modified" computer joystick that has been waterproofed.

Figure 1 is a block diagram of how all these components are integrated. Figure 2 is the software flow chart.

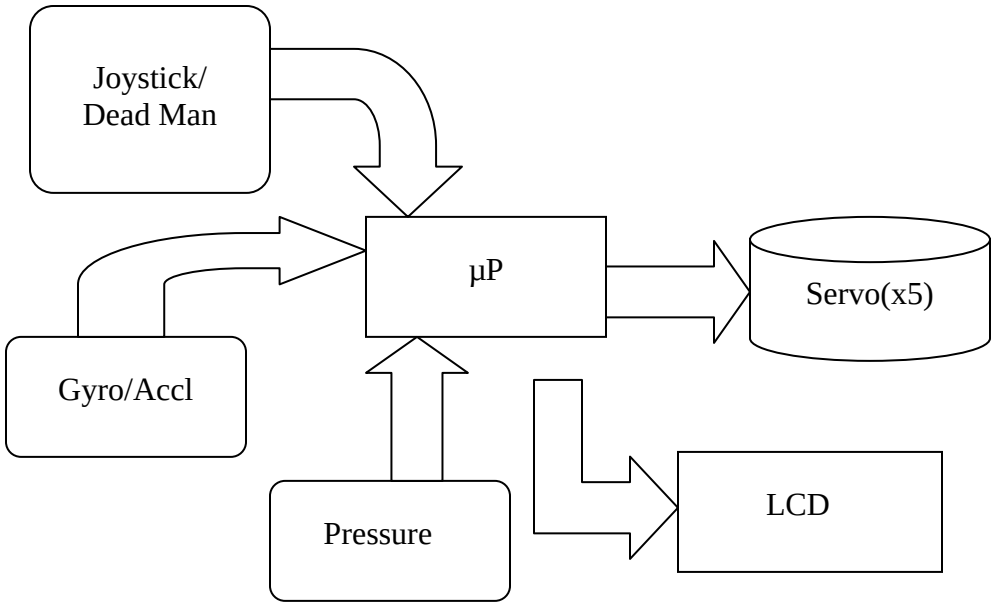

Fig. 1 *Block Diagram*

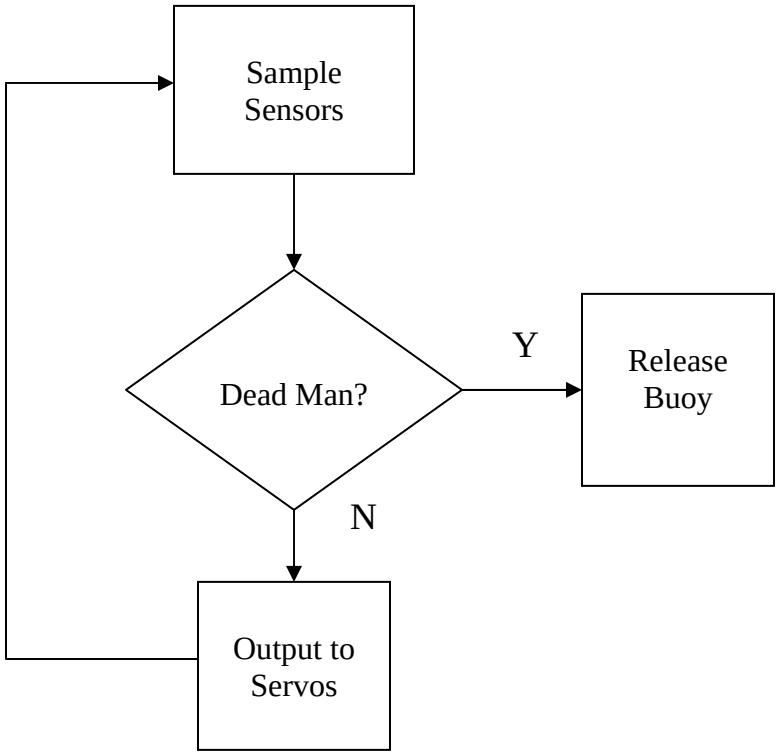

Fig. 2 *Program Flowchart*

HPS Issues:

The HPS is a "wet" sub and all electrical parts must be sealed from the water to a depth of no less than 30 ft. Waterproof boxes will need to be made to protect the electronic equipment. Size and weight are not much of a concern, there should be plenty of room and the sub weighs as much as the water it displaces. The fins on the sub will likely be under a great deal of force. There is a point where a fin rotates at where there is zero torque on the axis of rotation. If the shaft is placed to far from this point the torque increases dramatically. The fins will be placed as close to the zero torque point as possible and high torque servos will be used.

Timeline:

The project timeline and personal responsibilities are outlined in figure 3.

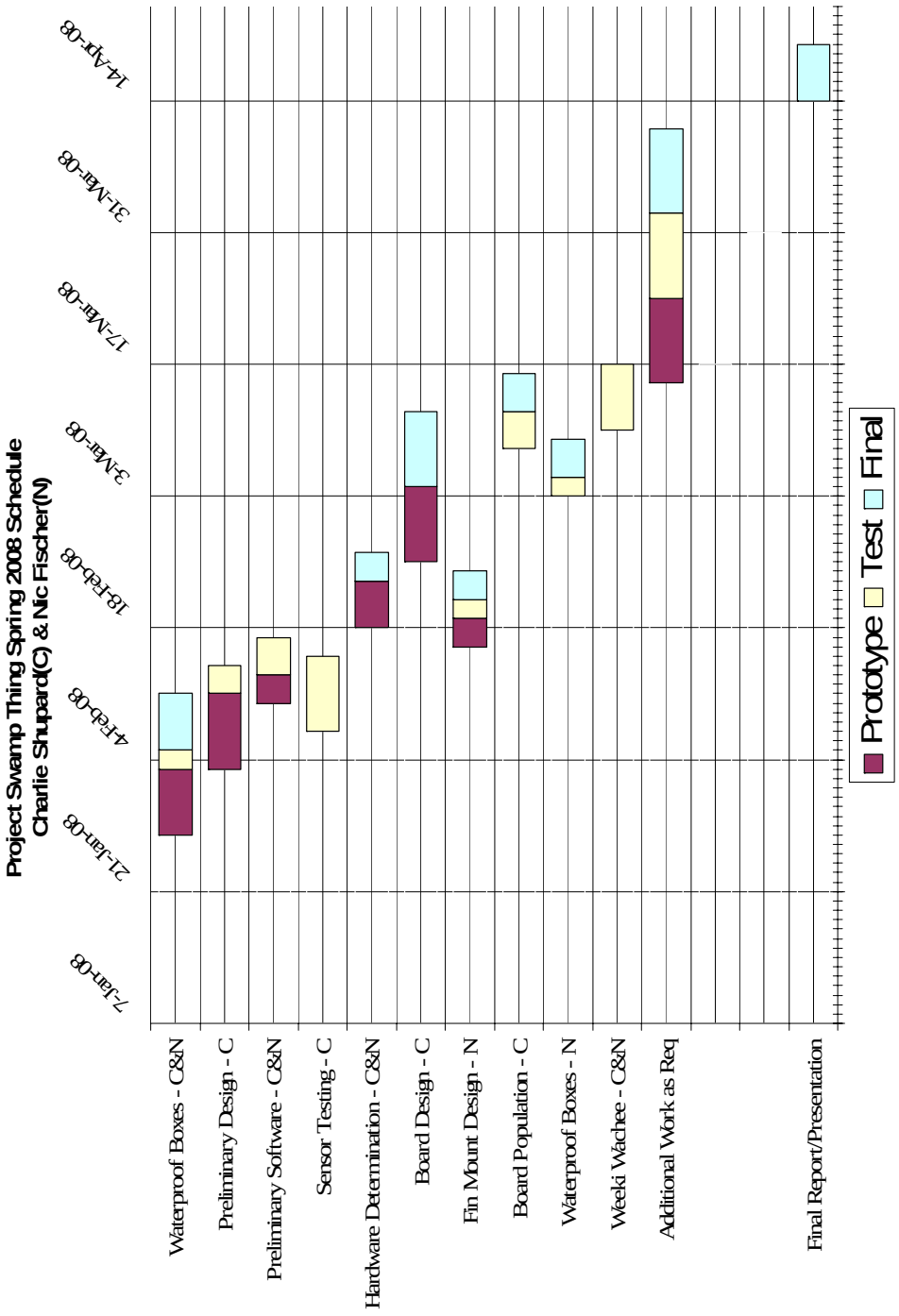

Figure 3 *Gantt Chart*