ECGR 4161 - Exam 2 - Spring 2009

1 Definition of Autonomous incorrect -5
Justification -3

2. Degrees of freedom/mechanical
Sensors
Actuators
Control

3 Control lines -5
All parts -5
All power lines -5

See attached solution

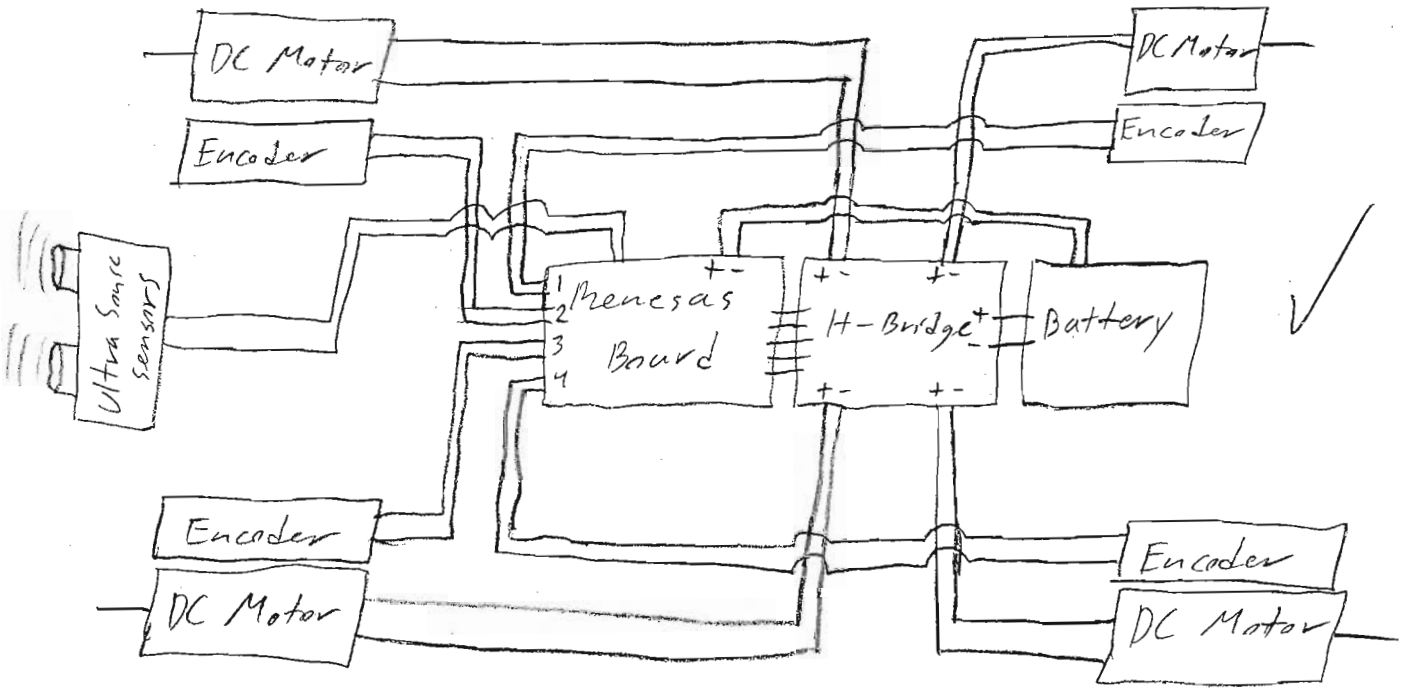
4 Set mr of a timer
Set an initial value of timer
set start timer

All got 15pts
too hard to do
(incomplete specification of problem)

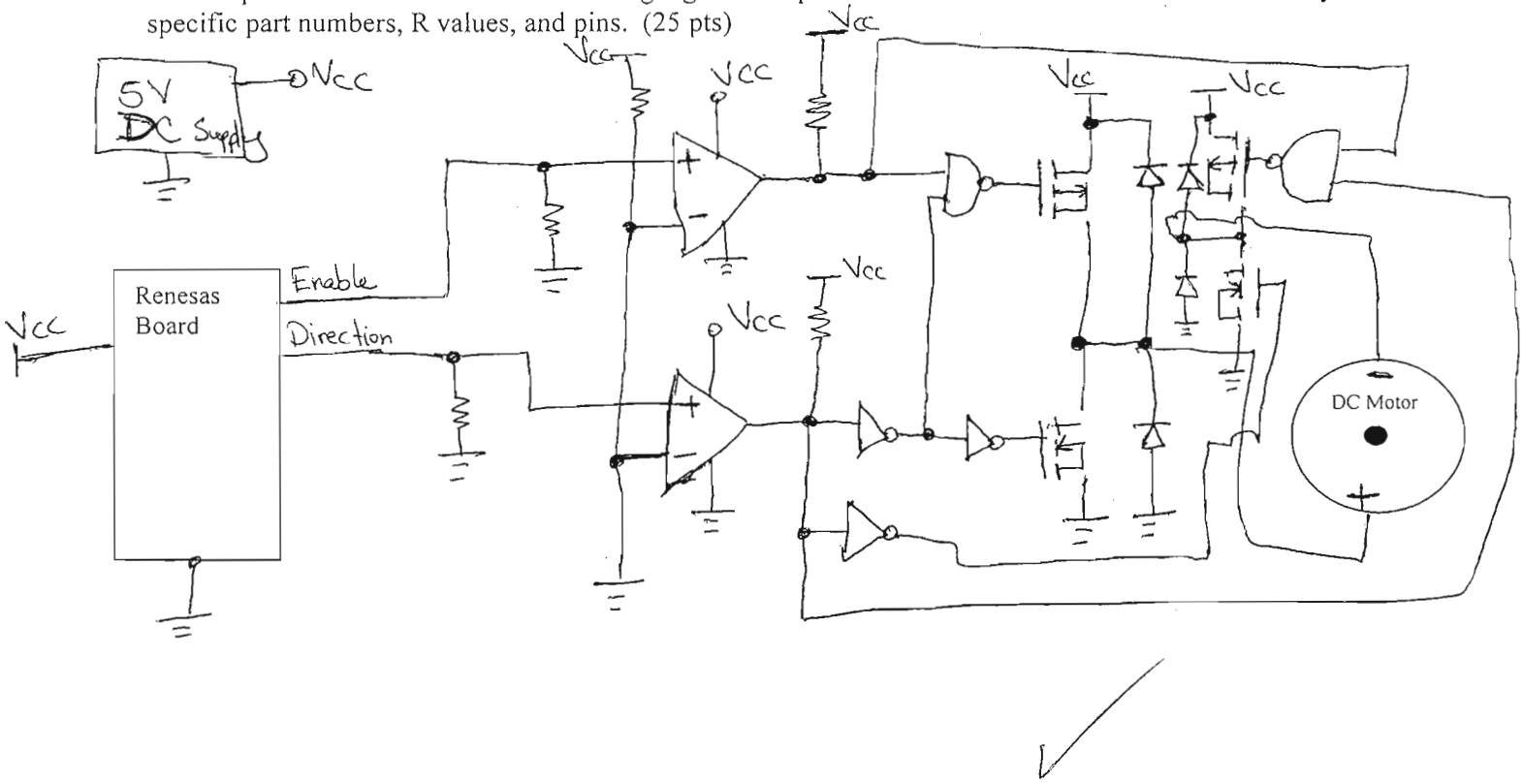
5 See attached solution

6 See attached (all got 75pts)
examples

3. So far in class you have learned about sensors, motors, controller boards, and power circuits. Draw a basic **block diagram** of the robotic vehicle we will build for lab 6&7 that has an ultrasonic sensor in front and a wheel encoder for all wheels. Include all power as well as logical wires. Include all parts needed to make the vehicle travel forward but not hit anything. (15 pts)

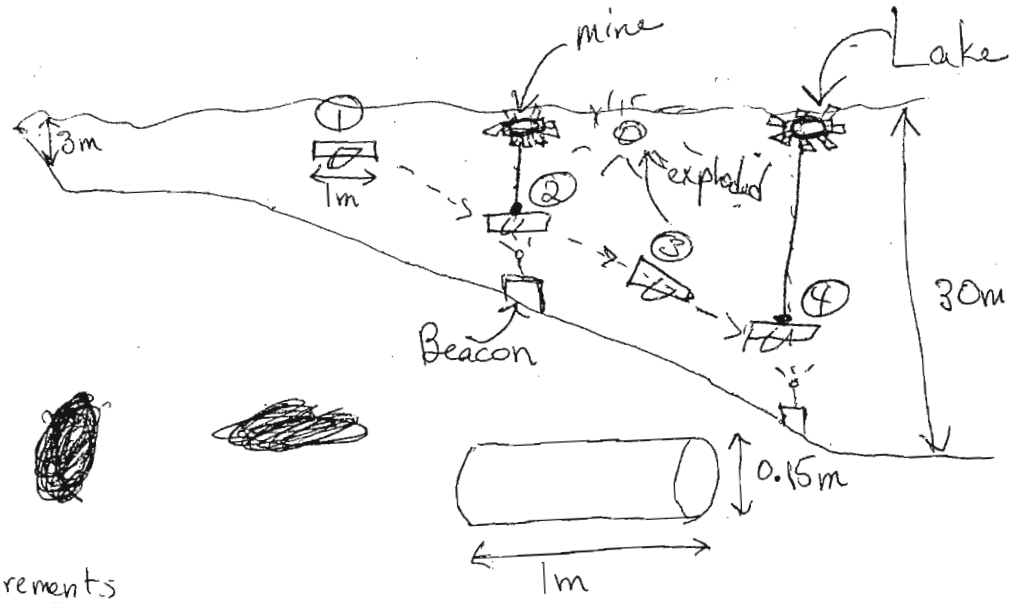


5. Starting with the box on the left hand side of the paper and the motor on the right hand side, draw the FULL schematic of a H-Bridge circuit that is controlled with enable and direction lines and drives one DC motor. Include power sources. I want to see all logic gates and power transistors. You do not need to identify specific part numbers, R values, and pins. (25 pts)



6. Consider you will design an autonomous robotic vehicle that can sense its environment and move to perform a task. The environment is underwater in a sea or lake with a minimum depth of 3 m and a maximum depth of 30 m. The underwater vehicle will be 1 meter in length and 0.15 m in diameter when stored (although the device can deploy fins or expand when activated). The vehicle will travel towards a pre-placed underwater beacon at specific frequency (the beacon source is on the ocean or lake floor). Once the vehicle is over the beacon, it will attach itself to the cable/chain holding a mine that is floating 1.5 m under the surface of the water. Once the vehicle is attached, it will wait for another beacon at another frequency. When it detects this new frequency, it will self destruct. It should be close to but not touching the mine.

   Using blank paper, write the requirements for the robotic vehicle. The requirements should include the type of sensing and motion. Also identify performance measures for the entire system (beacon and vehicle). You need to write at least 15 requirements. Use your knowledge of requirements from senior design and the labs as guidelines. (75 points)



Requirements

1) The vehicle must be able to sense depth. using pressure sensors.
2) The vehicle must have sonar sensors for beacon detection
3) The vehicle must have microcontroller to process sensor information
4) The vehicle must have metal sensing equip to detect cable.
5) The vehicle must have camera to detect obstacles.
6) The vehicle must be able to have enough buoyancy to stay afloat.
7) The vehicle must be able to move in three axis directions (3 DoF)
8) The vehicle must have control system for maintaing straight path.
9) The vehicle must be sealed from water environment
10) The vehicle must be self powered with no tether.
11) The vehicle must be able to sense 2 or more beacons at once.
12) The vehicle must be able to send out dummy vehicles to explode mines.
13) The beacons must send out low frequency signals that can be detected under water.
14) The beacons must not disturb the mines floating above the
15) The beacons must be able to sense and move under mines.
16) ~~The~~ beacons must be self powered.

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Req 01 - The Robot will be 1 meter in length and 0.15 me in diameter during storage

Req 02 - The robot will be able to propel itself in water at a speed of _ Kn

Req 03 - The robot will have a sensor that can detect a beacon of _____ Hz (frequency) and _____ Hz (Frequency)

Req 04 - The Robot will maneuver in the water utilizing the XYZ algorithm for beacon A search

Req 05 - Once a beacon A has been detected, the robot attach itself to the cable/chain floating 1.5m under the surface and 1 meter from the mine

Req 06 - When attached to a mine cable/chai the robot will Maneuever in the water utilizing the OMG algorithm for beacon B search

Req 07 - Once a beacon B has been detected, if a chain is attached, the robot will self destruct

Req 08 - The robot will utilize a vectored thrust system that allows motion in any direction.

Req 09 - The robots thrust system shall not protrude from the outer form.

Req 10 - The robot shall utilize a 48V, 2500 amp hour battery.

Req 11 - The robots thrust system will be powered by 48V at

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Req 12 – The Robot shall be able to search for 8 hours

Req 13 – The Robot shall surface and transmit a recovery signal if it has searched for 8 hours and no mine has been found

Req 14 – The Robot shall utilize parts that are available "off-the-shelf."

Req 15 – The Robot shall only use lasers to ward off shark attacks

Req 16 – The Robot shall surface every 100 meters to obtain a GPS Fix.

Req 17 – Except when obtaining a GPS fix, the Robot shall remain at least 2 meters below the water surface

Req 18 – When dolphins are present, the robot will attempt to read their mind to obtain knowledge of treacherous regions in the water.