AUTOMATED JACK PLATE CONTROLLER UNIT

LSU COLLEGE OF ENGINEERING

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Special Thanks To:
- Professor John Scalzo (course instructor)
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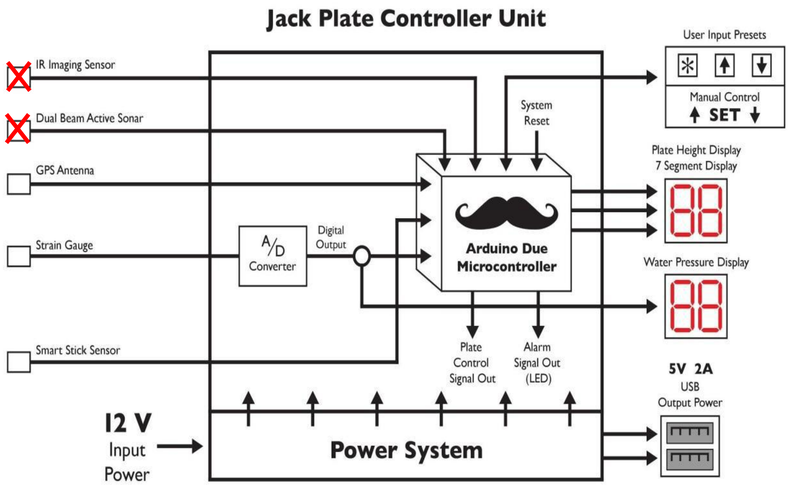
Objective:

Driver inattention is the leading cause of boating accidents in the US. The goal of our project is to create a control unit that will automatically sense the current height of the jack plate, find the optimum jack plate height based off of the water pressure in the outboard motor, as well as alert the user when they are approaching shallow water and warn of hazards in front of the boat such as submerged logs. This device will reduce the number of tasks that require the boater's attention while simultaneously increasing the overall fuel efficiency of the outboard motor.

Engineering Requirements:

1. The System will operate off 12V supply.
2. The system will make 100 depth measurements per second.
3. The system will provide floating hazard detection up to 100m in front of boat.
4. The system will measure motor pressure from 0-30psi within ±1psi.
5. The system will calculate height to within 5% accuracy.
6. The system will calculate boat speed once per second.
7. The system will provide alerts to operator in excess of 80dB at a distance of 3ft.



GPS Antenna

- The GPS system was used to calculate the speed of the boat in order to determine the optimum height of the jack plate.
- The system calculated the boat speed by calculating the distance the boat had traveled since the last update using the Haversine formula and then dividing it by the time since the previous update.
- Ultimately the system was able to get GPS updates and calculate the speed of the boat 4 times per second.

User Alert System

- The User Alert system was intended to provide an audible alert with a volume exceeding 80dB when one of the following situations occurred:
  - the water pressure was to low
  - the jack plate couldn't find the optimum height because it was at its maximum or minimum height
  - the system sensed a submerged object
  - the boat was approaching shallow water
- This system could not be heard over the outboard motor, and only produced a volume of 72dB at 3ft.

User Preset Buttons

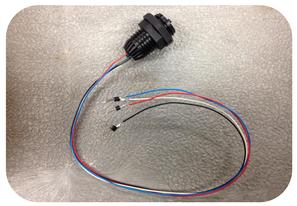
- The User Preset buttons are used to navigate the user preset menu, and also to enter and exit automatic mode.
- The user can take the boat out of automatic mode and operate the jack plate manually by simply by pressing up or down on the switch.

User Display

- The user display is used to navigate the user preset menu while setting the presets
- The display also shows the current engine water pressure and jack plate height when the user is not adjusting the presets.

Height Detection System

- The Height Detection System was designed to accurately measure the current height of the jack plate and transmit it to the central microcontroller.
- The height was measured using Hall Effect sensors triggered by a neodymium magnet mounted to the moving side of the jack plate.
- The magnetic sensor board could measure heights up to 8" in 0.25" increments.
- The height data was transmitted to the Arduino Due via UART.

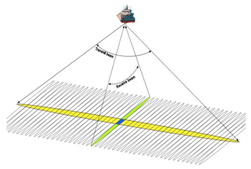


Water Pressure System

- This system was used to measure the water pressure in the outboard motor.
- This data was then used to determine whether to raise, lower or maintain the current height of the jack plate.
- The system was able to exactly measure pressures from 6psi up to 40psi.
- Since most outboard motors operate at pressures above 7psi and below 35psi, the minimum allowed preset pressure was set to 7psi, and the maximum allowed preset was set to 40psi.

Forward Hazard Detection

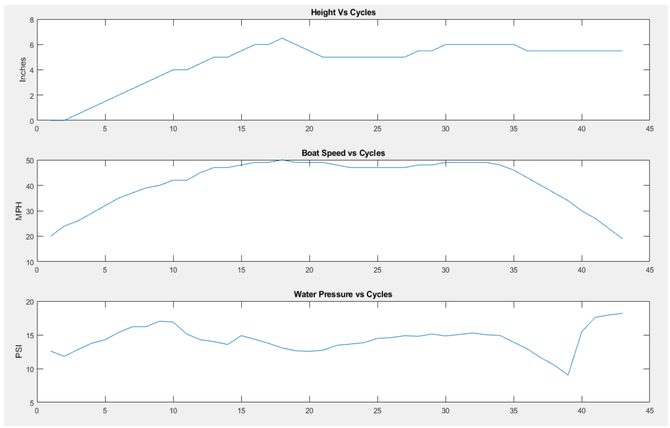
- The purpose of this system was to detect floating and submerged objects, such as logs.
- The imagers would be taken with a FLIR Lepton infrared camera using 14 bit1 grey scale.
- A Raspberry Pi was to be used to process the images with a Linear SVM image recognition using HOG feature Extraction.
- The system was abandoned due to insufficient time and funding.



Dual Beam Active Sonar

- The purpose of this system was primarily to detect shallow water and alert the user if the boat was in danger of running aground.
- The system was designed to sample the depth 100 times per second.
- The system was abandoned due to insufficient time and funding.

Testing:



- Above is the results of a single test run of the full system. The data was taken with the boat obtaining a top speed of 50mph.
- The minimum speed for the system to turn on was 20mph, and the system was set to maintain an engine water pressure of 12psi.
- To show that the system is finding the optimum height of the jack plate, the motor water pressure drops approximately 15 seconds into the test. The system then lowers the jack plate in response, and the water pressure is able to return to the preset 15psi.
- The large spike in water pressure around 38 seconds can be ignored as it is a result of how the boat obtains the water pressure and sends it to the sensor. It is not a result of our system.

Results:

1. The System will operate off 12V supply. –> ***Pass***
2. The system will make 100 depth measurements per second. –> ***Fail*****; System abandoned due to insufficient time and funds.**
3. The system will provide floating hazard detection up to 100m in front of boat. –> ***Fail*****; System abandoned due to insufficient time and funds.**
4. The system will measure motor pressure from 0-30psi within ±1psi. –> ***Pass***
5. The system will calculate height to within 5% accuracy. –> ***Pass***
6. The system will calculate boat speed once per second. –> ***Pass***
7. The system will provide alerts to operator in excess of 80dB at 3ft. –> ***Fail*****; Alerts were unable to be heard over outboard motor.**