DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING

Navigation and Control System of an Autonomous Hovercraft

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Client: Dr. David Barclay

Scope of Work

Team 6 was assigned by Dr. Barclay to design a navigation and control system on a hovercraft for the purpose of making bathymetric measurements. The current technology for making the measurements in shallow water is extremely limited. Techniques include manual surveys carried out with a survey rod, GPS and decent pair of hip-waders, by hull mounted Sonar on a manually operated jet-ski (Dugan et al., 2001; Omand et al., 2011; Chardón and Canals, 2012). Manual surveys are inefficient, labor intensive and provide sparse data, jet-ski surveys require a skilled operator and are limited to water depths greater than 10's of centimeters.

The aim of this project is to make the hovercraft travel from one point to another autonomously and manually by using a remote-control.

Initial Conditions

When the team started working with Dr. Barclay, there was no system on the hovercraft. The components on the hovercraft included 2 servo motors, power supply, a land mowing engine, and a remote control. At that time, the hovercraft was operating manually. The team was tasked to build the autonomous navigation and control system from scratch.

Project Location

DALHOUSIE UNIVERSITY
Oceanography Department
Dr. David Barclay
1355 Oxford St, Halifax, NS B3H 3Z1

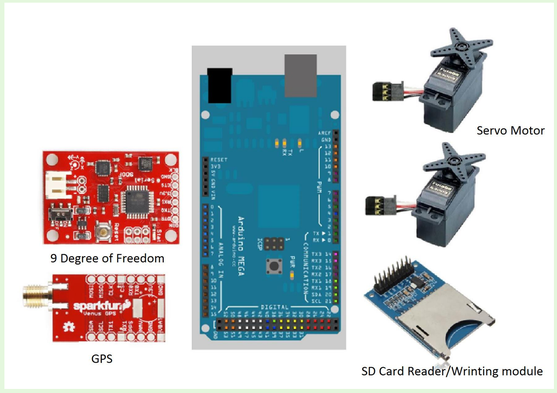
Design Process

The design process included:

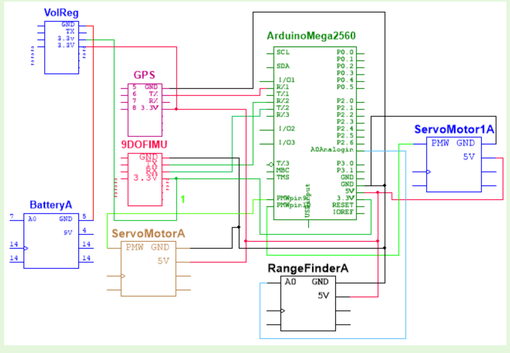
1. Familiarization with the scope of the project,
2. Analysis of physical components required to complete the design of the navigation system,
3. Testing of each of the physical components to ensure quality and calibration,
4. Creation of the navigation system using the Arduino programming language and MATLAB program,
5. Assembly of the physical components with the navigation system,
6. Testing of the final product,
7. Improvement of the final product

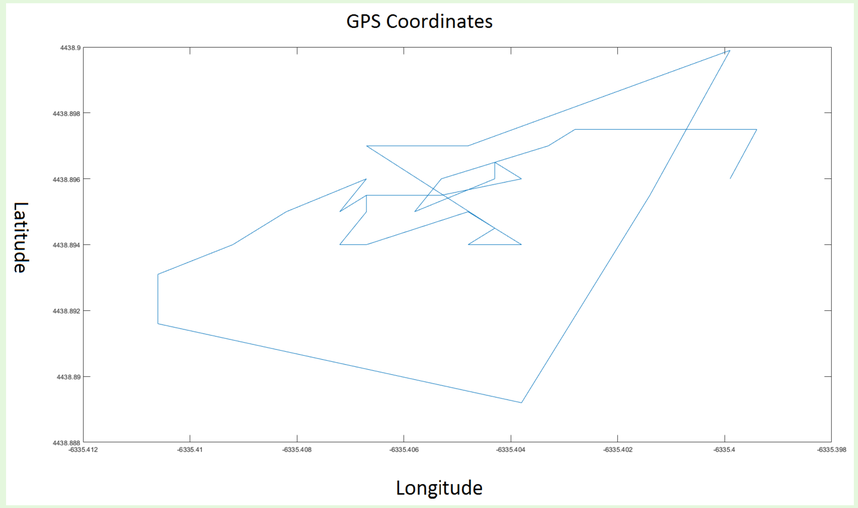
Details of Final Design

The main components of the system are shown in the picture below. The system is equipped with an Arduino board, two servo motors, 9DOF IMU, and a GPS. These components play major role in the project functionality. The GPS provides us with precise location coordinates, to help us know the heading with the support of the 9DOF IMU. The servo motors are dedicated for the steering and throttle. The board is the heart of the system, which means that the system code is implemented in it.



Conceptual schematic of the system.





The above graph shows the Latitudinal and Longitudinal Coordinates, collected by the GPS of the hovercraft, indicating the position of the hovercraft when the hovercraft was operated manually. Using the MATLAB program, each of the Latitudes' and longitudes' were converted from a string to integer so that the route of the hovercraft could be demonstrated on a graph. The probability of error given by the manufacturer, for each of the coordinates, is about 2.5 meters in radius from each point on the line-graph. In the future these coordinates will be used to simulate the behavior of the hovercraft without having to move the hovercraft physically. This way, it will be quicker to examine the behavior of the hovercraft in simulation and test different behaviors under variety of circumstances.

Conclusion and Recommendations

Conclusion

The navigation and control system will create a virtual path from one point to another the most efficient way, by calculating the distance and the bearing from the original points. When the hovercraft is on the wrong path it will autocorrect itself by estimating how far from the original path the hovercraft is located. Even though the team has not completed every task yet to make the navigation and control system fully autonomous. The team is expecting to finalize the project in less than 10 days, to be completed by the 10 of April 2017.

Recommendations

More research need to be done on the coding and testing. Evaluating if a PID control system would be better than a PI control system to reach the point of interest on the most efficient way with the less derivation from the original path.

References

Chardón, P., and Canals, M. (2012). "Jetski-based bathymetric surveying in Rincón, Puerto Rico," in 2012 Oceans (IEEE), pp. 1-4.

Dugan, J., Morris, W., Vierra, K., Piotrowski, C., Farruggia, G., and Campion, D. (2001). "Jetski-based nearshore bathymetric and current survey system," Journal of coastal research, 900-908