Navigation and Control of an Unmanned Surface Vessel

Mechatronics Project 488

Project Proposal

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Executive Summary

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| --- |
| **Title of Project** |
| Navigation and Control of an Unmanned Surface Vessel. |
| **Objectives** |
| The development of an independent navigation and control system that can be implemented on an unmanned surface vessel that uses electrical thrusters for propulsion and steering. |
| **What is new in this project?** |
| A new control system is going to be created to control the power to the thrusters and thereby steer the vessel. Building on this a navigation system will be created so that the vessel can navigate to a designated point autonomously. |
| **If the project is successful, how will it make a difference?** |
| With a successful navigation and control system, the system could be moved to vessels with better range and seafaring ability and these unmanned vessels can be used for research data collection, patrolling and search and rescue. |
| **What contributions have/will other students made/make?** |
| N/A |
| **Which aspects of the project will carry on after completion and why?** |
| For the vessel to be completely autonomous, a further project should add an obstacle avoidance system. This will be beneficial to avoid other sea vessels as well as fixed obstacles such as rocks and shore. |
| **What arrangements have been/will be made to expedite continuation?** |
| All the research and project documents will be archived with the university. |

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# Introduction

## Background

As technology has improved over the years, processes and systems have become more automated. Initially factories were replacing manual labour with automated machines but recently companies have been investigating self-driving cars and trucks. All over industries tasks are being automated or done remotely with fewer human involvement.

The ocean is the perfect area for unmanned surface vessels (USV) to be used as many of the issues faced with autonomous land vehicles such as self-driving cars are mitigated by open water. On the open water one gets a 360° of the surroundings of the vehicle and although there can still be high volumes of traffic in certain areas such as commercial shipping lanes, due to the expanse of the ocean these high traffic areas are avoidable. Finally, and probably the most desirable mitigating factor is that where a surface vehicle would need to look where the road surface is to follow it, an ocean vessel can move directly from point to point on any piece of water.

There are two major navigation and control systems to a USV, the navigation and propulsion control system and the obstacle avoidance system that would handle any unforeseen objects in the path of the USV. This project will focus on the former, the navigation and propulsion control of the USV.

## Objectives

As previously stated, this project will focus on the navigation and propulsion control of the USV. This is the building block of the USV upon which a future project can build an obstacle avoidance system. This project will have the following objectives:

1. Designing and producing the propulsion control system so that the vessel can be manually operated through the manual control dashboard.
2. Designing and implementing an autonomous navigation system that will in conjunction with the propulsion control system navigate the USV on a path of prescribe location points.
3. Expand the navigation system to enable it to calculate its own path using topographical maps given the destination.

## Motivation

There are many maritime tasks that are being undertaken using large vessels and their crew to accomplish tasks that can rather be done by USVs, such as sonar research, marine patrols and search and rescue. The use of USVs is becoming more prominent as a USV can be cheaper to operate and therefore organisations can either save costs in the case of sonar research or in the case or marine patrols and search and rescue, USVs can be used to fill up the ranks of vessels and close the possible gaps.

The tasks previously mentioned are often time consuming and the crew of the assigned vessel need time to rest whereas a fully autonomous USV can operate constantly, stopping only to replenish its energy source.

# Planned Activities

## Review Literature

Review the literature around navigation and control systems as well as those around global positioning satellites (GPS) and compare existing navigation and control systems of marine, land, and air vehicles.

## Review Similar Projects

Research and review projects that are similar to this project as well as projects that may have similarities on land or in the air.

## Design Initial Concept

Design the initial concept of the vessel and the control system including drawings and flow diagrams of the control system.

## Create Parts List and Order Parts

Using the concept design create a parts list for parts to be ordered. This must be done as soon as possible to allow time for the parts to arrive.

## Manufacture USV

Manufacturing the USV will have four elements. The first being the assembly of the microcontroller and other periphery electrical devices. Secondly the programming of the control software. Thirdly the outboard mount of the thrusters must be designed and mounted onto the vessel. Finally, all elements must be fixed to the vessel.

## Test USV

There will be multiple tests run with the USV with time between tests to troubleshoot and fix any problems that are found. Initially tests will be conducted using manual control to establish that the propulsion control is functioning as desired. Following this, the USV will be tested in autonomous control.

## Compile Final Report

Compile the initial research and literature review with the initial concept design and any subsequent design changes together with the results from the tests into the final report.

# Project Risk Assement

# Conclusions

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# References

Pompies, P, 1652, *My experiences on the Drommedaris*, 1st ed, Van Riebeeck Publishers, Cape Town.

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