# DEVELOPMENT AND FEASIBILITY OF OPEN-SOURCE HARDWARE AND SOFTWARE IN CONTROL THEORY APPLICATION

by

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# Abstract

Control theory is a methodology investigated by many mechanical and electrical engineering students throughout most universities in the world. Because of control theory?s broad and interdisciplinary nature, it necessitates further study by application through laboratory practice. Typically the hardware used to connect the theoretical aspects of controls to the practical can be expensive, big, and time consuming to the students and instructors teaching on the equipment. This is due to the fact that connecting various hardware components such as sensors, encoders, amplifiers, and motors can lead to data that does not fit perfectly the theoretical mold developed in the controls classroom, further dissuading students of the idea that there exists a connection between developed theoretical models and what is seen in practice.

There is a recent trend in universities wishing to develop open-source, inexpensive hardware for various applications. This thesis will investigate and conduct a multitude of experiments on an apparatus known as the Motorlab to determine the feasibility of such equipment in the field of control theory application. The results will be compared against time-tested hardware to demonstrate the practicality of open-source, inexpensive hardware.

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# Acknowledgments

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# Chapter 1

# Introduction

In this chapter there examples of various features you may want to incorporate into your document. Here's an example of a figure inserted into the text:

See the file chapter1.tex for examples of the commands used to insert a figure or table, add a caption, etc. Here is an example of a table:

**Table 1.1**: *Caption to appear above the table*

| Column 1 Heading | Column 2 Heading | Column 3 Heading |
|---|---|---|
| Col 1 Row 1 | Col 2 Row 1 | Col 3 Row 1 |
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| Col 1 Row 3 | Col 2 Row 3 | Col 3 Row 3 |

## 1.1 Making References to Figures or Tables

It is possible to create cross-references and hyperlinks to items or sections within your paper. For example, here is a reference to Fig. 1.1 mentioned at the beginning of this chapter and a reference to the Table 1.1.

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In this section, we refer back to text mentioned in Section 1.1 on page 2.

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# Chapter 2

# Background

Two pieces of apparatus were used to conduct the experiments in this thesis. This chapter will detail the purpose, design and recreation of the equipment. Section 2.1 will cover the new Motorlab, including the hardware implementation, design of components, and basic functionality. Section 2.1 will also detail how a new type of position sensor works that is used for the position measurements of the Motorlab. Then, the older Motorlab will be discussed and compared to the new Motorlab in section 2.2.

## 2.1 New Motorlab

The new Motorlab is experimental equipment that allows users to connect the theoretical ideas of control theory with those in practice. There are three main pieces of hardware that comprise the new Motorlab, namely the STM32 Nucleo, insert name here and insert name here. The STM32 Nucleo is an ARM based microcontroller that has pin headers for Arduino shields and other STM breakout boards. The Nucleo is the main development board of the new Motorlab

### 2.1.1 Motorlab Parts

### 2.1.2 Position Sensor

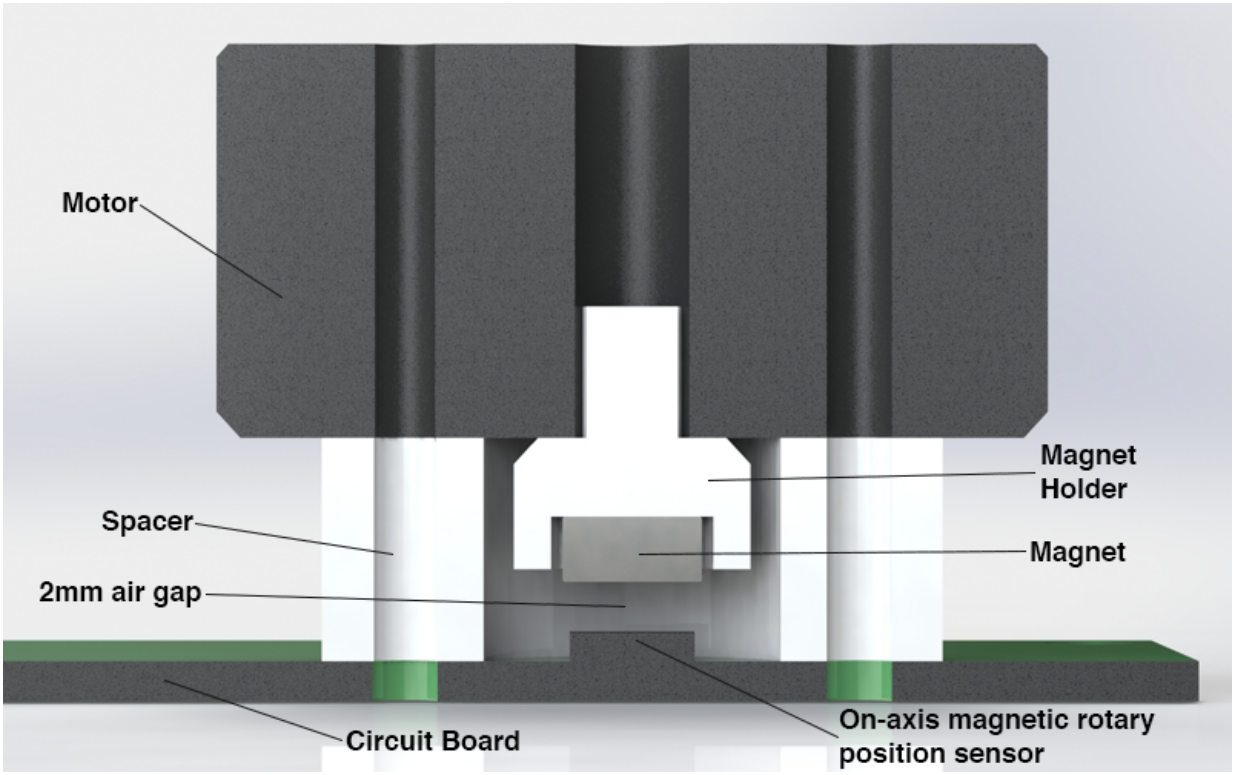


**Figure 2.1**: *Section View of Motorlab Assembly*

## 2.2 Old Motorlab

Need information here

# Chapter 3

# This is Chapter 3

Here are more examples of references to previous sections. In Chapter 1 there were several sections, including section 1.1, section 1.2, and section 1.3.

Likewise, in Chapter 2, there are sections 2.1 and 2.2.

# Appendix A

# Title for This Appendix

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# Appendix B

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