Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF AN AUTOMATED COMPUTER NUMERICAL CONTROL (CNC) ENGRAVING ROUTER SYSTEM

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours

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DEVELOPMENT OF AN AUTOMATED COMPUTER NUMERICAL CONTROL (CNC) ENGRAVING ROUTER SYSTEM

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A project report submitted
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DEDICATION

I am dedicating this thesis to my beloved mother, Kamsiah Binti Mohamad Siad, and father, Johari Bin Jelani, who always support and encourage me everything that I involve in and do during the whole time in my life without any doubt.

and

To all teachers and lectures that have taught me from not knowing an alphabet until I know and understand engineering discipline including about life.

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All my friends that some of them become family.

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ABSTRACT

Computer Numerical Control (CNC) is widely used in the industry. For a mini scale of CNC machine is only available only a single process. To develop a low cost mini CNC machine with three processes in one machine continuously without any post-process in every process using MKS DLC V2 board and GRBL firmware. This project integrated algorithm and electronic components from MKS DLC board and GRBL firmware with Arduino and relay for process switching. We did the machine accuracy evaluation by measuring the product length, which results in high accuracy of length cut in the range of 0.10mm.

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ABSTRAK

Computer Numerical Control (CNC) digunakan secara meluas dalam industri. Untuk mesin CNC skala kecil hanya tersedia satu proses sahaja. Dengan menggunakan MKS DLC V2 dan perisian GRBL untuk membangunkan mesin CNC mini kos rendah dengan tiga proses dalam satu mesin secara berterusan tanpa proses pasca dalam setiap proses. Projek mengintegrasikan algoritma dan komponen elektronik daripada papan MKS DLC dan perisian tegar GRBL dengan Arduino dan geganti untuk penukaran proses. Kami melakukan penilaian ketepatan mesin dengan mengukur panjang produk, yang menghasilkan ketepatan pemotongan panjang yang tinggi dalam julat 0.10mm.

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

TABLE OF CONTENTS

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF TABLES

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF FIGURES

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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LIST OF SYMBOLS

v - Voltage

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LIST OF ABBREVIATIONS

V	-	Voltage
MB	-	Manipulation Board
PSU	-	Power Supply Unit
CNC	-	Computer Numarical Control
mm	-	millimeter

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LIST OF APPENDICES

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CHAPTER 1

INTRODUCTION

CNC refers to a machine that has the ability to run a fabrication numerically of computer design by reading the G-code or M-code language and fully operating automatically without any human interference during the process. The design is made by any Computer-Aided Design (CAD) or Computer-Aided Manufacturing (CAM). CNC routers are used to produce a precise product for lighter material such as wood, plastic, acrylic, form and may work on soft metal like aluminum.

Engraving is one of the processes that can be done by a CNC machine. The method to do the process is by using different types of heads such as Spindle, Laser, Plotter, and Extruder depending on the suitable process. Engraving is a slow cutting process based on the shape designed by CAD or CAM.

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The flow of fabricating a product using a CNC router is started by using CAD or CAM to get a file that is suitable for any G-code converter. Then the converter program produces a G-code file for the CNC machine. The CNC controller will read, interpret and extracts commands code and move based on the G-code.

The CNC controller is a circuit board with an embedded system microprocessor chip to process the input data and control the output process. The controller algorithm will process the G-code and interpret it to the output. It will control the movement of the CNC router machine automatically base on the design created by CAD or CAM.

The project goal is to make a machine control system that integrates spindle laser and plotter to work in one sequence. This system will minimize the difficulty of machine operation, improve precision and reduce time in the head change process.

1.1 Background

Most of the small-scale CNC router machines have either spindle or laser and the double spindle is rare. Double spindle types are only used in industries for a specific operation. Few small-scale CNC router machines are exchangeable which can use one cutting element in one process. It needs to be fixed in and fix out manually. Each time the process change, the head needs to set a new datum point and level setting. The opportunity is innovating the machine to work with spindle laser and marker pen autonomously..

There are many parts in CNC router machine that can be modified, such as structure, material, working area, cutting tool, working table, clamping, and many more. This project is focusing on providing a system that can control these three elements. This is caused by one

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cutting element system will have its limitations. The machine can perform more operations as it has more cutting elements with a synchronized system.

The development of small-scale CNC machines with the integration of spindle, laser, and marker change control systems will increase production efficiency. The idea of the project is to place the laser source and a marker beside the spindle and make them work with one another in a single operation.

1.2 Problem Statement

Small-scale CNC routers machines have some cutting limitations. With one cutting element, the machine can perform one task only. Manual exchange of cutting elements leads to imprecision processing when in a mesh process and time consuming on head change. The system read only one specific task file either routing or lasering or plotting. The expectation for this project is to combine three types of feeders in one CNC machine system.

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1.3 Project Objective

The objectives of the project are as follows:

a) To design a control system that integrated laser, engraving, and plotter processes..

b) To fabricate a low cost CNC router machine that integrated laser, engraving, and plotter processes feeder.

c) To evaluate the accuracy of the design control system based on machining performance.

1.4 Scope of Project

This system design is focused on the automatic cutting elements change on spindle or laser and marker. This new integration of spindle and laser will increase efficiency. The machine will be developed by positioning the spindle, laser and marker closed to each other. It will be integrated by using machine language (G-code) and this combination will help users to cut and plot on any dimensions. The spindle will cut the large parts, the laser makes markings and cuts small curves, the marker draws the required part. This combination allows small scale machines to work with three tools within one process.

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