UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STUDY ON COMPUTER AIDED MANUFACTURING (CAM) SOFTWARE FOR A XY TABLE POSITIONING SYSTEM

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotic & Automation) with Honours.

By

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I hereby, declared this report entitled "Study on Computer Aided Manufacturing (CAM) software for a XY table positioning system" is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the Degree of Bachelor of Manufacturing Engineering (Robotic and Automation) with Honours. The member of the supervisory committee is as follow.

..…………………………….

Supervisor   : Mr. Shariman Bin Abdullah

Date   :

Stamp   :

ABSTRACT

This project is involves the study software design for CAM software for a XY table positioning system and create a CAM software that able to convert the parametric data from DXF file into the motion command for XY table. A few areas which are related are discussed such as motion control, CAD/CAM and XY table. A PC with motion control card will connected to XY table and software is needed to transfer the parametric data from drawing into instruction machine. The CAM software can be dividing into manually control and automatically control. In manually control, user need to key in number in term of pulse. In automatically control, the CAM software created is able to convert parametric data from General CAD software in DXF format into useable information with the help of Visual Basic, VB. The general CAD software used in this report is AutoCAD which is use to draw out simple drawing such as line, arc and circle. The drawing is saving as DXF file and this DXF file analyzed. The parametric data from DXF files will be extract out by using VB and process it into instruction machine. This instruction machine received the parametric data and send to the motion control card to control the XY table. Then the software is tested by using some simple drawing such as line, arc and circle to see the capability of CAM software in control the XY table according to the drawing. The result is using a marker pen to draw out the path of the XY tables. The drawn path is drawing on a graph paper for dimension measurement is same as the DXF file data in shape.

ABSTRAK

Projek ini melibatkan pengajian pada reka bentuk satu perisian CAM bagi mengawal pergerakkan XY meja dan menciptakan satu perisian CAM yang dapat menukarkan informasi dari DXF kepada arahan mesin untuk XY meja. Pengawalan gerakan, "CAD/CAM" dan XY meja akan dibincang. Satu PC dengan kad pengawalan gerakan akan disambung dengan XY meja dan perisian komputer diperlukan untuk menukarkan dimensi data dari perisian kepada maklumat berguna menjadi arahan mesin. Perisian CAM boleh dibahagikan kepada secara tangan dan secara automatik. Cara secara tangan adalah masukan number secara diri sendiri. Bagi cara secara automatik pula, perisian CAM dicipta dan menukarkan kepada perisian CAD dalam bentuk DXF dengan menggunakan VB. Secara umumnya, perisian CAD yang digunakan adalah AutoCAD untuk melukiskan lukisan yang mudah seperti bulat garisan, lengkungan dan bulat. Lukisan ini dikehendaki simpan dalam bentuk DXF. Maklumat dari DXF akan dikeluarkan dengan VB dan diproses menjadi arahan mesin. Arahan mesin ini akan berkerjasama dengan kad pengawalan gerakan untuk mengerakkan XY meja. Kemudian, perisian yang dicipta ini akan diuji dengan lukisan mudah untuk menunjukan kebolehan perisian untuk menukarkan dimensi data dari lukisan kepada arahan mesin untuk XY meja. Kemudian perisian itu diujikan untk melukis garisan, lengkungan dan bulatan supaya perisian CAM itu boleh menggerakkan XY meja sama dengan lukisan. Pen marker digunakan untuk melukis di atas XY meja. Dimensi yang dapat dilukis di atas graf adalah sama dengan bentuk data DXF.

DEDICATION

This report is dedication to my supervisor, Mr. Shariman Bin Abdullah and not forgotten to my parents, and to all my friends who have help me in this project.

ACKNOWLEDGEMENT

I would like to take this opportunity to thank my supervisor Mr. Shariman that give a lot of supports, supervises, encouragement, patience and constructive opinions throughout this project.

I am grateful for the cooperation and guidance which are given by my friends. First of all, I really appreciate the kindness of my friends who gave me so much important information about the project and willing to help me answering my entire question without hesitation.

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LIST OF ABBREVIATIONS

CAD - Computer Aided Design

CAM - Computer Aided Manufacturing

CAE - Computer Aided Engineering

CNC - Computer Numerical Control

CPU - Computer Power User

DXF - Drawing Exchange File

EMC - Embedded Motion Controller

ISA - Industry Standard Architecture

NC - Numerical Control

PC - Personal Computer

PCI - Peripheral Component Interconnect

PLC - Programmable Logic Controller

UPL - User Programming Language

USB - Universal Serial Bus

VME - Versa Module Europa

CHAPTER 1

INTRODUCTION

1.1   Introduction

Nowadays to manufacture a part, three different software programs are used which is CAD software, CAM software and control software. CAD software is used to make the design of the part, whereas CAM software is used to generate the NC program based on the drawing from CAD software. The last one, Control software, is used to read the NC program and let the machine actually move along these paths. This 3 procedures are consumes a lot of time in manufacturing process. Therefore, in this report, a method to shorten the procedures is proposed. This method is to convert the parametric data from drawing directly into instruction to move the XY table.
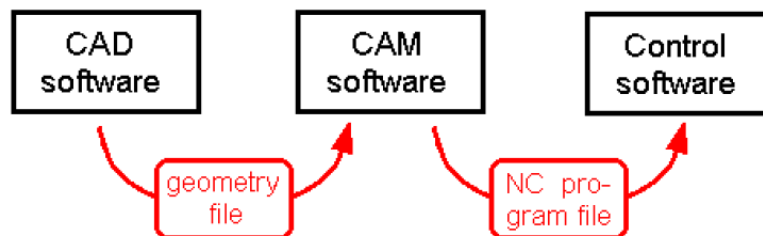
Figure1.1: The position of CAM Software in the process

1.2   Objective

The objectives of this project are:
- To create software can convert CAD data to command for control XY table.
- To create a graphical user interfaces to easy use the software.

1.3   Problem Statement

Nowadays, in order to convert parametric data from drawing to instruction for machine, CAM software is require converting the parametric data from drawing into NC program file. This NC program file will later convert by control software of machine into the instruction for machine such as XY table. All these procedures take times to accomplish and are consider as a waste. Other than that, it is also troublesome and inconvenient to use different software in converting a drawing into instruction for machine.

1.4   Scope

This project is involves the software design for CAM software for a XY table positioning system. In this project, the CAM software converts the parametric data from CAD software. The CAD data is in the form of AUTOCAD DXF files whereas includes CAD drawing parametric data. Other than that, CAD data convert the instruction data such as line, circle and arc in the 2D data to motion controller card for move the XY table positioning system to a position based on the CAD software. It is also to understand the application of Visual Basic.

1.5　Gantt chart

Tasks	PSM I (Weeks)														PSM II (Weeks)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Project determination	■	■																										
Review topic		■	■	■																								
Literature review					■	■	■	■	■	■																		
Methodology									■	■	■	■																
Report Submission												■	■															
Preparation & Presentation													■	■														
Project Planning															■	■												
Data collection																■	■	■										
Generate Software																		■	■	■	■	■	■	■	■			
Modification																				■	■	■	■	■	■	■		
Testing																						■	■	■	■	■		
Report Submission																										■	■	
Preparation & Presentation																											■	■

Figure 1.2: Gantt chart PSM I and PSM II

CHAPTER 2
LITERATURE REVIEW

2.1   Introduction

This project involves the study software design for CAM software for a XY table positioning system. The CAM software will convert parametric data from General CAD software to move the XY table by using the motion controller card. So, in this section there are some field involving in this project such as CAD/CAM, motion controller and XY table.

2.2   Computer Aided Design (CAD)

Computer Aided Design (CAD) is the technology concerned with the use of computer systems to assist in the creation, modification, analysis, and optimization of a design. The basic function of CAD is to define the geometry of design, such as a mechanical part, a product assembly, an architectural structure, an electronic circuit and a building layout.

An engineer would prepare a blueprint manually for the total product, including the tooling to produce the product. Other than that, other engineers would provide the drawings for their specialized area. These would be used throughout the product development process and updated or changed as the process continued. This process was very expensive in terms of time and money. CAD has improved the process a lot and reduced dramatically the development costs and time. [Ed. Richard C. Dorf, 2000]

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CAD allows different layers to be created, which is allows other software to take the part geometry from each layer and assign different tools to machine it. Furthermore, the computer also allows design to be viewed and tested before manufacturing. CAD systems stress-test parts to meet the strength requirements of the application. Graphics capabilities allow three-dimensional (3D) viewing of parts from any angle. The CAD systems also can export the CAD part file in Drawing Exchange File (DXF) format. The following is some advantages of using the CAD system. [Helmi A. Youssef, 2008]

    i. Increase the productivity of the designers
    ii. Create better designs
    iii. Reduced design timescales
    iv. Reduce redundant effort
    v. Reuse of designs
    vi. Allow easy and rapid modification of prints
    vii. Drawing errors can be corrected easily.

2.3   Computer Aided Manufacturing (CAM)

Computer-aided manufacture (CAM) is the technology concerned with the use of the computer into the manufacturing process, including such tasks as control the manufacturing operations through computer interface with the plant's production resources and controlling real-time production devices on the factory floor. [Mish, K.D. and Mello, J., 1999]. One of the most important areas of CAM is numerical control (NC). This is the technique of using programmed instructions to control a machine tool that cuts, mills, grinds, punches or turns raw stock into a finished part. Another significant CAM function is in the programming of robots. Process planning is also a target of computer automation.

CAM is a general term used to describe the complete range of computer applications in direct manufacturing activities. At the heart of CAD/CAM is the relationship of the design process to the machine programs of the manufacturing facility. The effectiveness and efficiency of this linkage has been one of the prime reasons for enhancing the accuracy and reliability of the product development process, shortening the manufacturing process times, and hence shortening the product introduction time and improvement in overall productivity. [Ed. Richard C. Dorf, 2000]

The following is a list of features of modern techniques:

- The programmer can relate with the model graphically to make the necessary adjustments and modifications before the CNC code is generated.
- CAM allows the programmer to develop a model that represents the part and the machining operations.
- CAM software can reads the DXF that has the part geometry and the levels that the geometry exists on.
- CAM software uses a job plan to assign the correct tool path to each level.
- The job plan knows the work material that will be used so that it can calculate speeds and feeds for each tool. [Helmi A. Youssef]

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2.4   Computer-Aided Design and Manufacturing (CAD/CAM)

The development of CAD/ CAM systems started in 1950s. A computer MIT was first used to generate simple pictures on a Cathode Ray Tube (CRT) display. During late 1950s the Automatically Programmed Tools (APT) was developed and General Motors began to explore the potential of interactive graphics. 1960s was the most critical research period for interactive computer graphics. As computer graphics become more developed, CAD began to establish as a technique when computer graphics was used in the design process. [Y C Kao* and G C I Lin*, 1996]

In the early 1970s, CAD systems with drafting and modeling capabilities become available. The new capabilities such as Finite Element, Analysis, and NC milling and Turning were added to these systems to help productivity. In the 1980s, CAD/CAM research took place, and new CAD/CAM systems the various elements of design and manufacturing. Then, the CAD/CAM system is including more applications such as mechanism and robotics analysis, and injection molding design and analysis. In the 1990s, when the new manufacturing algorithms and capabilities are developed, the CAD/CAM technology will become more mature. The faster computer hardware such as PC and workstation also are available.

Computer-aided design (CAD) and manufacturing (CAM) are defined by the use of computer software and hardware to assist in the manufacturing process. Inasmuch as the software is used to "drive" the production machinery in CAM, CAD is the use of software and hardware to assist in the design process.

CAM is a simply of the computer's use in the context of the manufacturing process. According to the Automation Encyclopaedia, CAM involves many different activities, including on-line planning, tool design and production, computer-numerical control (CNC), automated assembly, computer-aided process planning, scheduling, automated materials handling, and robotics. [Ed. Richard C. Dorf , 2000]

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2.4.1 CAD/ CAM Approach

The integrated CAD/CAM approach prepares the part program directly from the CAD part geometry by using NC programming commands. Other than that, the CAD/CAM system also can by passing the CAD geometry into a dedicated CAM program. The CAD drawings can be changed to CNC programs by using CAD/CAM systems. The CAD/CAM approach has the following advantages: [Helmi A. Youssef, 2008]

  i. Do not need to encode the part geometry and the tool motion
  ii. Allows the use of interactive graphics for program editing and verification
 iii. Displays the programmed motions of the cutter and allows visual verification of the program
  iv. Allows interactive editing of the tool path with the addition of the tool moves and standard cycles
   v. Includes the most sophisticated algorithms for part programming generation

The programming steps for CAD/CAM approach are as follows: [Helmi A. Youssef, 2008]

1. The aspects of the part geometry that are important for machining purposes are identified; geometry may be edited or additional geometry added to define boundaries for the tool motion.
2. Tool geometry is defined; for instance, by selecting tools from a library.
3. The desired sequence of machining operations is identified and tool paths are defined interactively for the main machining operations.
4. The tool motion is displayed and may be edited to refine the tool motion, or other details may be added for particular machining cycles or operations.
5. A CLDATA file is produced from the edited tool paths.
6. The CLDATA file is post processed to MCD, which is then transmitted to the machine.

2.4.2 Application CAD/CAM System for Deep Drawing Dies

In the middle of the methods of sheet metal forming, deep drawing is that most commonly used. However, the traditional process design of deep drawing is performed by human experts with their empirical knowledge. In recent years, some computer-aided process and die design systems based on the empirical knowledge of the field experts have been developed for axisymmetric deep drawing products. Tisza's work describes a modular CAD/CAM system, in process, for developing deep drawing process sequences and designing tools for the manufacture of sheet-metal components having axisymmetric and rectangular cross-sections [M. Tisza, 1987]. Furthermore, Sitaraman et al. developed a hybrid computer-aided engineering (CAE) system for automatic process sequence design for the manufacture of axisymmetric sheet-metal components. [S.K. Sitaraman et al, 1991]

At here, a CAD/CAM system for axisymmetric deep drawing processes has been developed. The inputs of the CAD/CAM system are the results of Pro–Deep [S.B. Park et al, 1998]. The system, Pro–Deep, is the process design of a deep drawing system for axisymmetric products [E. Doege et al, 1998]. A knowledge based approach is employed for the system. Under the environment of CAD/CAM software of Personal Designer, the system has been written in User Programming Language (UPL). The part drawings of die sets for each process are generated in the tool design module of the CAD/CAM system. Besides that, the die assembly drawings can be obtained. NC commands for the machining of the part can be generated in the developed CAD/CAM system. Other than that, the system can be applied to a blanking die set and deep drawing in a simple-action press.