IMPLEMENTATION OF AUTOMATION PROCESS IN GENERATING CAD MODEL

AZHAR BIN SHAFIE

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

IMPLEMENTATION OF AUTOMATION PROCESS IN GENERATING CAD MODEL

AZHAR BIN SHAFIE

This report is submitted in fulfillment of the requirement for the degree of Bachelor of Mechanical Engineering (Design and Innovation)

Faculty of Mechanical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MAY 2017

APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design and Innovation).

Signature   :

Name of Supervisor   : DR BASRI BIN ALI

Date   : 12/7/2017

DECLARATION

I declare that this project report entitled "STUDY ON AUTOMATION OF GENERATING CAD MODEL" is the result of my own work except as cited in the references

Signature :

Name : AZHAR BIN SHAFIE

Date :

i

DEDICATION

To my beloved family, my future wife, supervisor and friends

ABSTRACT

The purpose of this study is to develop a program that allow the automatic generation of Computer Aided Drawing (CAD) model by implement concept of automation process in CAD software. Automation process has been widely used in industrial field that give positive feedback in terms of its convenience in the drawing process and time saving. An automation be able to help human on completing a job without the excessive work and energy required.

Automation process have a high reliability and more accurate in getting the best result in job instead of traditional drawing process and conventional use of CAD software. It also allow human to carries a multiple task in design creation for a shorter time. The program of automation will be develop using the application of Macros tools in CAD software. For this project, the CAD software that has been used to be an example for the case study is Computer Aided Three-dimensional Interactive Application (CATIA) software. The version used is CATIA V5 R21.

The system consist of two stage of developing process, which is the first part is the construction process for the CAD model and the second one is the coding development process. The model which for this project is a car rims is first created and recorded in CATIA through the recording tools in Macros without any mistake happened during the modeling process. Then the coding script of the recorded process can be called in the Macros tools to be edited and developed so that the automation process can work with the model.

The coding are developed by implying the usage of Visual Basic language in Visual Basic editor in CATIA. The important parameter coding line for creating the basic shape of the model are identified and modified in order to synchronize the model and the input system.

iii

For this project, there are four main parameter that has been identified which is rim diameter, rim width, number of rim spoke and number of bolt hole. These parameter is required in the editing process when applying the application of dialogue box in VBA such as the user form. Original parameter is changed into the userform tools so that the input from the userform can be transferred into the model. The final model supposed to have an ability to alter into three different design with different parameter dimension.

ABSTRAK

Tujuan kajian ini dijalankan adalah untuk mencipta sebuah program yang boleh menjana sesebuah model lukisan secara automatik dengan menggunakan software Lukisan Berbantukan Komputer (CAD). Proses automasi telah digunakan secara meluas dalam bidang industri yang memberi maklum balas positif dari segi kemudahan dalam proses lukisan dan penjimatan masa. Proses automasi dapat membantu manusia untuk menyiapkan suatu pekerjaan tanpa urusan yang berlebihan dan tenaga yang diperlukan. Proses automasi mempunyai kebolehpercayaan yang tinggi dan lebih tepat dalam mendapatkan hasil yang terbaik dalam pekerjaan dan bukannya proses lukisan tradisional dan penggunaan konvensional perisian CAD. Ia juga membantu manusia untuk melaksanakan suatu tugasan yang pelbagai dalam proses penciptaan reka bentuk untuk jangka masa yang lebih pendek. Program automasi akan dibangunkan menggunakan aplikasi alatan Makro dalam perisian CAD. Untuk projek ini, perisian CAD yang telah digunakan untuk dijadikan sebagai contoh rujukan kajian adalah Permohonan Interaktif Perisian Tiga Dimensi Berbantukan Komputer (CATIA). Versi yang digunakan adalah CATIA V5 R21.

Sistem ini terdiri daripada dua peringkat dari segi pembangunan proses, di mana bahagian yang pertama adalah proses pembinaan untuk model CAD dan yang kedua adalah proses pembangunan kod program. Model rujukan dibina dan proses pembuatan model direkod di dalam CATIA melalui penggunaan alat rakaman dalam Macros tanpa melakukan sebarang kesilapan semasa proses pemodelan. Kemudian skrip kod program untuk proses pembuatan model yang telah dirakam boleh dikeluarkan semula di dalam alat Makro di mana ianya akan disunting dan dibangunkan supaya proses automasi boleh bekerjasama dengan model.

v

Proses pembangunan kod program dibangunkan dengan aplikasi penggunaan bahasa program Visual Visual yang sedia ada di dalam CATIA. Garis parameter proses pembangunan kod yang penting dalam proses pembinaan bentuk asas model perlu dikenalpasti dan disunting untuk menyelaraskan hubungan model dan sistem input. Untuk projek ini, terdapat empat parameter utama yang perlu dikenalpasti iaitu ukur lilit rim, lebar rim, bilangan jejari rim dan bilangan lubang bolt. Parameter-parameter ini perlu ada dalam proses penyuntingan semasa mengaplikasikan penggunaan *dialogue box* di dalam Visual Basic. Nilai parameter asal digantikan dengan arahan dari aplikasi *user form* supaya nilai input dari *user form* boleh dibaca oleh model lukisan. Hasil akhir model tersebut haruslah mempunyai keupayaan untuk mengubah bentuk ke dalam tiga reka bentuk yang berbeza serta ukuran parameter yang berbeza.

ACKNOWLEDGEMENT

I would like to express a highly special thanks to my project supervisor Dr Basri Bin Ali that continuously supporting and guiding me in knowledge and asset during this semester. A lot of knowledge that I received during last year in completing final year project and I indebted to who had made this final year project successful achieve the objective.

Also to mention, special thanks to my parents and family members who have supported me to complete this project in and encourage me in terms of spirits and financial assistance. And also thanks to my special love, Noor Farahana Binti Abdul Rahman who always support me in achieving the success of my coding process. Not to forget, thanks to all my friends and postgraduate students whom involved in this project. Last but not least, I would express my gratitude to the community in VB-Forum website who is willing to share with me their knowledge and give advice about my final year project. I also want to express my thanks to all person who involved in making this final year project possible to be done.

TABLE OF CONTENT

ix

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviation	Definition
CAD	Computer Aided Design
CATIA	Computer Aided Three-dimensional Interactive Application
CAE	Computer Aided Engineering
CAM	Computer Aided Manufacturing
CTR	Click-Through Rate
GRIP	General Interactive Processor
SAGE	Semi-Automatic Ground Environment
2D	Two-Dimensional
3D	Three-Dimensional
MIT	Massachusetts Institute of Technology
PRONTO	Program for Numerical Tool Operation
PDM	Project Data Management
IBM	International Business Machine
VB	Visual Basic
VBA	Visual Basic Advance
VBScript	Visual Basic Script
GUI	Graphic User Interface
IDE	Integrated Device Electronic
DLL	Dynamic Linked Libraries

CHAPTER 1

INTRODUCTION

1.1   OVERVIEW

Project designing is one of the vital process in every manufacturing industries. Computer Aided Design (CAD) is the use of computer systems to assist in the creation, optimization, modification, or analysis of a model for a design. The CAD modeling systems were developed to reduce time, cost and to minimize the trial and error adjustments.

A brief history of CAD shows that the first graphic system that was created was in middle year of 1950 by the US Air Force's SAGE (Semi-Automatic Ground Environment) air defense system. The system was developed at Massachusetts Institute of Technology's Lincoln Laboratory and involved the usage of Click-Through Rate (CTR) displays to show computer-processed radar data and other information.

Then in the year 1957, Dr. Patrick J. Hanratty which also known as "the Father of CAD/CAM" for his pioneering contributions to the field of computer-aided design and manufacturing, has developed the first commercial numerical-control programming system known as Program for Numerical Tool Operation (PRONTO). In year 1960 at Massachusetts Institute of Technology (MIT) Lincoln Laboratory, a person named Ivan Sutherland has produced a project called SKETCHPAD, which is considered as the first step to CAD industry.

1

In the past year CAD system softwares have their individual scripting languages for automation. Examples include AUTOLisp script language for AutoCAD and General Interactive Processor (GRIP) language for Unigraphics. But later with the use of Windows building blocks in CAD interface development, Visual Basic is used for scripting for all the modelling softwares such as Unigraphics, CATIA, SolidEdge, and SolidWorks.

Figure 2-1 Example of available cad software nowadays(Yip-Hoi, 2010)

The main purpose of the CAD is to create a prototypes to represent the construction of some system of interest while satisfying certain requirements of a user in an innovative way. As the CAD modelling techniques become more and more advanced, there is a need to complete the product modelling and design changes faster than ever. Updating the assemblies having hundreds of sub-assemblies and parts manually in Three-Dimensional (3D) modelling software is very complicated & time consuming.

The CAD models that have large number of parameters and high memory required more graphics and time to process the data. Hence updating the models affect the product lifecycle. A single error in the input data causes fatal error in the output results. To reduce the development time, minimizing the errors and introduce technologies faster to the market, many companies have been turning more and more to automation process.

2

Figure 2-2 Example of product modification by automation

With the increasing demands and competition in industries nowadays, four important aspects are needed to be considered which are low cost, shorter lead time, improved product performance and the possibility to adapt products to different costumer specifications. One of the way to achieve these requirement is by adopting an approach where products are based on prepared design.(Chandrasegaran et al., 2013) By doing this, the design process can become more effective and efficient as if some of the work related to these products and design tasks are automated. The realization and implementation as well as its applicability of the automation method has given advantages to industry in terms of designing process as its allows for the shortened lead-time of product designs, cost reduction, more optimized product designs and customer tailoring, while giving the designers more time for creative problem solving.

Basically, the automation process in CATIA can be done with the usage of macros tools application. Macros use the Visual Basic language in the programing script for the coding. Through the application tools in Visual Basic programing such as dialogue box, interaction between the user and the program can be created without a problem.

3

1.2 PROBLEM STATEMENT

Instead of repeatedly creating the similar models or changing the parameters in the same models, engineers should be able to create program so that it automatically creates the new CAD models or to generate the further modification of the same model. This project shows the procedure for automation to generate the CAD models on the basis of coding by using the macros programming software in CATIA.

The automation process are meant to help in reducing the development time of a product especially in mass production industry. The process not only saves time, but also increases quality of data input for a model and minimizing the possibility of human errors. Thus, this criteria will lead to increasing in terms of productivity.

Commonly, most individuals have a different demand in the order of a product they wanted to have. This may causes a problem in the production process as different design are required to fulfill the different demand of the customer. So the automation are needed to solve this situation and ease the ordering process of a product. For an example, a shop that using the automation process can create a simple form from the application of CAD automation where the customer can order their product easily through online or personally at the shop. The customer are only needed to put in the parameter that they wanted in the order form and the design of the product will be automatically created in the CAD and the can see the model. This can be apply in many type of product such as the grill in the front car's bumper. As the customer need a special tools editor when they want to purchase their demanding product, this project can act as the platform to produce ordering method in more systematic way and also with the graphics display. Once the model has been selected, then the product can undergoes the manufacturing process such as rapid prototyping and adaptive manufacturing. This paper shows the macro programming method for generating the CAD models in CATIA.

4

1.3   OBJECTIVES

The main purpose of the work is to shift from manual modelling method to CAD automation process. The objective of this research are details as follows:

- To study the development of cad automation drawing.

- To develop the programming for standard part using CATIA programing.

1.4   SCOPE

This research project primarily focuses on how the automation work in CATIA V5 software. The project will include:

- A modelling of part design of three type of rim wheel with different pattern by using the CATIA software.

- Creating the script of coding by using visual basic language in macros tool.

- Executing and testing the coding.

- Make an adjustment and editing to the coding to fill the programming requirement

5

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL CAD DEFINITION

Computer Aided Design (CAD) is defined as a system that includes the use of information technology in the Design process. A CAD system consists of information technology hardware, specialized software (depending on the particular area of application) and peripherals. System software is the core in a CAD system, which makes use of graphics for product representation. For example, the usage of databases for storing the product model and drives the peripherals for product presentation. The application of CAD does not change the landscape of a process in design modeling but as stated in the definition of CAD itself, it aids the user to design a product.

The application of CAD initiated in the MIT from Ian Sutherland, when the first system which known as Sketchpad was created within the SAGE research project. At first, industry in automotive and aerospace field were the first users and the forerunners of development of CAD technology. The first system were very expensive as in those period of time the computer graphics technology was not so advanced and flourish yet.

The application and usage of CAD are listed as follows:

- Accurately generated and easily modifiable graphical representation of the product. The user can nearly view the actual product on screen, make any modifications to it, and present his/her ideas on screen without any prototype, especially during the early stages of the design process.

- Perform complex design analysis in short time.

- Implementing Finite Elements Analysis methods, the user can perform: Static, Dynamic and Natural Frequency analysis, Heat transfer analysis, Plastic analysis, Fluid flow analysis, Motion analysis, Tolerance analysis, Design optimization.

- Record and recall information with consistency and speed. In particular, the use of Product Data Management (PDM) systems can store the whole design and processing history of a certain product, for future reuse and upgrade. The technique initiated in the MIT from Ian Sutherland, when the first system.(Yip-Hoi, 2010)

2.2   CAD AUTOMATION

The automation can be defined into three categories which is design automation, manufacturing automation and administrative (or control) automation. For design automation, the process are related to the computer assisted drafting, design and engineering. The next one which is manufacturing automation is the use of various control systems for operating equipment such as machinery, processes in factories, and other applications and vehicles with minimal or reduced human intervention. Some processes have been completely automated by the computer controlled processes. Lastly for administrative automation is for computerized accounting, inventory control system and shop floor tracking system. (Ali & Ibrahim, n.d.)

7

Over the past 20 years, computer-aided design (CAD) software have become a mainstream media in most industry as a tools for project designing. As the time passing, the software has rapidly evolving and continuously improve to become a programs with enormous capabilities and function. (Lowe & Hartman, 2000) CAD software always been related with the automation since the beginning history of CAD as creating and editing a Two-Dimensional (2D) and 3D model is faster when using a computer compared to manual hand drawing. But despite how intuitive and advance the development of the existing CAD system, most user still desperately manually doing the same bland CAD translation and repair work. Because of that, the application of CAD automation can help to ease the operating process by the user.(Venkatesan & Karnan, 2009)

The concept of CAD automation enables the user to automatically created the design or adjusting the method and process of the already made design to fulfill the criteria of the new design. The process allows the user to automate translation and repair processes of the design that are already in large part by enabling users to translate multiple files at one time without having to open or view them graphically.(Ramly et al, 2013)

There are two method that commonly used for CAD automation which the first one is by manually writing a complete programing code and other one is the application of macro tool in the modeling software. Depending on the applications and the requirement for the desired model, a particular method that is suitable is used.(Weisenberger, n.d.)

2.3   CATIA

CATIA (Computer Aided Three Dimensional Interactive Application) is one of the modeling software that available for use. It is a multi-platform software commercially used for Computer Aided Design (CAD), Computer Aided Manufacturing (CAM) or Computer Aided Engineering (CAE) software suite and is a world leading software for those

© Universiti Teknikal Malaysia Melaka

application. CATIA is developed and owned by French company Dassault Systems and it is marketed worldwide by International Business Machine (IBM). (Wayzode, 2012)

Catia is the first generation for the graphic terminal. Initially, the primary objective and application of Catia was to develop a software to define the shape of an airplanes which began at Dassault Aviation in 1967. From years to year, the development of CATIA keeps to progress further into more applicable and intuitive software. (Bernard, 2003)

Basically, the structure creation of programming line for CAD software is differ depending on type of CAD software used. As for CATIA V5 program structure, revolve around four main criteria where it is start with the part body, then sketch plane, definition of the axis for the sketch and lastly apply additional feature to convert a two dimension sketch into a three dimensional object.(Wayzode, 2012)

CATIA offers the ability to write or editing the programing script of a model through the application of macro tool. A macro recorder in the macro tools help to ease the automation of CAD in CATIA software. The programmer, need to be familiar with the variety of design interest and requirement before recording the macros. The general aspect that needed to be considered for the designer is the information on the requirement of the parametric design, understanding the flow of the macros programming and how to overcome the problem with error from the program line or command.(Ramly et al. 2013)

The advantage of using the CATIA automation is it helps in terms of reducing the cost by improving the efficiencies in drawing and better quality through standardization. While in terms of customization it provides additional functionality which are not provide in the native products. It also help to manipulate the existing function to better fit the customer processes.(Wayzode, 2012)

9