REDESIGN AND ENHANCEMENT OF MULTIFUNCTION CATERPILLAR

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This thesis is submitted to the Faculty of Mechanical Engineering in partial fulfillment of requirement for the degree Bachelor of Mechanical Engineering (Design & Innovation)

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DECLARATION

I hereby the author, declare this report entitled "REDESIGN AND ENCHANCEMENT OF MULTIFUNCTION CATERPILLAR" is my own except for quotations and summaries which have been duly acknowledged.

Signature : .....

Author : MOHD RODZI B HASAN

Date : 8 MAY 2007

DECLARATION

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

Signature : .....

Name of Supervisor : MR MOHD RUZI B HJ HARUN

Date : 8 MAY 2007

DEDICATION

To beloved my mother, Hjh ROKIAH BT A. BAKAR and family, to my supervisor Mr. MOHD RUZI B. HJ HARUN, and friends.

Thank you for the motivation and full support.

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ABSTRACT

Nowadays robot is used widely in industries and other field. The technologies of the robot grow rapidly due to the applications and works. Out there have many research and development (R&D) for the robot of individuals and parties. The lot of researches and R&D help many sides especially in industries. It is because they want the production come out in big quantity but less time. The application of robot is to replace and as the assistant for human at various work. Some job only can be perfectly done by technologies. According to the technologies, it also affects the method of HVAC inspection. The problem of ducting inspection is un-ability of human to crawl along the ducting to do inspection. This is especially to located the ducting crack or find any problem along the ducting. Air duct robot become as human eyes to inspect the critical location on the ducting. The existing robots are very expansive and limited function. At certain robot was the same mechanism but difference of the material and the structure. For this project will be develop new mechanisms that can apply to the air duct robot. A simple mechanism is used to reduce the cost but high efficiency of the function.

ABSTRAK

Pada masa sekarang penggunaan robot amat meluas di dalam industri-industri dan juga di bidang lain. Teknologi tentang robot membangun dengan pantas bersesuaian dengan penggunaan dan kerja yang dilakukan. Pelbagai penyelidikan dan pembangunan (R&D) dibuat oleh individu dan pihak-pihak yang berkaitan. Kajian ini diharap dapat membantu dalam pelbagai bidang terutama sekali bidang perkilangan. Ini kerana bidang perkilangan amat mementingkan kuantiti produk yang banyak pada masa yang terhad. Penggunan robot bertujuan untuk menggantikan tenaga manusia dan membantu dalam semua kerja. Sesetengah kerja hanya dapat mencapai kualiti yang tinggi dengan penggunaan robot. Berdasarkan teknologi, ia juga mempengaruhi kaedah dalam membuat pemantauan HVAC. Pemantauan HVAC adalah di luar kuasa manusia untuk masuk ke dalam HVAC dan membuat pemeriksaan terutama sekali untuk membuat pemeriksaan retakan dan di sepanjang HVAC. "Air duct" robot akan menggantikan manusia di dalam membuat pemantauan. Robot yang sedia ada terlalu mahal dan penggunaannya amat terhad. Sesetengah robot mempunyai fungsi yang sama tetapi berlainan bahan dan rangkanya. Projek ini akan membangunkan satu mekanisma yang akan dapat diaplikasikan kepada "air duct" robot. Mekanismanya mudah tetapi akan mengurangkan kos dan meningkatkan kecekapannya.

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2 LITERITURE REVIEW

3 PRODUCT CASE STUDY

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Air ducting robot is device to monitor, check and clean the air duct system. The air duct robot is control by human operator from distance. Its can travel trough to air duct system. It rides on chain track by using stepping motor as their engine. The concept of the robot is like military tank. This is because chain track can move in all situations like plain, hilly and it can climb if the has a resistance and also can move through in flat or circle ducting. Air duct robot can measure the dept if ducting also can measure the temperature. It also can clean the dust by using a brush that rotated at high rpm. These robot designs to make inspection in the system where human cannot detect the specific area of defect occur.

This type of duct robot can use at any position either under or above the ceiling because is very light. The factor that occur the design is the functional of the robot use. It uses to replace the human that cannot into the ducting because some of factor. This is because the size of ducting cannot support the size of human body. Another is human body so heavy and it can collapse the ducting. Human also cannot detect crack along ducting system. So robot is the best solution to solve the problem. Normally, this kind of robot can be use by JKR and Environment & Health Department to make sure the

ducting system is operated without any problem. Air duct robot being design to solve the problem in inspection on temperature or the air duct system either in good condition or not. So the concept of the robot can be applied for all company that supplied the air-conditional or provide that service.

1.2 PROBLEM STATEMENTS

Heating and cooling system components can become contaminated with pollen, dust, mold, and other debris if not properly installed and maintained. These contaminants may cause allergic reactions in some sensitive people. To clean it, there has no enough space to enter in the ducting. So the objective of this project is improving and designs a new robot for cleaning in the ducting.

The current design there has a camera but limited because it use a wire as their connection to supply an electric source. For s certain robots they design wire less but they not attach with thermometer to measure a temperature in the ducting. This two devices is important to inspection because in the ducting system there has a bacteria and a lot of dust that hold the system efficiency.

At the certain robot there has a wheel as their device to move it but a certain robot there used a flat track. Each type has an advantage but the best one is flat track. The material that use is to heavy and not suitable for ducting system and might cause a problem.

1.3 OBJECTIVES OF PROJECT

The objective of this design is to make sure to achieve the goals in order to face the problem in real life although to create a simple design but multi function of air duct robot.

1. To design structure for the robot but less cost by choosing the best material.
2. To making analysis for the structure to make sure the specification that was needed is achieve.
3. To improve the current design and become more functional

1.4 SCOPES OF PROJECT

To achieve the entire objective, there a have a few scope of project as a guideline in order to make this project become reality:

1. Creating design concept of air duct cleaning robot regarding to benchmarking (existing product).
2. To create mechanism and function more efficiency and simply.
3. To design structure of air duct and choosing the best material to applied it.
4. Making analysis like forces that were create from vibration by Catia analysis software

1.5 METHODOLOGIES

Air duct system is produce to supply the air to a building or to flow out the non used air out the building. Heating, ventilation, and air conditioning systems accumulate all types of contaminants including construction debris and dust. This debris and any mold or bacteria thriving inside dirty air duct systems can have a negative impact on the quality of the indoor air in a building. For a long time, the system can't function smoothly. So cleaning in the system must do to remove the dust. The big problem is the hole is too small for human to inside it. Robot is the best solution to keep monitor and

clean it inside the hole. A clean air duct system creates a cleaner, healthier indoor environment which increases efficiency and lowers energy costs. A few concepts were generating before starting doing this project. The concepts generations have done are:-

1. Brainstorming
2. Surfing Internet
3. Case study

- **Brainstorming**

  From discussion with lecturer, 20 concepts were created. Some information was get with Jabatan Kerja Raya (JKR) and other companies that made and supply a duct hose. Lecturers from Faculty of Electronic also help and give some idea to make this project successful.

- **Surfing Internet**

  Internet is very helpful in saw the market demand on this product and to overcome the problem of can. Other reason is to get some information about the problem of the community. All of the current markets today not fulfill the consumer needed and a little bit of upgrade from the current product.

- **Case Study**

  To apply our study like static, dynamic, manufacturing, solid mechanic and mechanical engineering design also design software like Catia and AutoCAD. This is for to combine the theory and practical to make the product success.

1.5.1 FLOW CHART

Flow chat (refer *figure 1.1*) show how the flow in creating multifunction caterpillar. The chart show the process start until complete the product. The flow chart is divided in two sections. First is PSM 1 and second is PSM II.

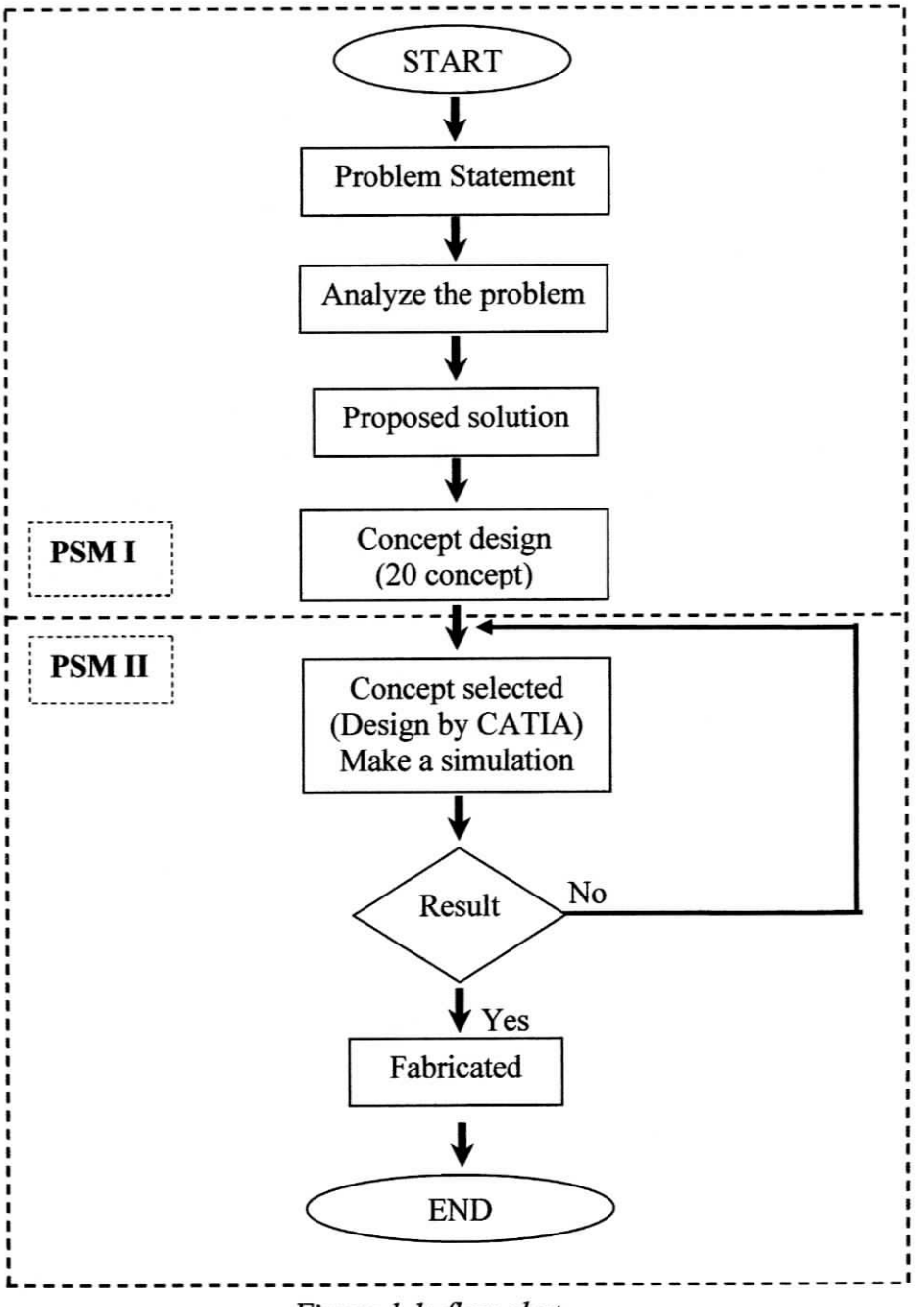

Figure 1.1: flow chat

1.5.2 METHODOLOGY EXPLANATION

Problem statement

Problem statement is about what the problem that was face. To find out the problem, there are a few methods. The methods are:

- Client request
- Modification on existing design
- Generation of new product

Analyze the problem

After find the problem, the next step is analyzing the problem. Analyze the problem is use to find the source to get the information. The method's to fine the information are:

- Market Survey
- Current design/ trend
- Future expectation
- Design standard, specification, and regulation
- Review existing patent

Concept design

Concept generation is the first concept that create based on the information. the amount of the concept is depend to the designer. The process in generate the concept are:

- Free-hand sketches
- Touch up from Adobe Photoshop software.
- Basic CAD and feasibility study, CAE application
- Alternative solution of design and mechanism, simple BQ/BOM
- Ergonomics and ecstatically value

Concept selected/detail design

Concept selected is to fine the final concept between all the concept that generate. Concept selected including are:

- Detail design on Cad
- Detail BOM/ BQ generation
- CAE application
- Generation of part, assembly, tooling drawing
- Optimization
- CAM application

Prototyping

Prototype is the first model before final concept was fabricated. The prototype model is use for testing. There are two method are:

- Mockup
- Prototype (functional)

Testing

Testing is done by follow the specification. The specification is depend with the requirement. The requirements are:

- Refer to the customer requirement
- Regulation/QA

Fabricated

Fabricated is the last process in design process. After accept the final concept, product can produce for launching.

- Rapid Manufacturing
- CAM application
- Pilot Product
- Evaluation and testing
- Pre-Mass production
- Mass Production

1.6 THESIS OUTLINE

Chapter 1 including all the beginning step process to produce a new concept of multifunction caterpillar. In this chapter need to making a research about the problem of ducting system and to overcome the problem.

Chapter 2 is continuing searching the information in this project. The information will use in the next process. All process need to refer the information and relate due to this chapter.

Chapter 3 is product study case. This chapter needs to study the existing product in the market and critic the product. The result from the study will help in creating the mechanism of the crawler.

Chapter 4 is concept generation. After study the existing product and get the information that need, it can help in generating the new concept of crawler. This chapter include the selection metrics that come out with final concept .This final concept will go the next process.