UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN OF CAR HOOD LIFTING MECHANISM USING SENSITIVE HYDRAULIC SYSTEM

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering Manufacturing Design (Hons.)

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ABSTRAK

Objektif projek adalah “design of car hood lifting mechanism using sensitive hydraulic system. Proton Saga dipilih sebagai model kenderaan untuk projek ini. Biasanya, pengguna Proton Saga perlu membuka hud kereta secara manual. Pengguna perlu melaksanakan beberapa langkah supaya hud kereta boleh dibuka. Oleh itu, ini akan menyebabkan pengguna berasa susah dalam proses pembukaan hud kereta kerana memerlukan beberapa langkah. Oleh itu, sistem hidraulik sensitif digunakan untuk reka bentuk mekanisme yang boleh mengangkat hud kereta. Sistem hidraulik sensitif bermaksud hidraulik perlu tarik balik dengan jarak yang dekat untuk mengangkat hud kereta pesat. Sistem hidraulik sensitif akan difokus untuk mengelak menggunakan saiz yang lebih besar silinder hidraulik. Beberapa cara yang akan digunakan untuk menjalankan projek ini. Kaji selidik ini dijalankan untuk mendapatkan maklum balas daripada pengguna. Lima lakaran konsep telah dilukis. Di samping itu, kaedah “Pugh Matrix” digunakan bagi pemilihan konsep. 3 Lukisan Rekabentuk Berbantu Komputer yang dipilih akan dilukis dengan menggunakan “Computer Aided Design”. Analisis pergerakan dan analisis unsur dilakukan untuk memilih konsep reka bentuk yang terbaik. Analisis unsur digunakan untuk mengkaji sama ada komponen dapat mengekalkan beban. Perbandingan akan dilaksanakan untuk memilih konsep reka bentuk yang terbaik. Oleh itu, konsep 2 dipilih sebagai konsep terbaik kerana hanya memerlukan anjakan omboh yang singkat iaitu 50 mm. Konsep 2 juga mencapai factor tertinggi keselamatan sebanyak 5.36201 berbanding dengan konsep yang lain. Kemudian, kaji selidik kedua telah dilakukan untuk mengesahkan konsep yang telah dipilih. Kaji selidik adalah langkah terakhir untuk projek ini.

ABSTRACT

The main objective of this project is design of car hood lifting mechanism using sensitive hydraulic system. Firstly, the Proton Saga is selected as vehicle model for this project. Usually, the Proton Saga users need to open their car hood manually. It is required few steps to open the car hood. Therefore, it is a hassle for the users in the opening process of car hood as it requires a few steps. So, the sensitive hydraulic system is used to design car hood lifting mechanism to overcome this problem. The sensitive hydraulic system means that the hydraulic piston needs withdraws with small distance in order to lift the car hood exponentially. The sensitive hydraulic system is focused in this project because it can prevents the larger size of hydraulic cylinder to be used. Several approaches are used for conducting this project successfully. First of all, first survey is conducted to acquire some feedback. Five hand sketching design concepts are drawn and then Pugh Matrix method is used for concept selection. 3 Dimensional Computer Aided Design (3D CAD) of the selected design concepts are drawn using Computer Aided Design. Motion analysis and finite element analysis are performed to select the best design concept. Displacement can be obtained from motion analysis. Finite element analysis can test whether the components able sustain the load. Hence, the simulation results are compared to select the best design concept. Concept 2 is selected as the best concept design because it proves that it only requires shortest displacement of piston which is 50 mm. Besides that, concept 2 achieves highest factor of safety which is 5.36201 compared to other design concepts. Lastly, the second survey is conducted for concept validation. Second survey will be the last step for this project.

DEDICATION

To my beloved supervisor, Mr. Abdul Rahim Bin Samsudin, my beloved parents, dearest siblings, all my lecturers and friends.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

CAD	-	Computer Aided Design
SW	-	SolidWorks
3D CAD	-	3 Dimensional Computer Aided Design

CHAPTER 1
INTRODUCTION

1.1 Project Background

Nowadays, hydraulic system is widely used in the variety of applications such as hydraulic excavator, hydraulic jack, telescopic hydraulic cylinder and many more. The hydraulic system is very useful because it has ability to perform works. According to the Rabie (2009) stated that the hydraulic power systems is transferred to mechanical power when presence of hydraulic liquids in the hydraulic system.

First of all, one of the vehicle models is selected to design of car hood lifting mechanism for this project. The Proton Saga is selected as vehicle model for this project because it consists of manual opening mechanism of car hood. The Figure 1.1 shows the image of Proton Saga. Basically, the user has follow few steps or procedure in order to open their car hood. The user has to open their car hood manually. It is a hassle for the users in the opening process of car hood as it requires a few steps. Therefore, the project is to design lifting mechanism that it can open the car hood of Proton Saga automatically.

Figure 1.1: Proton Saga

In this project, the car hood lifting mechanism is designed using sensitive hydraulic system. The sensitive hydraulic system means that the hydraulic piston only needs to withdraw a small distance in order to open the car hood exponentially. The main purpose of using sensitive hydraulic system is to avoid use larger size of hydraulic cylinder in order to lift the car hood. It can considered as stroke length. Therefore, the hydraulic cylinder will be focused because it has ability to lift the car hood and sustain the weight of car hood. Hence, the lifting mechanism can helps the users to open the car hood automatically.

For the project, survey will be conducted to acquire customer and user feedback. Based on the survey result, the customer requirements will be the selection criteria for this project. The conceptual designs will generate and develop first before proceeds to the concept selection for this project. Therefore, five design concepts will be develop as conceptual designs. Then, concept selection is used to select three design concepts based on the selection criteria. So, 3D modeling of the design concepts will develop by using Computer Aided Design (CAD). In addition, SolidWorks software is used to analyze the design concepts. The best design concept is selected by comparing simulation results. Lastly, second survey will be conduct for concept evaluation.

1.2 Problem statement

For those Proton Saga users need to open their car hood manually. Firstly, the users have to pull the interior hood latch as illustrated in the Figure 1.2. After that, the user needs to unlock the latch which it is located inside of car hood as illustrated in Figure 1.3. Then, the car hood supporter is lifted and inserted into the underside of the car hood to hold the car hood up securely as shown in the Figure 1.4. Therefore, it is a hassle for the users in the opening process of car hood as it requires a few steps.

In addition, the weight of car hood is heavy and the users need to hold the car hood first before it is supported by a car hood supporter. Due to the weight of car hood, it is

inconvenience for the users in the opening process of car hood. Besides that, the users need be careful while opening the car hood. Therefore, the car hood lifting mechanism using sensitive hydraulic system is designed to the front car hood in order to provide a convenient, time-saving and safe car hood opening process to the users.

Figure 1.2: Pull the interior hood

Figure 1.3: Unlock latch system

Figure 1.4: Lift the car hood

1.3 Objectives

The main aim of the project is to design of car hood lifting mechanism using sensitive hydraulic cylinder. The hydraulic cylinder is used to lift the car hood. Another aim of the project is to ensure that the hydraulic piston only withdraw a small distance in order to open the car hood exponentially. The shortest the stroke length of hydraulic piston can avoids the use of the bigger size of hydraulic cylinder.

The objectives of project are:

i. To acquire customer and user feedback through survey.
ii. To design of car hood lifting mechanism using sensitive hydraulic cylinder.
iii. To validate the concepts by using Computer Aided Design (CAD).

1.4 Scopes

One of the vehicle models is selected for this project is Proton Saga. One vehicle model only chosen for this project. Therefore, the dimension of Proton Saga car hood is measured to obtain the dimension of car hood. Besides that, the scope of the project is to design of car hood lifting mechanism using sensitive hydraulic cylinder. Therefore, the type and specification hydraulic cylinder must be similar for all design concepts so that the comparisons can be compared accurately by referring the simulation result. A study on the working principle of hydraulic cylinder is required for this project. In this project, the hydraulic cylinder and Proton Saga car hood are highly focused for designing car hood lifting mechanism.

Survey will be conducted in early and last of stage of this project. Online survey will be conducted in this project. The purpose of this survey is to obtain customer or user feedback. Next, the conceptual design will be developed once the survey is conducted. Simulation on the selected concepts will be performed to achieve the best concept. The computer aided design (CAD) will be used for the simulation stage. The final concept is selected based on the simulation results. Lastly, the second survey will be conducted in the last stage for this project. It is conducted for concept validation stage. The rate of achievement and effectiveness of the final selected concept have been rated, validated and evaluated from the respondent's feedback and level of satisfaction. Therefore, the final selected design concept will be used and rated from the respondents.

1.5 Limitations

This project does not study on the various types of car hood available. Only Proton Saga is selected as our vehicle model for this project. Due to time constraint, other types of vehicle model does not focused. Meanwhile, the hydraulic cylinder will be used and

focused to lift the car hood. Besides that, 3 Dimensional Computer Aided Design (3D CAD) of car body does not construct using SolidWorks software.

1.6 Structure of the report

This report consists of five chapters. Each of the chapters will be discussed and explained clearly in the report.

Chapter 1 is the introduction of the project. It introduces about the overview of the project which includes the introduction, problem statement, objectives, aim, scopes as well as limitations of the project.

Chapter 2 is the literature review. It is covers about the working principles of hydraulic cylinder, design specification of hydraulic cylinder, type of hydraulic cylinder and many more. All information related to the project will be collected and explained in the Chapter 2. The resources are comes from journals, books, articles, patent and internet.

Chapter 3 is the methodology. It will discusses about the methods used to achieve the objectives of this project. It explains how the methods are then conducted. The project flow chart and Gantt chart will be included in the chapter.

Chapter 4 is the result and discussion. All results that obtained are explained in this chapter. The survey, conceptual designs and analysis result will discuss in the chapter. The conceptual designs and analysis result are the main part of this project.

Chapter 5 is the conclusion and recommendations. It will conclude about the final finding of the project. The final finding must meets the objectives which are stated in chapter 1.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

Chapter 2 will discusses about the literature review. Any information that related to this project is explained in the chapter. The information that obtained can improve this project. Study on the hydraulic system and other mechanism will explain in the chapter.

2.2 Classification of power systems

Power systems are very essential because it allows and transfers power. The power systems are divided into three categories which are mechanical, electrical and fluid power systems. The classification of power systems is displayed as shown in Figure 2.1 (Rabie, 2009). In this project, hydraulic system will mainly use. Basically understand the general of hydraulic system first before start this project. The introduction of hydraulic system is explained next part.

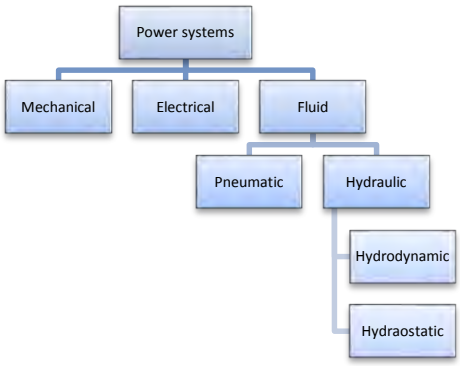

Figure 2.1: Classification of power system (Rabie, 2009)

2.3 Introduction of hydraulic systems

The Greek word of 'Hydra' mean water while 'Aulos' mean pipes. The hydraulic word comes from Greek word by combination of these words, which simplifies in English means water in pipes (Doddannavar et al., 2005). According to the Rabie (2009) stated that the energy of hydraulic liquids in the hydraulic system will occur when the hydraulic power systems transfer to mechanical power. Generally, the main difference between hydrodynamic and hydrostatic is hydrodynamic relates to moving fluids where the forces are produced by motion whereas hydrostatic relates to stationary fluids where the forces are produced by motion (Trevor, 1996).

2.3.1 Introduction of hydrodynamic power system

According to the Doddannavar et al. (2005) stated that it is involves the motion of liquid when the liquid impacts on an object and releases its energy to perform works. In other word to describe the hydrodynamic is hydrokinetic. Hydrodynamic power systems are occurring when the kinetic energy of hydraulic liquid is increased. The hydrodynamic power systems can be hydraulic coupling and torque converter in hydraulic system (Rabie, 2009). The structure design of hydraulic coupling device is in closed area like surrounding with wall to allow the fluid can pass quickly to other part.

According to Rabie (2009) described the mechanism of hydraulic coupling for the hydrodynamic power system. The components in the hydraulic coupling are turbine and centrifugal pump. The power is transfers from input to output shaft. Firstly, the pump drive is rotates and allows the liquid such as oil passes through to the turbine. When the oil passes through the turbine, the collision will happen due to the kinetic energy is lost.

2.3.2 Introduction of hydrostatic power system

Hydrostatic is happening where a liquid is pressurized (Newsnes, 2005). The power is transfers when the pressure energy of liquid is increased considered as hydrostatic power systems. It can be used in industry area, mobile equipment, airspace and many more (Rabie, 2009). The hydrodynamic power system is connected to the prime mover and pump whereas the hydraulic motor is connects to the load. The components in the hydrodynamic power system can produces flow to a hydraulic motor.

2.4 Type of hydraulic components

Although the hydraulic system can be applied in variety of applications but the basic components still remain same to perform works. The quantity and arrangement of the components will be different and depending on its applications. The basic components in the hydraulic system are reservoir, hydraulic pump, hydraulic actuator, control valves, piping and hydraulic fluid. Each of the components consist certain functions (Mobley, 2000). The description of each component is explained in the part.

2.4.1 Reservoir

Normally, reservoir is to stores fluid such as mineral oil, water and other kind of fluid in closed container. Reservoir not only stores fluid but it can involves filtration process of the fluid before it is passing through other components in the system. It can involves separation of water in the reservoir (Mobley, 2000). The most important of reservoir is to eliminate the air bubbles that generated by the hydraulic pump (Vaxjo, 2007). The Figure 2.2 shows the example of reservoir.