TO CARRY OUT FUNCTIONAL AND ERGONOMIC STUDY OF THE GRAPHENE POLE PNEUMATIC CUTTER PROTOTYPE FOR FURTHER DEVELOPMENT TOWARDS COMMERCIALIZATION

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This report is submitted

in fulfillment of the requirements for the degree of

Bachelor of Mechanical Engineering

Faculty of Mechanical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

OGOS 2021

DECLARATION

I declare that this thesis entitled "TO CARRY OUT FUNCTIONAL AND ERGONOMIC STUDY OF THE GRAPHENE POLE PNEUMATIC CUTTER PROTOTYPE FOR FURTHER DEVELOPMENT TOWARDS COMMERCIALIZATION." is the result of my own researchexcept as cited in the references.

Signature : 

Name : MUHAMMAD HADIIMAN BIN HAMIM

Date : AUGUST 2021

SUPERVISOR'S DECLARATION

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 with Honors.

Signature :

Supervisor Name :

Date :

DEDICATION

I want to dedicate this report to myself, my family and friends.

ABSTRACT

Ergonomics is a combined word which is “ergon” is work and “nomos” means laws Ergonomics is comes from a science-based application that involving anatomy, psychology, physiology, engineering and mathematical to proposed a design that can complement the human ability and strengths and can minimizing the effect of the human limitation. unpleasant body posture while doing work can cause discomfort and bring health issue to human This problem is detected during working with long pole when harvesting palm oil tree. This study was performed in purpose to design new prototype that can be commercialize and can lighten human jobs. This project is based on the previous design that has been created. In this project, researcher need to develop a new design that must be better compared to the previous design and increase the ergonomics of the pneumatic pole. Several designs have been created and two decision method was used to choose the right design for this project. The project is continue with redraw the selected design using CAD application called SOLIDWORKS. The final design is analyze using ANSYS application and some calculation is presented.

ABSTRAK

Ergonomik adalah kata gabungan yang "ergon" adalah kerja dan "nomos" bermaksud undang-undang Ergonomi berasal dari aplikasi berasaskan sains yang melibatkan anatomi, psikologi, fisiologi, kejuruteraan dan matematik untuk mengusulkan reka bentuk yang dapat melengkapi kemampuan dan kekuatan manusia dan dapat meminimumkan kesan batasan manusia. postur badan yang tidak menyenangkan semasa melakukan kerja boleh menyebabkan rasa tidak selesa dan membawa masalah kesihatan kepada manusia Masalah ini dikesan semasa bekerja dengan galah panjang semasa menuai pokok kelapa sawit. Kajian ini dilakukan dengan tujuan untuk menghasilkan reka bentuk yang dapat dikomersialkan dan dapat meringankan pekerjaan manusia. Projek ini berdasarkan reka bentuk sebelumnya yang telah dibuat. Dalam projek ini, penyelidik perlu mengembangkan reka bentuk baru yang mesti lebih baik daripada reka bentuk sebelumnya dan meningkatkan ergonomi galah pneumatik. Beberapa reka bentuk telah dibuat dan dua kaedah keputusan digunakan untuk memilih reka bentuk yang tepat untuk projek ini. Projek ini dilanjutkan dengan melukis semula reka bentuk yang dipilih menggunakan aplikasi CAD yang disebut SOLIDWORKS. Reka bentuk akhir dianalisis menggunakan aplikasi ANSYS

ACKNOWLEDEMENT

My gratitute towards our Faculty of Mechanical Engineering for giving me the opportunity to undergo and experience Project Sarjana Muda during my final year which entitled " TO CARRY OUT FUNCTIONAL AND ERGONOMIC STUDY OF THE GRAPHENE POLE PNEUMATIC CUTTER PROTOTYPE FOR FURTHER DEVELOPMENT TOWARDS COMMERCIALIZATION ". I was able to complete the concept design and model analysis within the time limit given by the faculty. Throughout the completion of this Project Sarjana Muda, I gained a lot of new learning experince, and this acted as a suitable platform for me to apply my engineering knowledge learnt during the whole of Bachelor of Mechanical Engineering with Honours course. I would like to thank PROF. MADYA IR. DR. ABDUL TALIB BIN DIN that act as my Project Sarjana Muda supervisor. Without his guidance and assistance, I would not have a clear path on how to engage this project succesfully. Additionally, I would also like to thank all lecturers, staffs and coursemates that were involve in accomplishing this Project Sarjana Muda. Last but not least, warm appreciation to our parents with their moral supports and encouragement throughout the Project Sarjana Muda timeline.

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CHAPTER 1 INTRODUCTION

1.1 BACKGROUND

Elaeis guineensis is a tropical forest palm native to West and Central Africa. The African oil palm originated in Africa, along the coastal strip (200–300 km wide) between Liberia and Angola, from whence it spread north, south and east to Senegal, the Indian Ocean, Zanzibar (Tanzania) and Madagascar (NewCROP 1996). It retains many traditional uses in Africa (Maley and Chepstow-Lusty 2001). Since its domestication, oil palm has been introduced and cultivated throughout the humid tropics (16°N to 16°S) (NewCROP 1996). Harvesting palm oil tree is the main economical activities in Malaysia since 1960. Before that time the palm oil was introduced to Malaysia as an ornament plant. In Malaysia, the high yielding tenera, which is a cross between dura and pisifera species, is the most commonly cultivated palm tree. The Malaysian palm oil contributes to about 13% of total vegetable oil production in the world in 2011 (MPOB 2011).

at the early stage when the tree at three meter tall, the harvesting method is significantly easy. It can be harvested using a chisel attached to pole. The pole can be made from steel or graphite. When the tree starts to grow taller, the combination of sickle and pole is needed for harvesting. This method is not compatible as the trees goes taller more than 5 meter. It is because the pole is getting heavier and it might be dangerous to the worker. More energy will be used for handling the pole and need a very skillful person to handling the pole. The heave pole can cause muscle pain and worse case it can be dislocated shoulder.

Another method for harvesting palm oil tree is using e cutter. It was invented by the collaboration of Universiti Putra Malaysia and MPOB. The method is generally used an electrical motor that connected to generator. The 0.8 liter tank generator required two time fueling that will provide 8 hours working. It has small body that allow user to carry it easily.

1.2 PROBLEM STATEMENT

A prototype of tool for harvesting palm oil tree was developed in Universiti teknikal Malaysia Melaka. The tools are called the graphene pole pneumatic cutter. Basically, the cutter used compressed air to cut the palm oil branches and fruits. The prototype is still in undergoing development process. The tools are not completely done and it required several studies before it can be commercial. The tools must fulfill all the criteria that needed for harvesting palm oil tree and the ergonomic for the tools must be considered for creating well performed tools

1.3 OBJECTIVE

The objectives of this project are as follows:

1. To create design concept using conceptual generation method.
2. To design ergonomic handle for operating the pole.
3. To improve the connection method based on the previous design
4. To provide analysis on the handle of the graphene pole pneumatic cutter.

1.4 SCOPE OF PROJECT

The scopes of this project are:

1. Conceptual design for graphene pole pneumatic cutter.
2. Designing handle for the pole.
3. Designing improved connection method for the pole connection.
4. Decision making using The Pugh Selection Method and weighted decision matrix.

CHAPTER 2 LITERATURE REVIEW

2.1 INTRODUCTION

Literature review is a specifically elaboration the project. In this chapter, the detail of the project will be given. In order to obtain the detail of this project, this literature review is carried out to achieve the aim and objective of this project.

2.2 ERGONOMICS

Ergonomics is a combined word which is “ergon” is work and “nomos” means laws. It also known as “law of works” or “science of work”. Good ergonomics design will provide a good relation between the work and the worker and eventually creates the optimal task environment. Ergonomics is comes from a science-based application that involving anatomy, psychology, physiology, engineering and mathematical to proposed a design that can complement the human ability and strengths and can minimizing the effect of the human limitation. Rather than asking people to adapt to a design that requires them to work in an unpleasant, frustrating or unsafe manner, ergonomists and human factors researchers strive to learn how a product, workplace or structure should be built to accommodate people who need to use it.

The aim of ergonomics is to reduce your vulnerability to workplace hazards. Danger is established, it is a physical element in the work atmosphere that can affect your body. Ergonomics hazards like operating in painful or uncomfortable postures and using undue force power or high repetition to complete a task. Ergonomics relies on the transition in jobs climate, changing a job by using ergonomically comfortable equipment or various job practices to improve performance and reducethe risk of pain, or harm.

Human can improve their ergonomics by avoiding these task or posture:

- Lifting heavy object
- Forceful exertion
- Repeating tasks
- Wrong postures or awkward posture

According to the (PECB University, 2016), they have stated that there are five benefits of ergonomics in workplace. The five benefits of the ergonomics which are:

- Ergonomics improves productivity - Implemented correctly, an ergonomic solution improves productivity from 10 to 15%. Ergonomics leads to healthy and pain-free employees. By designing a working environment which encourages good posture, less exertion, and fewer motions, in turn makes the workstation more efficient.
- Ergonomics improves quality - Poor ergonomics leads to frustrated and fatigued workers who will not be able to give off their best. When the job or task is physically too difficult for the employee, they may not perform their job or task as they have been trained to do. This will damage the reputation of the company and its products
- Ergonomics improves employee's engagement - Employees notice when the company is providing them with the best conditions to improve their employees' health and safety. If an employee does not experience fatigue and discomfort during their working day, it can reduce absenteeism, improve morale and increase your employees' involvement. This in turn will have the knock-on effect of increasing your employees' motivation simply by implementing your ergonomic improvement program.
- Ergonomics creates an improved understanding and awareness leading to safety oriented culture - Ergonomics shows your company's commitment to safety and health as a core

value. Healthy employees are your most valuable asset; creating and fostering a healthy culture within your company leads directly to increased level of organizational structure.

- Costs involved in employing ergonomic methods and equipment - Many studies have shown that ergonomics doesn't have to be costly and can even save you money. The cost of ergonomic training, or an OHSAS 18001 (Occupational Health and Safety) training program, is cost effective as by investing in your employee's health & wellbeing will prevent costly injuries and lost time, leading to systematically increasing your revenues and customer satisfaction levels. The Health and safety of employees are one of the strongest assets that a company has that should be nourished.

2.3 Palm Tree

Figure 2.1 palm tree

The oil palm tree or Elaeis guineensis originates in West Africa, where it grows in the wild and evolves into an agricultural crop later on. It was introduced as an ornamental plant to Malaysia, then Malaya, by the British in the early 1870s. In 1917, the first commercial planting took place at Selangor's Tennamaran Estate, laying the foundations for Malaysia's extensive oil palm plantations and palm oil industry. In the early 1960s, oil palm production increased at a rapid pace under the government's agricultural diversification policy, which was launched to reduce the economic dependency of the country on rubber and tin

The oil palm is a tree with no branches except at its top with several large leaves. Because of its unprecedented efficiency, it has been the world's number one fruit crop; it is simply the world's most efficient oil plant. Oil is shown to be better for human consumption than vegetable oils that are hydrogenated. There is an increasing awareness of the risks associated with the use of trans fats and this has made palm oil even more popular in packaged food goods as a substitute ingredient. It has also acquired credibility as a cooking oil. Oil palm harvesting, however, still defies the strongest mechanization attempts.

Oil palm is a single crop and on the same tree it bears both male and female flowers. With 1000 to 3000 fruitlets per bunch, each tree produces compact bundles weighing between 10 and 25 kilograms. Each fruitlet has a nearly spherical or elongated form. The fruitlet is normally dark purple, almost black, and when mature, the color turns to orange-red. Every fruitlet consists of a hard kernel (seed) that is surrounded by a fleshy mesocarp, encased in a shell (endocarp).

Figure 2.2 palm fruit branch

Palm oil is rich in carotenoids, (pigments found in plants and animals) from which it derives its deep red colour, and the major component of its glycerides is the saturated fatty acid palmitic; hence it is a viscous semi-solid, even at tropical ambients, and a solid fat in temperate climates.

The individual fruit, ranging from 6 to 20 gm, are made up of an outer skin (the exocarp), a pulp (mesocarp) containing the palm oil in a fibrous matrix; a central nut consisting of a shell (endocarp); and the kernel, which itself contains an oil, quite different to palm oil, resembling coconut oil.

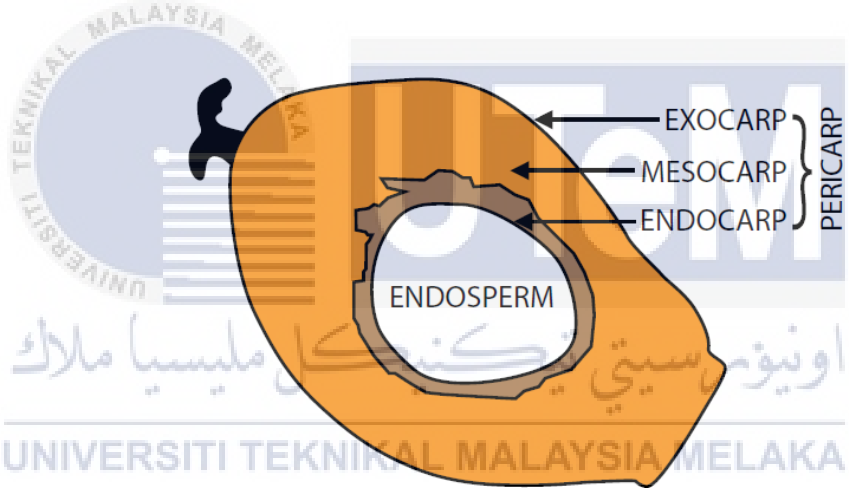

Figure 2.3 Cross-section of palm fruit

2.4 harvesting tool

Locally, short trees within arm-reach are harvested using either the cutlass or the chisel to cut the bunches and fronds. On the other hand, very tall trees above 9 m in height are harvested using either the single rope-and-cutlass (SRC) or the double rope-and-cutlass (DRC) method. The SRC method is more common because it is relatively much faster though less safe (Ironbar, 1981).

In this method, the harvester manually climbs the tree by the use of a rope tied around the tree and his torso. Once within arm-reach of the crown, the harvester uses a cutlass to cut the fronds and bunches. Medium-height trees beyond arm-reach up to a height of about 9 m are harvested using the bamboo pole and knife (BPK) method. In this method, a Malaysian knife, which is a curved knife with the sharp edge along its convex side, is attached to the end of a bamboo pole. The length of the pole depends on the average height of the trees on the plantation plot to be harvested. The harvester stands on the ground while the pole and knife are raised to the tree crown in order to harvest the bunches. Yet another method is the Aluminium pole and knife (APK) method. In this method, a 40 mm diameter aluminium tube replaces the bamboo pole of the BPK method. It works very well and even faster than the BPK method for trees of height below 5.5 m. Above this height, bending of long harvesting poles that carry relatively heavier cutting knives on top constitutes a very serious problem as it becomes very difficult to engage the stalks of palm fronds and bunches. Harvesters' hand-pole slippage while cutting with the pole also constitutes another serious problem as the harvester inevitably sweats on his palms while on the job. For these reasons, the APK method is yet to enjoy wide application. Generally, once the harvester reaches the tree crown, it is a lot easier to cut (fronds and fruit bunches) using the cutlass than it is using the Malaysian knife.

Figure 2.4 chisel

Figure 2.5 Sabit or Malaysian knive

2.5 Graphene

Graphene is defined as a single-atomic-layer, 2-dimensional allotrope of carbon atom. This material has superlative properties of strength, elasticity, electrical conductivity, and thermal conductivity. It can potentially provide a higher energy density than that of a common