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DEVELOPMENT OF PORTABLE PALM OIL HARVESTER BASED ON 21 VOLT DC MINI CHAIN SAW ELECTRIC MOTOR

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Abstract

The objective of this research was to create a portable palm oil harvester using a mini chain saw electric motor. The focus was on the design, construction, and performance trials of the harvester. The palm oil industry requires efficient harvesting methods to keep up with the increasing demand. Traditional harvesting techniques are time-consuming, labor-intensive, and pose risks to workers. This research aimed to address these challenges by developing a more compact, lightweight, and efficient harvester using a mini chain saw electric motor. The study included ergonomic design, prototype construction, strength and durability testing, and performance evaluation under various field conditions. The final test results for the Portable Oil Palm Harvester showed an average cutting time of 21.4 seconds in the initial position (3m tube position) and 37.4 seconds in the maximum position (5m tube position) for oil palm harvesters weighing around 6kg.

Keywords: ***Palm Oil, Electric Motor, Harvester***

1. INTRODUCTION

The palm oil industry plays a vital role in the global economy, especially in tropical countries like Indonesia, Malaysia, and Nigeria. There's a growing demand for palm oil and its derivative products like crude palm oil and non-food items such as biodiesel, which has led to the industry's expansion [1]. Efficient and productive harvesting is crucial for maintaining the quality and quantity of palm oil. However, the traditional methods used for harvesting are time-consuming, labor-intensive, and expensive. Manual harvesting can also lead to worker injuries and requires a large amount of labor [2]. To improve the efficiency and productivity of oil palm harvesting, the development of portable harvesters is an exciting area of research [3]. One promising approach involves using a mini chain saw motor as the foundation for a portable harvester. These motors are compact, lightweight, and powerful enough to efficiently harvest oil palms. Despite its potential, the development of a portable palm oil harvester based on a mini chain saw motor requires careful consideration of factors such as ergonomic design, sturdy construction, and optimal performance to ensure their effective use in the field. Therefore, this research is focused on developing a portable oil palm harvester with a mini chain saw motor as its base. By concentrating on design, construction, and performance trials, this study aims to improve the efficiency and productivity of oil palm harvesting and reduce the risk of worker injuries in the field.

2. LITERATURE REVIEW

In In previous research, the oil palm harvester still uses a gasoline motor as its driving force [4], so the efficiency of energy use is inferior; so, in this study, a 21 Volt DC mini chain saw electric motor is used to overcome the efficiency of energy use. The height of the stick or pole pipe used in this study can also be adjusted or set according to the height of the oil palm tree. This study uses an electric power source from a lithium battery. It has advantages: high energy density, high power density, low self-discharge, fast charging, no memory effect, and a long-life cycle [5]. For connecting and breaking the electricity flow, an ON / OFF switch is used as a breaker of electricity between the battery and the mini-chain saw machine so that the oil palm harvester is OFF [6]. The pipe or pole in the palm harvesting tool is one of the vital harvesting tool components. This tool is generally paired with a cutting knife or dodos to cut the Fresh Fruit Bunches (FFB) ready to be harvested on tall palm trees. For this reason, the materials and procedures used in producing the Harvest Pipe or

Pole significantly affect the product's ability to withstand the knife's weight when the pipe is used or placed on the palm tree with a height range of 5 meters. In this study, pipes made from fibre composite materials were used to be lighter and more accessible for operators to use [7].

3. METHOD

This section will explain the main system design in the form of electrical design and mechanical design in the development of portable palm oil harvesters.

3.1 Block Diagram of Portable Oil Palm Harvester Development System

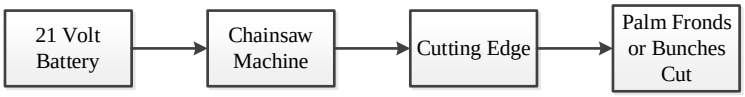

Figure 1. Block diagram of the working system design.

From the above block diagram, it can be seen that the working principle of the development of a portable palm oil harvester, sourced from a 21 volt battery, is channeled to a mini chainsaw engine that functions to cut palm fronds and harvest palm oil.

3.2 How the Portable Palm Permanent Tool Development System Works

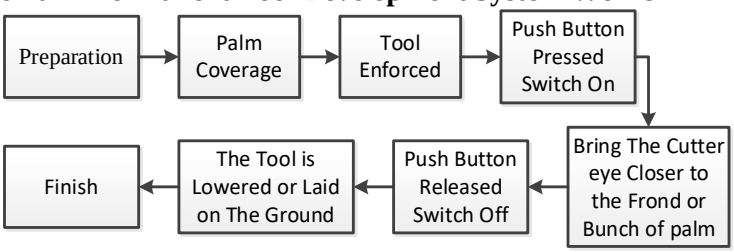

Figure 2. How the oil palm harvester works

Here is how the development of a portable oil palm harvester works. Preparation, reach the palm you want to cut, the tool is upright with the cutting eye at the very top, the push button is pressed ON switch to channel energy to the chainsaw engine so that the eye rotates, bringing the cutting eye closer to the frond or palm tree until it is cut, the push button is released OFF switch to disconnect energy from the battery, the tool is lowered or laid on the ground, finished.

3.3 Flowchart of Portable Oil Palm Harvester Development System

The system flowchart on the development of portable oil palm harvesters can be seen in Figure 3 below.

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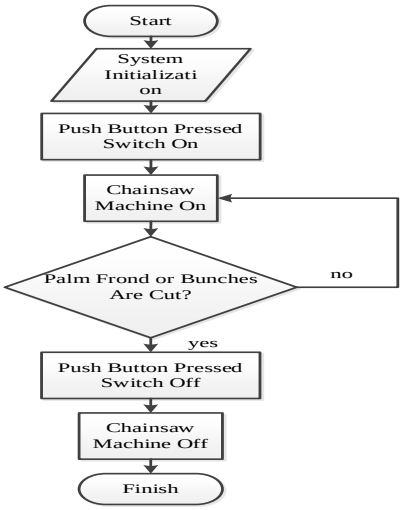

Figure 3. Flowchart of working system design.

Figure 3 above explains how the development of a portable palm oil harvester works. When the system starts, it is still in the initialization process. After initialization, the push button is pressed, and the ON switch starts the chainsaw engine. When the chainsaw engine has been turned on, the fronds/palm bunches are cut, but if not, then the chainsaw engine remains alive until the fronds or palm bunches are cut, then the push button is released, the OFF switch the chainsaw engine is OFF, and the process is complete.

3.4 The tool design

The attachment of the portable oil palm harvester development design can be seen in Figure 4 to Figure 6 below.

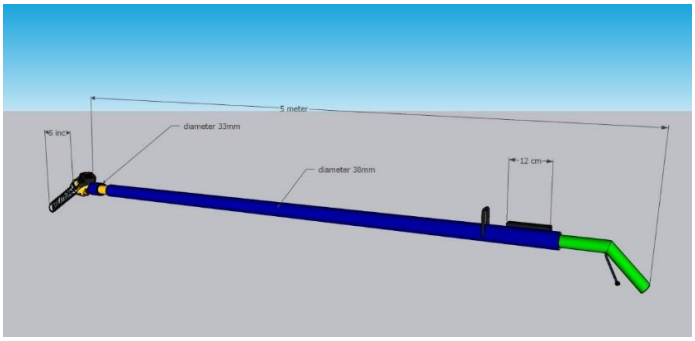

Figure 4. Development of a portable palm oil harvester.

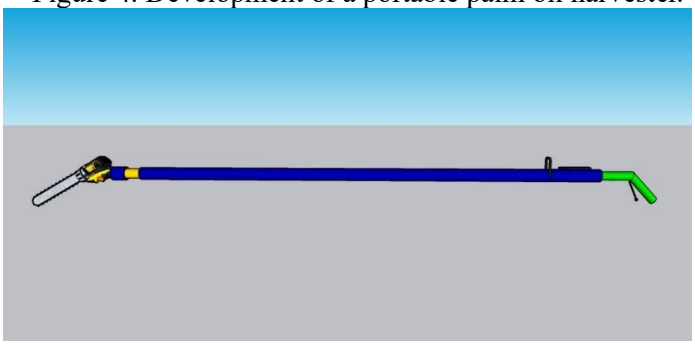

Figure 5. The portable palm oil harvester is shown left.

Figure 6. The portable oil palm harvester is shown right.

3.5 The Design System and Its Parts

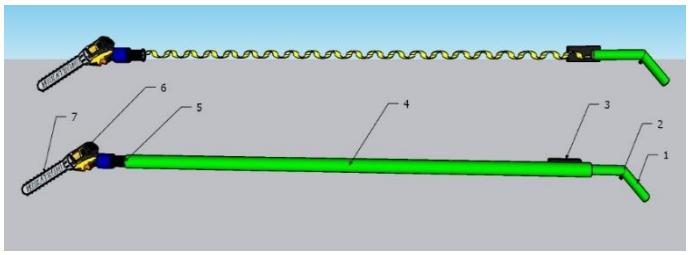

Figure 7. The explanation of the development design of a portable oil palm harvester.

Description :

1. **Right-hand grip**
   Functions as a counterweight to the pole.
2. ***Pushbutton ON/OFF***
   Acts as a switch to turn the chainsaw engine on and of.
3. **The Battery**
   Serves as a source of energy for the chainsaw engine.
4. **3-meter of pipe or pole**
   It is used to reach the height of the oil palm 3 meters
5. **2-meter of pipe or pole**
   Function to reach the height of maximum palm oil of 5 meters
6. **Chainsaw Machine**
   Functioning as a driver and cutter of palm fronds or bunches
7. **Cutting Edge**
   Used to cut bunches and palm fronds.

3.6 Electrical System Design

First, the current from the battery enters, and then, if the push button is pressed on the ON switch, the current will enter the chainsaw (DC motor). Then, the chainsaw is ON, and the cutting blade will rotate. Then, if the push button is pressed in front of the OFF switch, the current entering the chainsaw (DC motor) will be cut off, and the cutting blade will stop rotating.

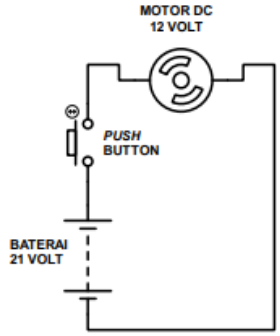

Figure 8. Electrical Circuit Working System for Development of Portable Palm Oil Harvesting Equipment

4. RESULTS AND DISCUSSION

4.1 Contents Results and Discussion

After completing the design and manufacturing process, the final results are shown in Figure 9 below.

Figure 9. Tool Results

Description :

1. Right-hand grip
2. *Push the button on*/OFF
3. Battery
4. 3-meter pipe or pole
5. 2-meter pipe or pole
6. Chainsaw machine
7. Cutting eye

4.2 DC motor testing

This test determines the current and voltage on the motor without load and with a load, measured using a digital multimeter.

Table1. DC Motor Current and Voltage Measurement Results.

Motor Without Load		Motor With Load	
Current (A)	Voltage(V)	Current (A)	Voltage(V)
1,68 A	18,47 V	2,24 A	17,84 V

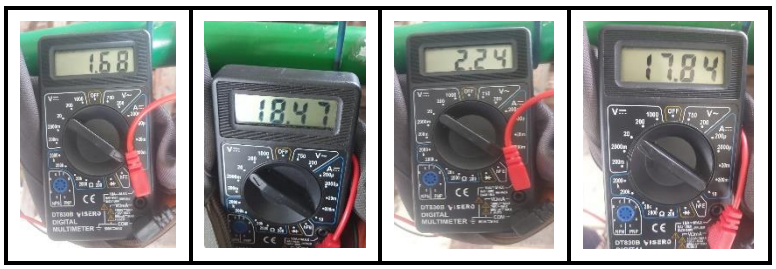

Table 1 of the test above shows that if the current and voltage on the motor are without load and there is a different load, the value with the load is more significant. When the motor is loaded, the voltage value on the motor will decrease, and the current value will be better.

4.3 Testing the Development Process of Portable Oil Palm Harvester

Testing the entire system is conducted to determine whether the entire system is functioning correctly or not.

Table 2: Cutting Time Test Results bel 2.

Pipe or pole	Cutting time	Average time
Original position (3 meter pole or pipe)	21 seconds	21,4 seconds
	13 seconds	
	33 seconds	
	24 seconds	
	16 seconds	
Maximum position (5 meter pole or pipe)	43 seconds	37,4 seconds
	32 seconds	
	51 seconds	
	23 seconds	
	38 seconds	

Gambar 10. Cutting Tests on Oil Palm.

From Table 2 of the tests above, it can be seen that the portable palm oil development test in the original position (pole or 3-meter pipe) had an average value of 21.4 seconds, in the maximum position (pole or 5-meter pipe) had an average value of 37.4 seconds. Second. The palm oil harvesting

tool should not be too upright because it can cause the cutting edge to get stuck in the palm frond and stem, for the weight of the palm oil harvesting tool is ±6 kg.

5. CLOSING

5.1 Conclusion

Based on the results of testing and analysis of the system that has been carried out in the development of portable palm oil harvesting equipment, several conclusions can be drawn, namely: The palm oil harvester cuts the fronds or harvests the palm oil well and quickly. Then, each palm frond and harvest takes 10-50 seconds.

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