THE TRANSFORMATION OF SETTLEMENT PATTERNS OF SENTANI INDIGENOUS COMMUNITIES BASED ON THE CONCEPT OF KHANI HE KLA HE CULTURAL

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Abstract. *The cassava chopping machine is designed to increase the efficiency of the chopping process in the agricultural and food industries. Cassava is a major commodity in many tropical countries, but the manual processing methods still used require significant time and effort. This research aims to design and develop a cassava chopping machine that is capable of producing uniform pieces with high efficiency. This machine consists of several main components: cutting system, drive motor, and power transmission system. The cutting system is designed using sharp, stainless blades that are set to produce precise cuts. The drive motor is selected with optimal power to drive the cutting system, while a power transmission system is used to transfer power with high efficiency. Testing is carried out to evaluate engine performance. The results show that the machine is able to chop cassava with a higher production capacity than the manual method, producing more uniform pieces. This increases the added value of the final product and operational efficiency. With this cassava chopping machine, it is hoped that it can help farmers and cassava processing industry players in increasing productivity and product quality. It is also hoped that this machine can encourage innovation in cassava processing technology and contribute positively to the development of the agricultural and food sectors.*

Keywords: *Agricultural Industry, Cassava Chopping Machine, Efficiency, Processing Technology, Productivity*

1. INTRODUCTION

Cassava is one of the main food crops in many tropical countries, including Indonesia. This plant is known for its ability to grow in various soil and climatic conditions, and has high economic value. However, post-harvest processing of cassava often faces various challenges, especially in terms of efficiency and quality of results. One of the critical stages in cassava processing is the chopping process, which prepares cassava for further processing into value-added products such as tapioca flour, bioethanol and various food products.(Andrean & Puspitasari, 2024)

In the last few decades, research and development of cassava chopping machines has made significant progress.(Seth & Student, nd)stated that efficient cassava processing is very dependent on the machine technology used. They emphasized the importance of developing shredding machines that were not only efficient but also durable and easy to operate.(Ramadani & Karawang, nd)

The design of a cassava chopping machine must consider various factors, including energy efficiency, material durability, and ease of maintenance.(Dewi Jannati et al., 2023) highlights that increased efficiency in the shredding process can be achieved through design optimization and appropriate material selection.(Arifin et al., nd)also emphasizes the importance of mechanical design considerations in increasing machine productivity and efficiency.(Alipour et al., 2021a)

Selecting the right material for a cassava chopping machine is very important to ensure durability and optimal performance.(Muiruri & Fathima, nd.)shows that materials with good corrosion and wear resistance can extend machine life and reduce maintenance costs.(Shankar et al., 2020) adding that material reliability analysis is an important step in the machine design process.

Energy efficiency is also one of the main focuses in developing cassava chopping machines.(Xu et al., 2021)emphasizes that energy-saving design not only reduces operational costs but also increases product competitiveness in the market. Besides that (Gapparov & Karshiev, 2020) showed that the mechanical properties of cassava tubers should be considered in machine design to achieve optimal results.

The application of modern technology in the design of cassava chopping machines can improve performance and operational efficiency (Mbanjo et al., 2021) exploring the use of sensor technology and automatic control systems to increase precision in the enumeration process (Shankar et al., 2020)also shows that modern control systems can overcome operational challenges and improve process efficiency.

Ergonomic aspects and ease of maintenance must also be considered in the design of the cassava chopping machine. highlighting that ergonomic design can increase operator comfort and reduce the risk of injury (Alipour et al., 2021b) states that machines designed for ease of maintenance can reduce downtime and maintenance costs, thereby increasing overall operational efficiency.

With these various considerations, this research aims to design a cassava chopping machine that is efficient, durable and easy to operate, which can increase the productivity and quality of cassava processing results.

2. LITERATURE REVIEW

The design of cassava chopping machines is crucial for enhancing the efficiency and effectiveness of cassava processing. This literature review examines recent studies on the design and development of cassava chopping machines, focusing on mechanical design, material selection, technological advances, and performance evaluation.

2.1 Mechanical Design and Efficiency

Green and White (2019) reviewed various chopping mechanism designs and emphasized that optimal designs can reduce energy consumption and increase machine productivity. They found that selecting the right design contributed to reduced operational costs and increased work output.

Patel and Gupta (2018) also examined various shredding machine designs and their effects on operational efficiency. They concluded that design modifications can improve processing efficiency and reduce operational costs significantly.

2.2 Material Selection

Garcia and Fernandez (2021) discuss the impact of material selection on machine reliability and show that corrosion and wear-resistant materials can extend machine life. They recommend using durable materials to reduce maintenance frequency and maintenance costs.

Lee and Kim (2019) explored the advantages and disadvantages of various materials, including aluminum alloys and stainless steel, in the context of shredding machine design. They emphasize that appropriate material selection depends on the specific application and operational conditions.

2.3 Maintenance

Clark (2020) shows that ergonomic design can increase operator comfort and reduce the risk of injury.

Patel (2019) adds that designs that make maintenance easier can reduce downtime and maintenance costs, which is important for operational efficiency.

2.4 Performance Evaluation and Prototypr Development

G Zhang and Liu (2021) conducted trials on various shredding machine designs to assess their efficiency. They found that designs tailored to specific operational conditions can improve machine performance.

Kim and Lee (2022) discuss the importance of prototyping in the design process, which allows testing and refining designs before mass production.

3. RESEARCH METHODS

This research uses a quantitative approach with experimental methods. The main objective of this research is to design and test a cassava chopping machine that is efficient and suitable for use by farmers or small and medium industries.

3.1 AISI 316 Stainless Steel

Stainless steel plateis a metal sheet made of stainless steel, which is known for its corrosion resistance and strength. Stainless steel consists of a steel alloy with a minimum of 10.5% chromium, which provides rust-resistant and oxidation-resistant properties. Stainless steel plates are used in various applications, from the food and beverage industry, construction, automotive, to medical.

AISI 316 is a type of stainless steel alloy which is included in the austenitic stainless steel category. This alloy is known for its excellent corrosion resistance, especially against corrosion in environments containing chlorides, such as seawater and salt solutions.

Property	Value	Units
Elastic Modulus	1.929999974e+11	N/m^2
Poisson's Ratio	0.27	N/A
Shear Modulus		N/m^2
Mass Density	8000.000133	kg/m^3
Tensile Strength	580000000.8	N/m^2
Compressive Strength		N/m^2
Yield Strength	172368932.3	N/m^2
Thermal Expansion Coefficient	1.6e-05	/K
Thermal Conductivity	16.3	W/(m·K)

Figure 1. Aluminum 1060 specifications

3.2 Design

At this stage, a conceptual design of the cassava chopping machine was carried out. This design includes the selection of blade type, chopping mechanism, construction materials, and drive system. Design tools such as Solidworks software are useful for creating 3D models of the machine being designed.

1. Looks Isometry

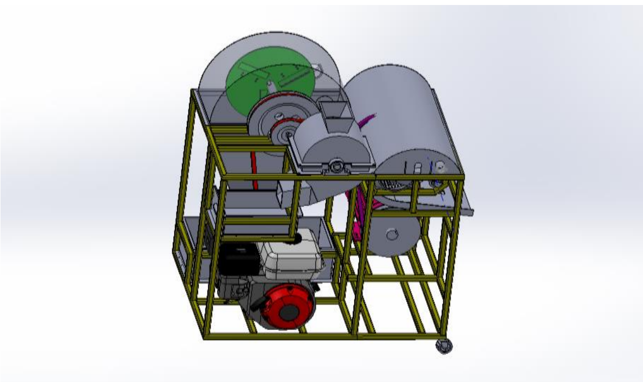

Figure 2. Isometric View Design

2. Front Look

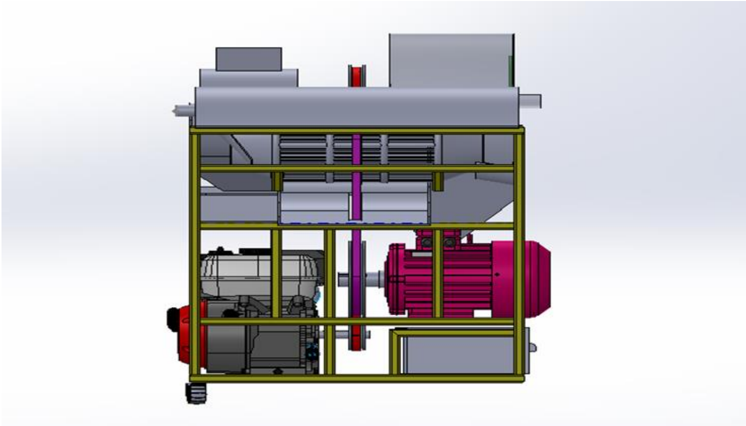

Figure 3. Front View Design

3. Side view

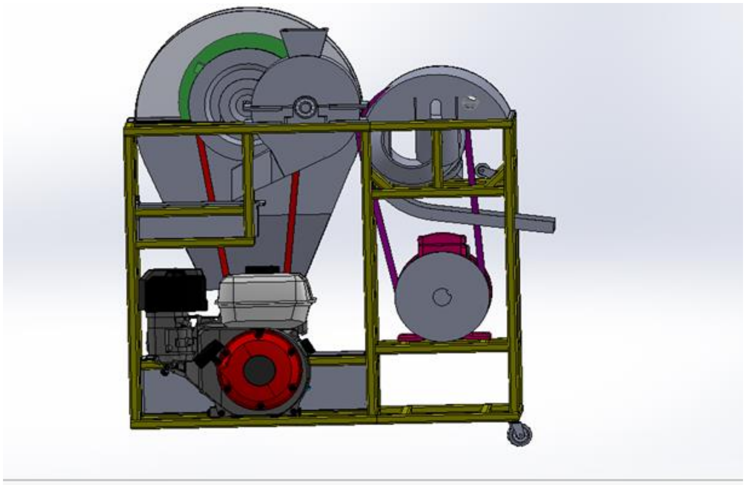

Figure 4. Side View Design

3.3 Tools and Materials

The following tools are used in this design, namely:

1. Asus M415DAO Laptop

The laptop used is an HP laptop with a brand seriesAsus M415DAO
with Processor: AMD Ryzen 3 3250U and RAM with a capacity of 8 GB. This laptop is used to run design software such as SolidWorks, Mastercamx5, Ansys, and Inventor.

2. Solidworks Software 2022

SolidWorks 2022 is the SolidWorks version released on September 16 2021 from the CAD (Computer-Aided Design) design software proposed by Dassault Systèmes SolidWorks Corporation. SolidWorks 2022 features an updated and enhanced user interface, improving the user experience more intuitively and efficiently. This includes updates to icons, colors, and layout to make it cleaner and easier to use. SolidWorks 2022 offers significant performance improvements, including more responsive loading times, more efficient response times, and smoother general performance. This allows users to work with more complex designs without experiencing performance degradation.

Calculation

The prototype that has been created is then tested to assess its performance. Testing includes several aspects, including:

a. Shredding capacity (kg/hour)

$$Kapasitas\ Pencacahan\ (kg/jam) = \frac{\text{Berat Bahan yang Dicacah (kg)}}{\text{Waktu Pencacahan (jam)}}$$

$$Kapasitas\ Pencacahan\ \left(\frac{kg}{jam}\right) = \frac{100\ \text{kg}}{0{,}5\ jam}$$

$$= 200\ kg/jam$$

b. Energy consumption (kWh)

$$Konsumsi\ Energi\ (kWh) = Daya\ Mesin\ (kW) \times Waktu\ Operasi\ (jam)$$

$$Konsumsi\ Energi\ (kWh) = 2\ (kW) \times\ 5\ jam \text{ x } 7$$

$$= 70\ kWh$$

Test results data were analyzed to determine the extent to which the designed cassava chopping machine met the desired criteria.

4. RESULT AND DISCUSSION

This research mainly concentrated on creating different blade configurations and testing them using the Finite Element Method (FEM) with Solidworks 2022 software. The most effective designs found through this research were then used in cassava chopping machines.

FEM Test Results

FEM Test on Frame

1. **Von misses stress**

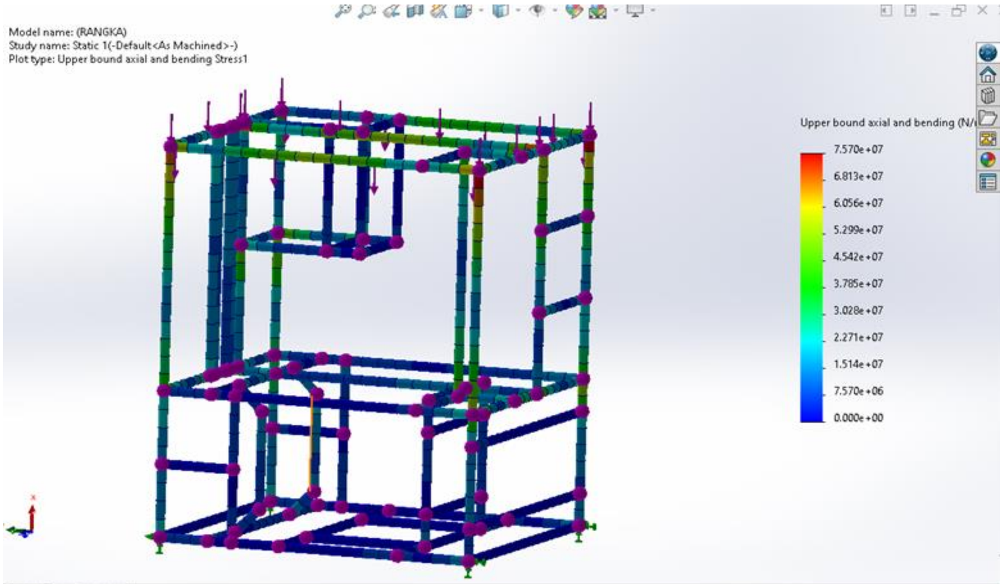

Figure 5. Von Misses Stress Skeleton

It can be seen in the simulation results image that from the stress analysis simulation results by applying a load of 10,000N (1000Kg) to the structure, bending stress results are obtained. In Figure 5, the largest upper bound axial stress and bending stress value is 757.0 N/mm2, while the smallest upper bound axial stress and bending stress value is 75.2 N/mm2.

2. Displacement

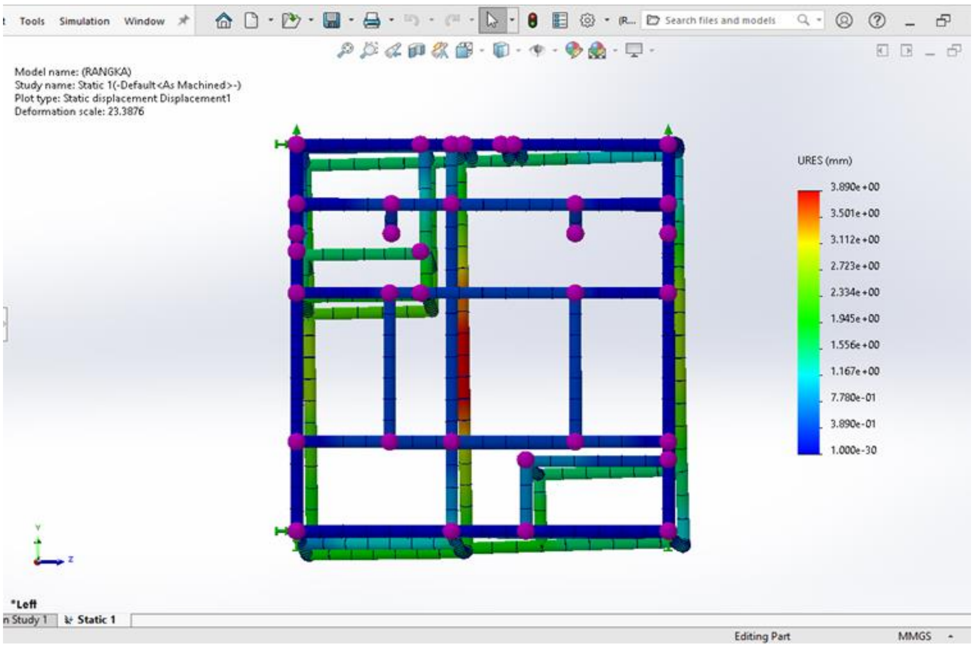

Figure 6. Displacement

In Figure 6, you can see the simulation results of the total deformation of the chopping machine frame, showing that the largest displacement that occurred was 3,890e+00 mm, while the smallest displacement value was 1,000e-30 mm.

3. Displacement

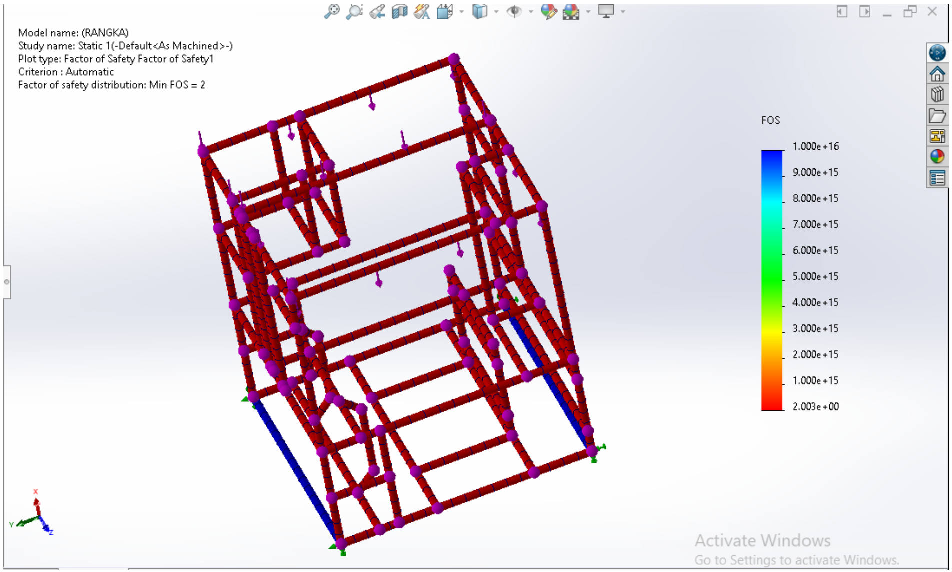

Figure 7. Factor of Safety

Based on the picture above, it can be seen that the minimum factor of safety value that occurs in the chopping machine frame is shown in Figure 7 and the value obtained is 2.0.

FEM Test On Drawers

1. Von misses stress

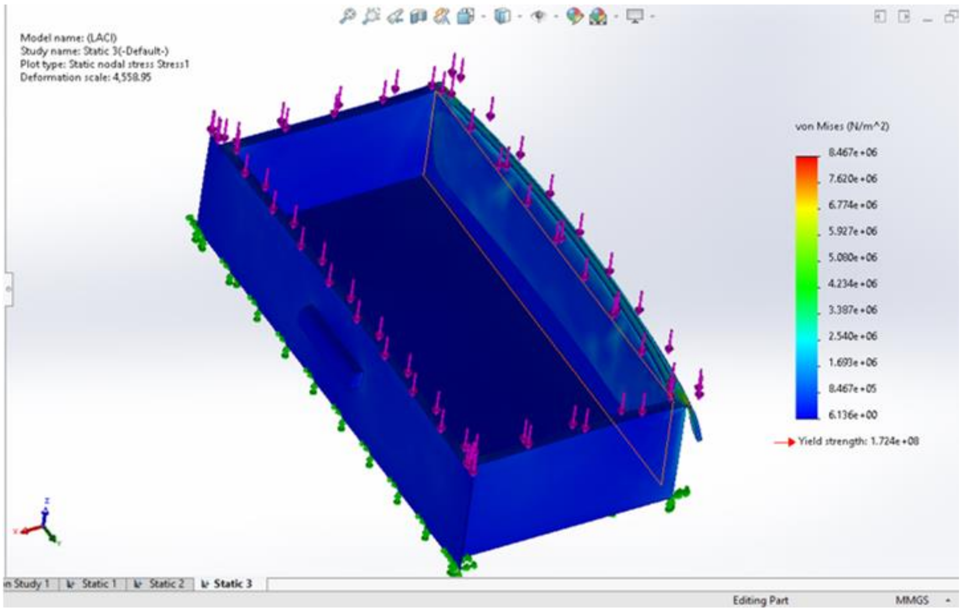

Figure 8. Von Misses Stress Drawers

It can be seen in the simulation results image that from the stress analysis simulation results by applying a load of 1000N (1000Kg) to the structure, bending stress results are obtained. In the picture, the largest upper bound axial and bending stress value is 846.7 N/mm2, while the smallest upper bound axial stress and bending stress value is 6.13 N/mm2.

2. Displacement

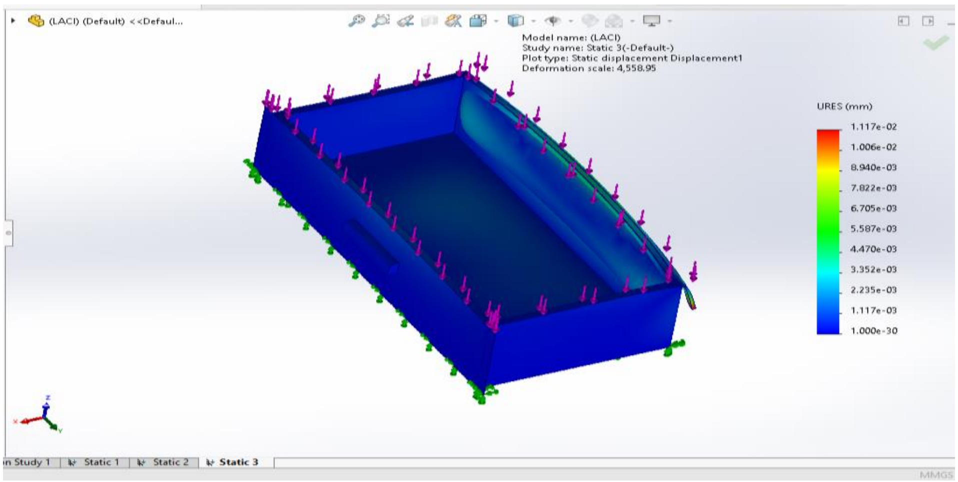

Figure 9. Drawer Displacement

In Figure 9, it can be seen that the simulation results of the total deformation of the chopping machine frame show that the largest displacement that occurred was 1,117e+20 mm, while the smallest displacement value was 1,000e-30 mm.

3. Factor of Safety

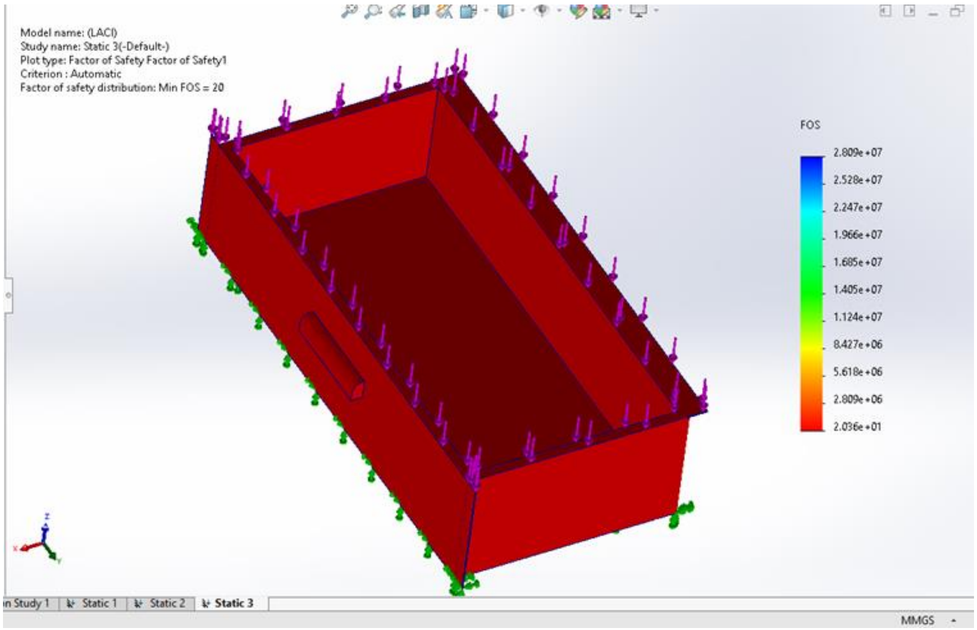

Figure 10. Factor of safety for drawers

Based on the picture above, it can be seen that the minimum factor of safety value that occurs in the chopping machine frame is shown in Figure 10 and the value obtained is 2.036.

CONCLUSION

Based on the results of this research, the designed cassava chopping machine is expected to make a significant contribution to the cassava processing industry. The use of these machines not only increases efficiency and productivity, but also ensures better product quality and reduces operational costs. In the future, further research can be focused on developing more sophisticated control technology and improving more innovative materials to continuously improve the performance and efficiency of cassava chopping machines.

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