International Journal of Engineering Trends and Technology
ISSN: 2231 – 5381 /doi:10.14445/22315381/IJETT-V69I10P206
Volume 69 Issue 10, 38-45, October, 2021

Original Article

Webbing Design Analysis for Rice Cake Casing

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***Abstract** - Rice cake, also known as ketupat, is a traditional dish available in South East Asia. The casing for the rice cake is made of two woven palm leaves placed in a diamond and rhombus pattern. The rice was then put in the casing to cook and served as a complement to meat meals. The casings are constructed by weaving two palm leaves together by hand. Experts are necessary to make the case since the abilities required are fairly high, but they are typically found in the older generation. This project involves making a webbing design, modeling the design for rice cake casing, and analyzing the simulation results for the webbing design. Solidworks 2019 SP2 student edition software is used to simulate the webbing design. The time required to weave increased from 24 to 36 seconds as the number of squares increased, although the power of the actuators' motors stayed constant at 129.6 Watt. Satay rice cake casing is the best type of rice cake casing since it has 24 squares and takes the least time to weave at 24 seconds. By the end of this report, the design had been successfully simulated in software.*

Keywords — *casing, ketupat, rice cake, webbing.*

I. INTRODUCTION

The rice cake casings that are commonly found are satay rice cake, *palas* rice cake, and *bawang* rice cake. Nowadays, all rice cakes use plastic casings to replace the palm leaves and are already made into an instant that only needs a few minutes to be the cook. Even though there are a few innovations made for the rice cake casing, there is still some difference in taste that makes the woven casings more in demand as they have better taste than the plastic casings. Some skills are needed in order to weave the rice cake casings. This study shows how to weave a complete rice cake casing a variety of times.

The overall goal of this project is to simulate a webbing design that can weave palm leaves into rice cake casing without utilizing the traditional approach, which requires more knowledge to manufacture a larger quantity of rice cake casing. The initial mission is to design the webbing for the rice cake casing. Then, simulate the webbing design for the rice cake case, and finally, analyze the webbing design simulation results.

The aim of this project is to examine five different types of rice cake casings to determine how many squares there are. The purpose of this project is to explore five parameters: squares, time, voltage, current, and power. Solidworks 2019 SP2 student edition was utilized since it makes it easy to construct a 3D design. The simulations of webbing design and satay rice cake casing are presented in this article. It will report the amount of time required to weave a complete casing based on the number of squares in the casing pattern. Then follows a discussion about how the type of rice cake casing impacts the completion time.

II. LITERATURE REVIEW

Numerous developments in spinning and cloth finishing technologies have contributed to loom technology advancements. In 1733, when John Kay devised the flying shuttle, the first significant step toward mechanical weaving was taken [1]. When the weaver was pulled, a chain or handle moved the shuttle over the textile width, so initiating the flight of the flying shuttle.

Not only did they construct a machine that weaves four times faster, but they also enabled a weaver to create cloth wider than the stretch of his arm. The current automatic looms [2] depicted in Fig. 1 are based on the simple mechanisms of the traditional handloom (hand shuttle loom) depicted in Fig. 2.

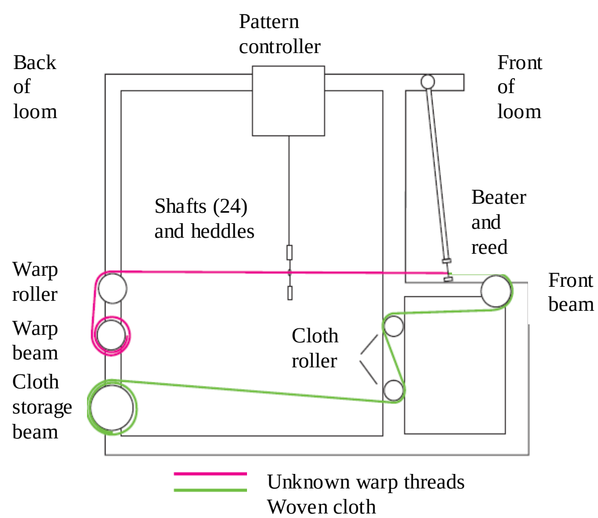


Fig. 1 Modern automatic loom parts [2]

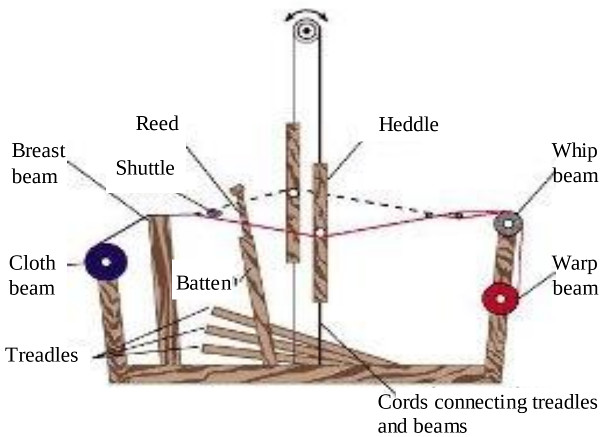


Fig. 2 Traditional handloom [3]

It is necessary to study the mechanisms of a conventional handloom in order to comprehend how an automatic loom operates [3]-[5]. To begin, the reed, also known as a sley, is made up of wires that are tightly packed between the two slats to aid in the separation of the warp threads. During the last two decades, the phrase "weaving machine" has supplanted the term "loom," owing to the weaving machine's ability to operate at both high precision and high speed [6]-[8]. Additionally, textile industries have incorporated mechatronics technology. Air-jet looms have been widely adopted and are now employed in a large number of weaving factories. In the air-jet weft insertion, the frictional drag between the air stream and the yarn surface moves the weft yarn. Airflow is highly difficult in an air jet loom because it is turbulent and is either compressible or incompressible, depending on its speed. Air drag force has an effect on airflow. Apart from this, there is another type of weaving machine called a jacquard loom [9]-[11], as illustrated in Fig. 3.

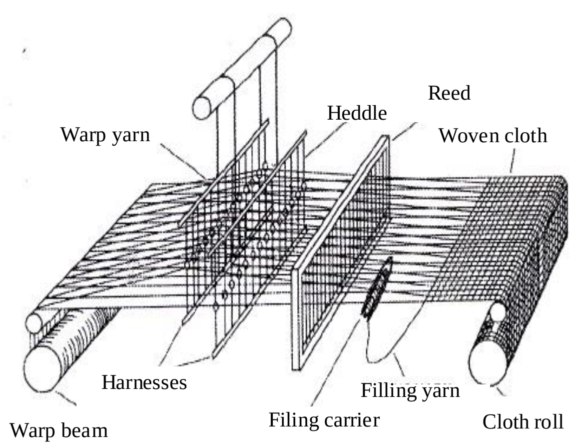


Fig. 3 Jacquard loom [5]

Typically, warp-weft interlacing is carried out mechanically on a loom [12], [13]. A loom is a machine that requires a series of irregular movements to manage its many components, and everything must be carefully timed and set in order to maintain a continuous sequence. Thus, the intention should be to integrate the components in such a way that they cannot be in conflict with one another. Numerous fashion fabrics are constructed of yarns (although some are made entirely of fibers) [14]. As previously stated, yarns are formed by twisting staple fibers or continuous filaments together throughout their length to give cohesion. There are numerous ways to manufacture fabrics, but the most well-known is the woven fabric, which is created by interlacing the warp and weft yarns at right angles to one another. The warp threads run parallel to the fabric's length (also called ends), while the weft threads run parallel to the fabric's width (also called picks).

Sarawak is a multiethnic and multicultural state in Malaysia. The Ulu people, one of the ethnic groups in that state, are well-known for their handicraft products, which include mats woven from rattan, bemban, bamboo, or pandan [15]-[18]. Mats are commonly woven from rattan and are square or rectangular in shape, as illustrated in Fig. 4.

Fig. 4. Rattan mat [9]

The Ulu people utilized mats as sleeping blankets or as a place to sit. Mats come in a variety of sizes, based on the type of leaves used and the methods required to produce them. The mat is typically woven in a checkered pattern with numerous leaves, much like the rice cake casings, as both are woven items. The only difference is that the mat is a two-dimensional product built from numerous leaves, whereas the rice cake case is a three-dimensional object made from the same two leaves.

The rice cake is one of the most anticipated delicacies that must be served throughout the festivities since it serves as the event's defining symbol. Rice cakes come in a variety of styles, including satay rice cakes, bawang rice cakes, palas rice cakes, bantal rice cakes, and jantung rice cakes [12], as illustrated in Fig. 5. Satay rice cake features the simplest pattern, making it the world's most popular rice cake. The rice cake is square in shape, similar to a pillow, and is typically served as a side dish with satay, whereas bawang rice cake is shaped like an onion but is more intricate than a satay rice cake. The majority of rice cakes are named after their shape resembles an object. Nowadays, the most often utilized type of rice cake is the mini rice cake, which is already packaged in simple plastic casings. However, it is necessary to preserve the rice cake formed with leaves as part of our cultural history.

III. METHODOLOGY

There are numerous phases involved in designing this project. Thus, the flowchart is created to ensure that the project proceeds smoothly, as illustrated in Fig.6. Each shape in the flowchart represents a distinct sort of function.

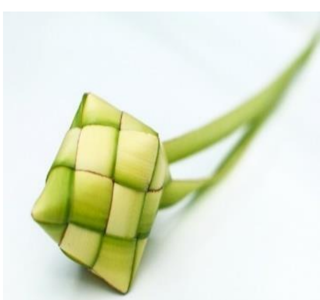
The rectangle shape denotes the flowchart's process, while the diamond shape denotes the decision made. To begin, the research should determine the variety of rice cake casings available. The goal of this study is to discover the best appropriate rice cake casing for this project. The rice cake webbing is then designed according to the type of rice cake case chosen. After the design process is complete, the number of squares must be computed.

Following that, Solidworks 2019 SP2 version software is used to simulate the webbing design. After considering all factors, the Solidworksprogramme was chosen since it made the 3D design process simpler and easier. Finally, the simulation results are assessed in terms of the time needed to complete the weave rice cake casing, as well as the current, voltage, and power consumption of the motor utilized if the webbing machine is made. However, if the outcomes are not reliable, the webbing design simulation must be run again. After completing all objectives, this project can be considered successful.

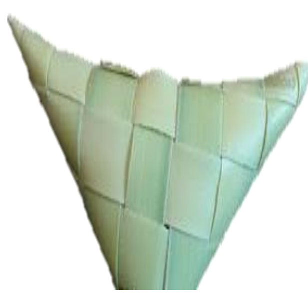
Satay rice cake

Bawang rice cake

*Bantal*rice cake



*Jantung*rice cake



*Tanduk*rice cake

Mini rice cake

Fig. 5 Type of rice cake [12]

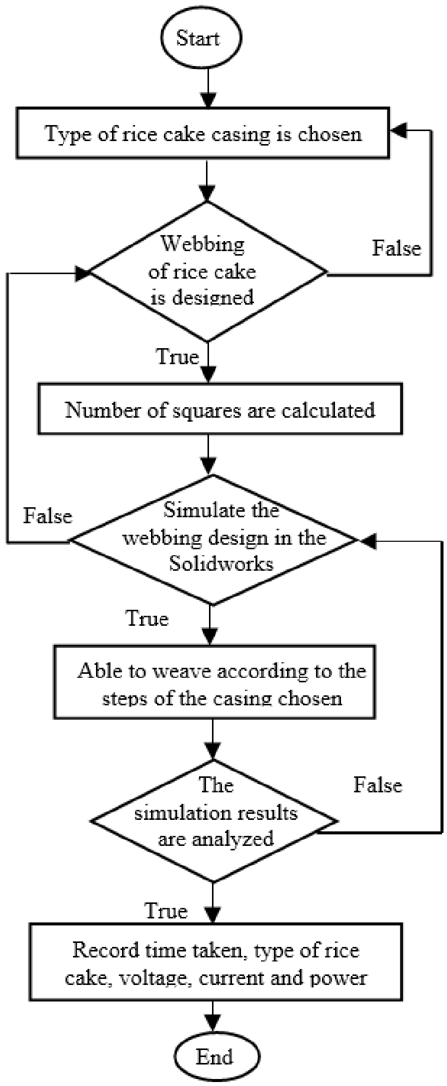


Fig.6 Flowchart

IV. SIMULATION

The simulation is carried out using Solidworks software, as illustrated in Fig. 7, Fig. 8and Fig. 9 from varied angles. The simulation makes use of flexible rods, static rods, and actuators powered by DC motors. Five actuators with a 12V dc motor [13] are used in the simulation to weave one of the leaves, called leaf B, into the other coiled leaf, called leaf A.

The rod that supported leaf A is manually coiled with leaves and made flexible at three spots. As a result, the actuators can raise the rod to make the checked pattern with the leaves. Three components comprise the webbing design: a flexible rod, a static rod, and actuators powered by DC motors. The computer software had been used successfully to create the webbing design.

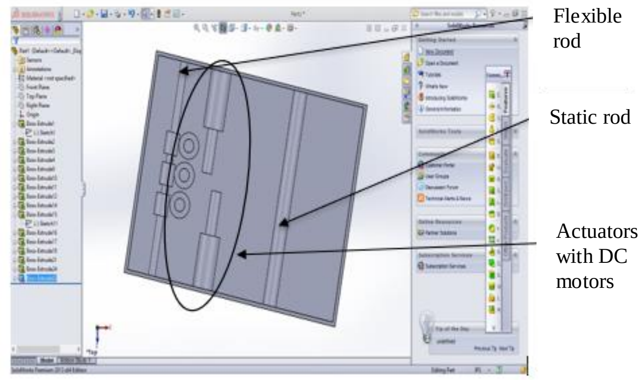


Fig. 7 Upper view of the webbing design

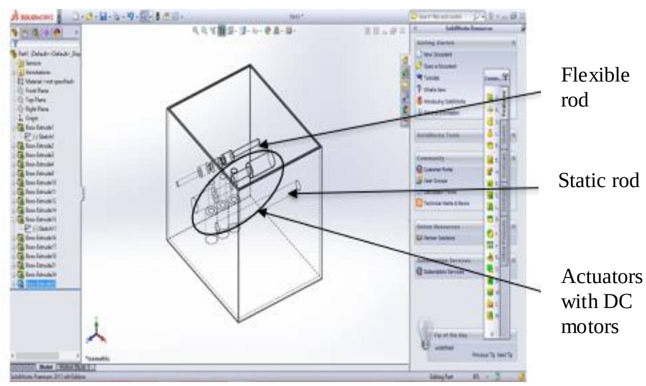


Fig. 8 Isometric view of the webbing design

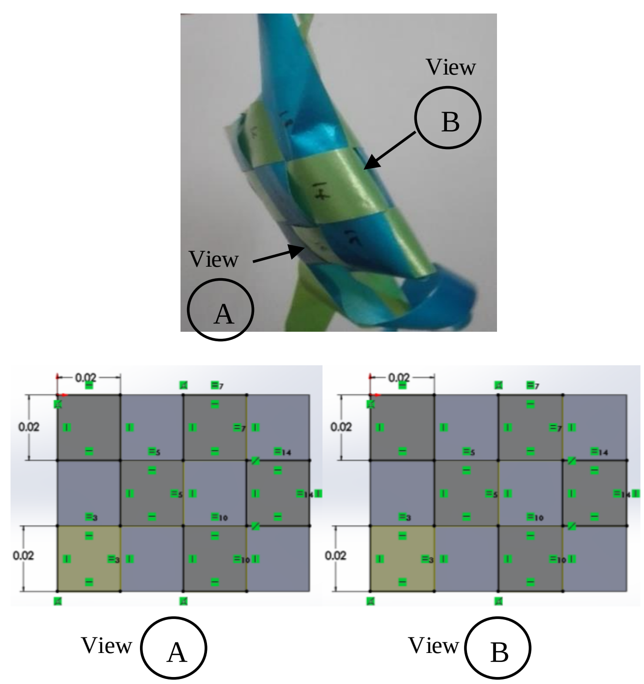


Fig. 9 Satay rice cakecasing

Satay rice cake was chosen because it lacks intricate patterns and is the most often used rice cake casing. The pattern for the satay rice cake casing is shown in Fig. 9 after it has been completed by the webbing design, which must weave exactly like the actual casing. There are a total of twelve squares, four in each column and three in each row. Each square is roughly 0.02m x 0.02m in size to correspond to the casing of the satay rice cake. On one side of the satay rice cake casing, there are 12 squares. Thus, when both sides are added together, there are a total of 24 squares, as the case is three-dimensional, as seen in Fig.5.

V. RESULTS AND ANALYSIS

This section demonstrates the relationship between rice cake casing type and weaving time. Before running the simulation in the software, the type of rice cake casing must be defined. Finding the ideal rice cake casings while counting the squares is crucial. As a result, Table 1 to Table 6 compares the time necessary to weave per square. These tables compare how many squares each rice cake casing style forms.

TABLE 1
EACH SQUARE TAKES ONE SECOND TO WEAVE

Type of rice cake casings	No. of squares	Time (s)	Electrical profile of five actuators' motor		
			Voltage (V)	Current (A)	Power (W)
Sate	24	24	36	3.6	129.6
Tanduk	25	25	36	3.6	129.6
Bawang	26	26	36	3.6	129.6
Bantal	30	30	36	3.6	129.6
Jantung	36	36	36	3.6	129.6

*The time taken to weave is 1 second per square

TABLE 2
EACH SQUARE TAKES TWO SECONDS TO WEAVE

Type of rice cake casings	No. of squares	Time (s)	Electrical profile of five actuators' motor		
			Voltage (V)	Current (A)	Power (W)
Sate	24	48	36	3.6	129.6
Tanduk	25	50	36	3.6	129.6
Bawang	26	52	36	3.6	129.6
Bantal	30	60	36	3.6	129.6
Jantung	36	72	36	3.6	129.6

* The time taken to weave is 2 seconds per square

TABLE 3
EACH SQUARE TAKES THREE SECONDS TO WEAVE

Type of rice cake casings	No. of squares	Time (s)	Electrical profile of five actuators' motor		
			Voltage (V)	Current (A)	Power (W)
Sate	24	72	36	3.6	129.6
Tanduk	25	75	36	3.6	129.6
Bawang	26	78	36	3.6	129.6
Bantal	30	90	36	3.6	129.6
Jantung	36	108	36	3.6	129.6

* The time taken to weave is 3 seconds per square

TABLE 4
TIME AND POWER DERIVED FROM EQUATION IN FIG. 10

No. of squares	Time (s)	Power (W)
10	48.5	129.6
15	63.0	129.6
20	77.5	129.6
25	92.0	129.6
30	106.5	129.6
35	121.0	129.6
40	135.5	129.6
45	150.0	129.6

TABLE 5
TIME AND POWER DERIVED FROM EQUATION IN FIG. 11

No. of squares	Time (s)	Power (W)
10	97	129.6
15	126	129.6
20	155	129.6
25	184	129.6
30	213	129.6
35	242	129.6
40	271	129.6
45	300	129.6

TABLE 6
TIME AND POWER DERIVED FROM EQUATION IN FIG. 12

No. of squares	Time (s)	Power (W)
10	145.5	129.6
15	189.0	129.6
20	232.5	129.6
25	276.0	129.6
30	319.5	129.6
35	363.0	129.6
40	406.5	129.6
45	450.0	129.6

The relationship between the number of squares, time, and power is seen in Fig.10. Additionally, the graph depicts equation (1), which represents the power consumed by the actuators' motors, and equation (2), which represents the time required to weave.

$$Power = 129.6W \quad (1)$$
$$Time = (2.9 \times No. of\ squares) + 19.5s \quad (2)$$

The graph, based on Fig. 11, illustrates the influence of squares' number on time and power consumed. Equations (3) and (4) are presented below.

$$Power = 129.6W \quad (3)$$
$$Time = (5.8 \times No. of\ squares) + 39s \quad (4)$$

Fig.12 illustrates the relationship between time and power as a function of the number of squares on the casings. Equation (5) calculates the power consumed, while equation (6) calculates the time required to weave.

$$Power = 129.6W \quad (5)$$
$$Time = (8.7 \times No. of\ squares) + 58.5s \quad (6)$$

Apart from that, Fig. 13 illustrates the link between time and power in terms of the number of squares using data from Table 4. Figs. 14 and 15 also illustrate the link between time and power and the number of squares, but they are based on other tables, Tables 5 and 6.

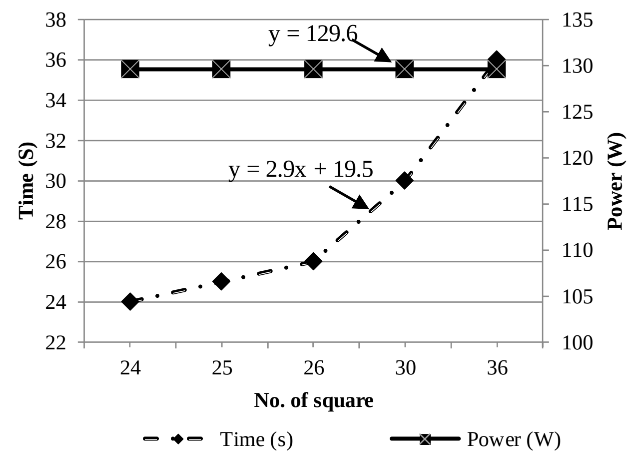


Fig.10 Effect of the square number on time and poweraccordingTable 1

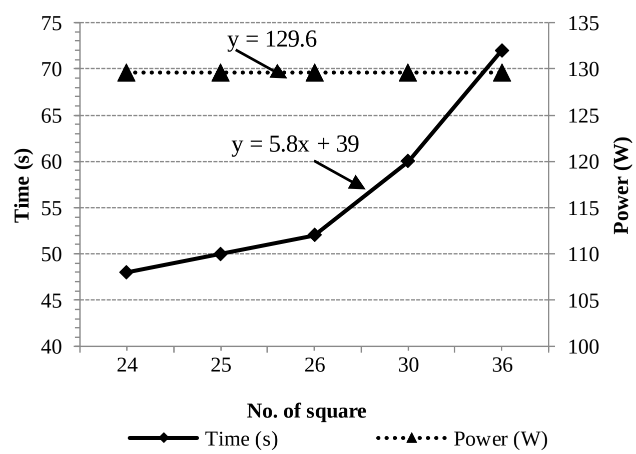


Fig. 11 Effect of the square number on time and poweraccordingTable 2

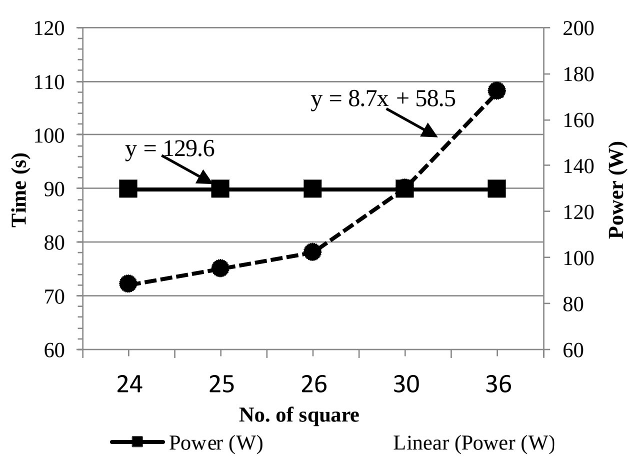


Fig. 12 Effect of square number on time and poweraccordingTable 3

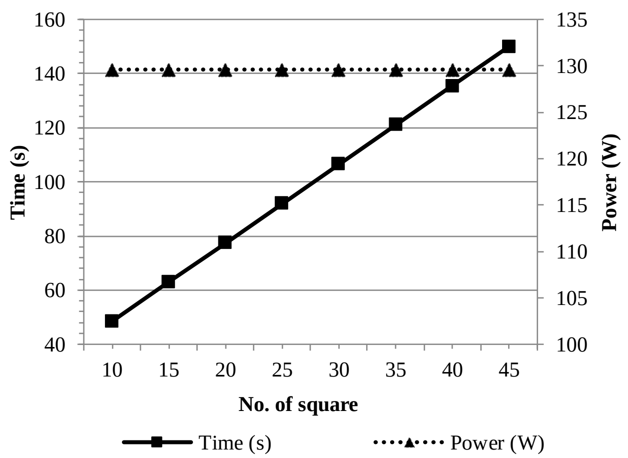


Fig. 13 Effect of the square number on time and poweraccordingTable 4

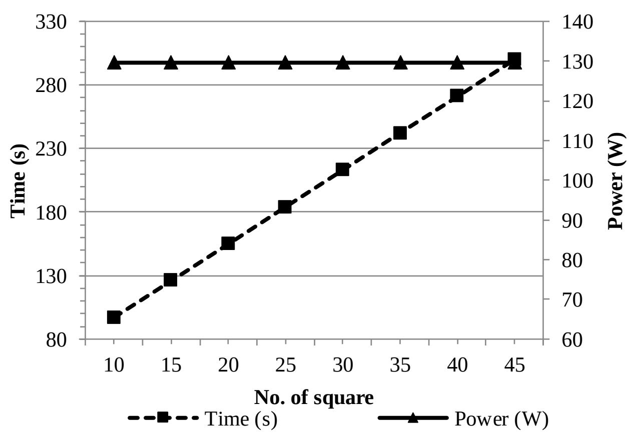


Fig. 14 Effect of the square number on time and poweraccordingTable 5

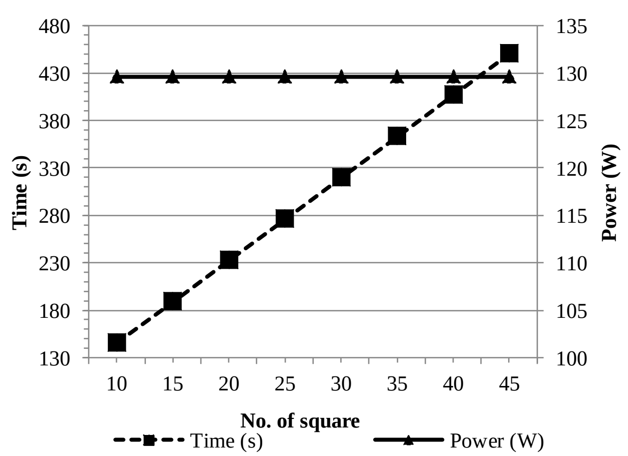


Fig. 15 Effect of square number on time and poweraccordingTable 6

All graphs and tables are based on the five-actuator webbing design. The total voltage used is 36V with a current of 3.6A, depending on whether the circuit is connected in series or parallel. Rice cake casings such as satay rice cake, tanduk rice cake, bawang rice cake, bantal rice cake, and jantung rice cake have been used.

According to Table 1, when the number of squares is 24, the time required to weave the satay rice cake is estimated to be 24 seconds, as each square takes just one second to weave. Meanwhile, if the casing is jantung rice cake, the number of squares determined equals 36, implying a weaving period of 36 seconds. In comparison to the other rice cakes, the jantung rice cake has the most squares.

Then, in Table 2, the time required to weave one square is calculated to be two seconds. The number of squares and power consumption remained unchanged for the all rice cake casings type, as it continued to employ five actuators, but the time required to weave is two times slower, as each square is expected to be woven in two seconds. Following that, Table 3 requires three seconds to weave each square's casing for all types of rice cake casings. Then, Tables 4, 5, and 6 are built using the equations shown in Figures 10, 11, and 12.

Fig. 13 is produced using equations (1), $y=129.6$, and (2), $y=2.9x+19.5$, which were generated using Fig. 10. Fig. 14 is plotted using the previous Fig.11's equations $y=5.8x + 39$ (4) and $y=129.6$ (3). Meanwhile, the equations from the preceding graph in Fig. 12 are used to compute the time and power required to plot Fig. 15. The graphs demonstrate that as the number of squares increases, the time required to complete the task increases as well, but the power remains constant. The power output remained constant due to the constant number of actuators. Because weaving time is computed per square, as the number of squares increases, the time required to weave a complete casing increases as well.

VI. CONCLUSION

As a result, the first and second objectives of this project have been met. Analyzing simulation results for webbing design is our final goal for this project. Researchers count squares in order to determine how long it will take to weave a rice cake case. 129.6 watts of electricity is required for the design because there are only five actuators using 12V DC motors with a current of 1.2A. The time required to weave each square is set to one second, two seconds, and three seconds. Finally, the advantage of this project is that it takes less time to develop a complete casing than it does to weave one of these in the conventional way.

ACKNOWLEDGMENT

The authors would like to express their gratitude to UniversitiTeknikal Malaysia Melaka for providing laboratory space and technical assistance.

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