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MECHANIZATION OF KUIH ROS AUTOMATIC MACHINE: PRODUCTION AND YIELD MONITORING

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Abstract— Mechanization and automation utilizing technologies that have the potential to advance the country's agro-food sector. The use of technology will provide a steady supply of high-quality products. Manually producing Kuih Ros requires repetitive processes which are time-consuming and laborious. The process of dipping, frying, and dispensing is needed to produce one piece of Kuih Ros. Therefore, this paper proposed a machine that can do the whole process by utilizing the sequence of motor movements mimicking the traditional method. The automatic Kuih Ros machine also provided with counting mechanism for the production record. The result is divided into two parts which are addressing the automatic production of Kuih Ros and monitoring the yields. Compared to the manual method which uses a single mould, the automatic machine shows a higher production number per time. The developed automatic machine with combined mould is shown to increase the product yield. Meanwhile, the manual count produced the same result as the system's automatic count during the test. This demonstrates that the system's data is accurate and reliable. The whole completed process assures that the Kuih Ros produced are of consistent quality while minimizing human error.

I. Introduction

Malaysia's agro-food business is a fast-growing sector that generated RM22.5 billion (USD7.3 billion) or 6.3 percent of GDP in 2011 [1]. This leads to a quantitative increase in the trend of industrial company innovation with the number of research publications in the food industry [2]. The Engineering Research Centre of the Malaysian Agricultural Research and Development Institute (MARDI) has established mechanization and automation technologies for the country's agro-food sector [3]. Changes in the nature of food demand and supply, as well as higher levels of competition, make innovation not only necessary but also one of the most significant corporate activities for achieving overall profit improvements [4,5].

To manufacture better quality goods and services, mechanized innovation will speed up production, complete tasks, and minimize tiredness and human labour [6,7]. As a result, food process mechanization can be defined as the process of utilizing equipment and machinery to increase food production by providing efficient, greater capacity production and better food production.

Small and medium businesses (SMEs) are in high demand in our country right now. As a result, additional equipment with the latest technology must be produced in accordance with the market trends. The operator is exposed to dangers such as hot oil during the frying process when using traditional methods to make Kuih Ros. It will take more manpower to produce huge quantities utilizing the manual method. As a result, the cost of making the Kuih Ros will be higher. Manual approaches could not guarantee product yield uniformity in terms of quality.

A single operator can now create up to 1,200-1,500 pieces per hour thanks to the invention of the Kuih Ros machine. All of the moulds were dipped into the batter at the same time, which took approximately 20-30 seconds. The frying procedure takes 2 minutes at 180 degrees Celsius. The mechanical equipment used to process Kuih Ros usually has 18-25 moulds attached to it. The most optimal size of the mould is 60mm in diameter, however other sizes that meet the user's needs are also acceptable [1]. The machine was priced at RM12,000 for semi-automatic and RM50,000 for fully automatic [8].

The main goal of this study is to give innovation in the mechanization of Kuih Ros production processes. The invention of automatic Kuih Ros has eliminated the need for manual manufacture, which is less laborious whereby all repeated processes are done automatically. In addition, the machine that was designed used a combination attached mould to boost production per time. The dispensing system, on the other hand, assists the machine's operator while also ensuring constant quality for the Kuih Ros produced. This machine is entirely automated and can be operated by just one person. The entire design included gears with four stepper motors, a heating element, an aluminium food-grade machine body, an electrical power source, an LCD, an infrared sensor and an Arduino controller. This invention has the potential to improve the food industry, particularly small and medium businesses (SMEs), because mechanization will allow them to produce on a larger scale with consistent quality while using less energy, thereby expanding their market. It also provides accountancy of consumer safety which is unneglectable.

II. Methodology

This part is divided into two major phases. Phase 1 involved developing a mechanization design for an automatic Kuih Ros machine while phase 2 covered developing the real-time monitoring system to count the number of Kuih Ros production.

A. Phase 1: Production of automatic machine

The process generates ideas in the form of solutions, which must be combined to create a conceptual design. In designing, sketching, and drawing technical parts for the product design, all critical measurements such as usability, safety, and efficiency are considered. To create a balanced and fair result, the materials should be chosen in accordance with the design, considering each part as well as the associated costs. In this particular phase, three important processes are carried out which are forming, frying and dispensing. Figure 1 shows the overall machine developed. The height of the product designed is 100cm, 40cm in width and 100cm long. The body is connected to the heightened leg to allow the air to circulate beneath the fryer tray while the oil is heating up.

Figure 1. Kuih Ros Machine

Figure 2 shows the combined mould mounted on the machine. There are nine Kuih Ros moulds combined to maximize the number of productions at one time. In forming process, the machine should be able to dip all the moulds into the batter and put them inside the fryer.

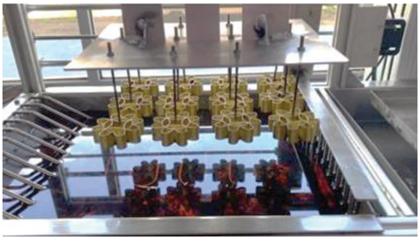


Figure 2. Combined mould

Figure 3 shows the dipping tray located on top of the batter tray. The battery tray is a stationary piece of equipment used to fill the mixed ingredient. Only the dipping tray moves up and down to cover the mould with enough batter while simultaneously swirling to prevent it from simmering. The movement is done using a DC motor. It is important that the mould is not covered by the batter otherwise, the batter will stick to the moulds and the shape of the Kuih Ros will not be formed.

Figure 3. Dipping tray and batter tray

Figure 4 shows the controller box which is located on the back and away from the hot oil. As a result, it will be able to keep the wire and microcontroller from the oil heat. Inside there are four motor drivers, a power supply and Arduino. The steps of machine operation are described in the flow chart in Figure 5.

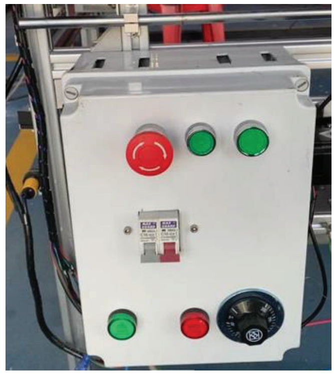


Figure 4. Controller box

The manufacturing process begins with motor 1 sliding the mould to the fryer. Motor 2 then dipped the mould into the hot oil with a constant temperature of 180^0C. With the preheated mould, motor 1 slides the mould to the dipping tray. Motor 3 lift the dipping tray while motor 2 dipped the mould into the batter. Motor 1 slides the covered mould to the fryer and then motor 2 dipped the covered mould into the fryer. After the batter hardens and set in shape, motor 2 lifts the mould to slide off the batter. Motor 1 slide back the mould to the dipping tray while the scrapper dispenses the fried Kuih Ros by using motor 4 and the process repeat.

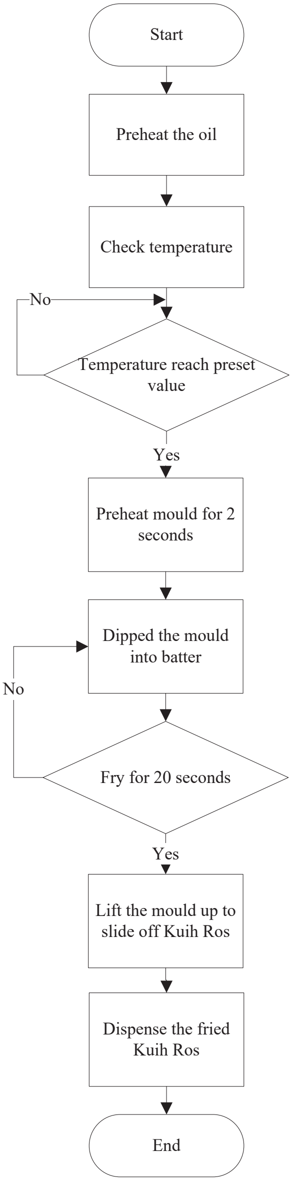


Figure 5: Flow chart of Kuih Ros production

B. Phase 2: Real-time monitoring system for counting the number of Kuih Ros production

The next phase is to display the number of Kuih Ros production. The system should be able to count the number of products based on the time. Rather than human counting, an automatic counting system will improve production convenience. To calculate the total number of productions in real-time, an automatic counting method is proposed. The system is attached to the dispenser unit of the Kuih Ros machine as shown in Figure 6.

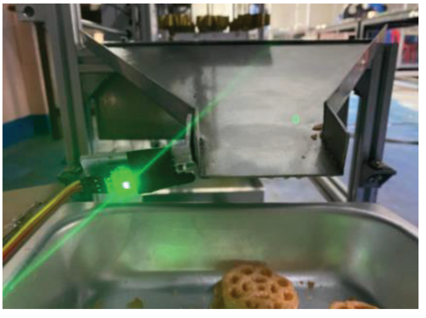


Figure 6: Counting System

The infrared sensor, Arduino, and LCD are the primary components of the suggested design. The project's block diagram is shown in Figure 7.

The IR sensor is utilized to detect the presence of Kuih Ros flowing out of the dispenser. The Arduino Mega 2560 functions as a microcontroller, processing all input data and instructing the output to do the intended action. The Arduino will act as a communicator, reading information from the sensor and transmitting it to the LCD for display.

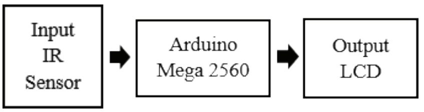


Figure 7: Block diagram for monitoring system

The flowchart in Figure 8 depicts the project's workflow for the entire process, implying the sequence of the programming phases. The sensor communicates logic low (0V) to Arduino whenever it finds objects that block the light reflection. If no objects are found, logic will be set to high (5V). The Arduino started counting each time an output low was received. If the sensor produces another low output later, the number will be added and increased. The Arduino data on the current condition will be displayed on the LCD.

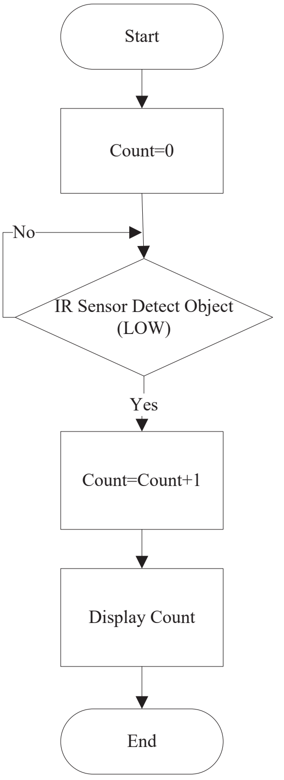


Figure 8: Flowchart for the counting system

Based on the application of the electronic and electrical components used in this project, the connection between components was set up according to the pins defined in Arduino. Figure 9 shows the connection between the electronic components of the product.

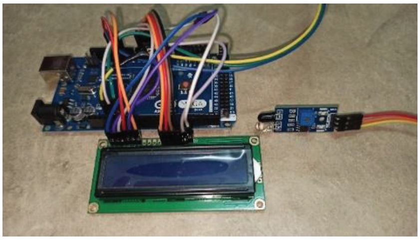
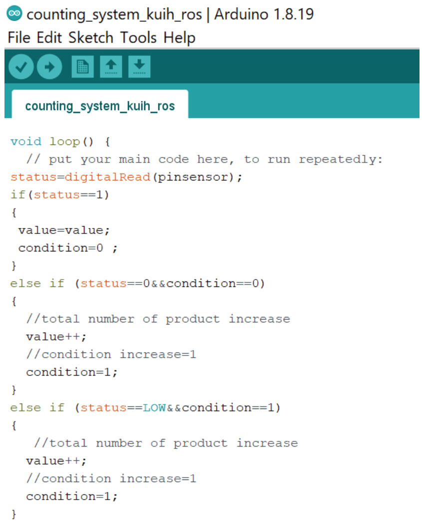


Figure 9: Connection of the monitoring system

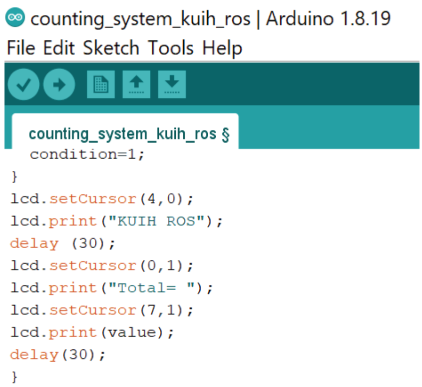
Arduino IDE software was used to organize the system operation. Arduino is programmed to count the Kuih Ros slide off from the dispenser based on the product existence sensed by the IR sensor. Figure 10 shows the code for the counting procedure. The total number of counts would increase if the condition received from the sensor is low. Otherwise, the number of counts will remain the same.

Finally, as illustrated in Figure 11, the number of Kuih Ros counted by the system is displayed on the LCD. On the two available lines, the LCD is programmed with what and where it should display. In this case, the entire amount is displayed on the second line of the LCD monitor.




```
void loop() {
  // put your main code here, to run repeatedly:
status=digitalRead(pinsensor);
if(status==1)
{
 value=value;
 condition=0 ;
}
else if (status==0&&condition==0)
{
  //total number of product increase
  value++;
  //condition increase=1
  condition=1;
}
else if (status==LOW&&condition==1)
{
   //total number of product increase
  value++;
  //condition increase=1
  condition=1;
}
```

Figure 10: Counter programming




```
  condition=1;
}
lcd.setCursor(4,0);
lcd.print("KUIH ROS");
delay (30);
lcd.setCursor(0,1);
lcd.print("Total= ");
lcd.setCursor(7,1);
lcd.print(value);
delay(30);
}
```

Figure 11: LCD displayed the total number

III. Results and Discussions

This paper carried out two stages of analysis to find out the performance of the developed system. The stages consist of the mechanization of Kuih Ros

Production and the product yield monitoring system.

A. Production of Kuih Ros Mechanization

The evolution of an automatic machine is discussed. As demonstrated in Figure 12, the automatic machine is compared to the traditional approach of manually employing a single mould. The data is taken for each half-hour. The graph shows increasing trends while the automatic Kuih Ros machines always outperforms the manual method.

An operator utilizing the manual approach takes 15 seconds to complete each cycle of dipping, frying and dispensing [9]. Each cycle of the automatic machine could produce 9 pieces of Kuih Ros in 31.2 s. The results reveal that by merging the moulds, the automatic machine produces more products than the traditional single-operator approach. The time, energy, and consistency of manual frying and dispensing procedures are all dependent on human efficiency. Furthermore, the automatic dispenser allowed for uniform, evenly cooked food with less shape deterioration.

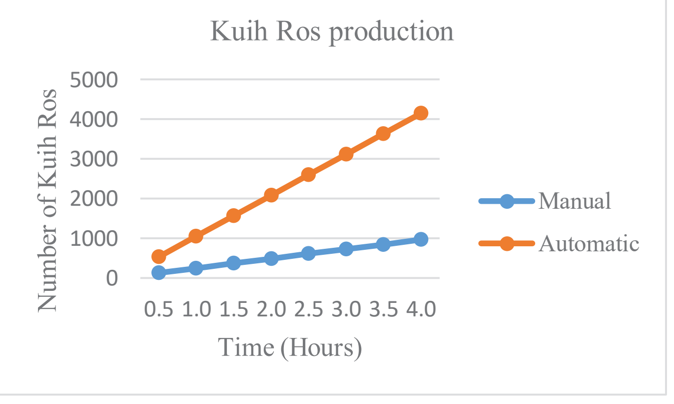


Figure 12: Comparison of manual and automatic Kuih Ros production

B. Monitoring System

For the counting system, the number is displayed as shown in Figure 13. With the information retrieved by the IR sensor, Arduino will count the number of Kuih Ros passes through the dispenser each time a signal low is received. The number will then be presented on an LCD screen and updated in real-time.

Figure 13: Displayed number on LCD

The result was taken from the recorded LCD for each 5 min reliability test. For comparison, the result was compared to the manual count recorded in Table 1. This test took 40 min to complete, and the data was collected.

According to Table 1, the number of Kuih Ros has been growing over time for both counting methods. Every 10 min, the machine can manufacture 173 pieces. Each time data is recorded in 10 min intervals, the overall number appears to be equal. Therefore, it is found that the counting accuracy is 100% when compared to manual count.

Table 1: Number of calculated Kuih Ros Production

Time [min]	Number of products counted by the system	Number of products counted manually
10	173	173
20	346	346
30	519	519
40	692	692
50	865	865
60	1038	1038

IV. Conclusion

In conclusion, this project was effective in achieving its goal. The main goal is to create an automated production system with yield monitoring for Kuih Ros. It comprises a system built with a stepper motor for the sequence movement, Arduino as the microcontroller, an infrared sensor for counting means and an LCD for monitoring purposes. The results reported show that the developed automated Kuih Ros machine improved manufacturing efficiency. The automation of the dipping, frying, lifting, and dispensing processes reduces the need for human monitoring and mistakes while making the operation less laborious due to that repeated action. Product quality homogeneity was achieved by the structured sequence and constant temperature. Furthermore, the manual count produced the same result as the system's automatic count during the test. This demonstrates that the system's data is accurate and trustworthy. As a result, the counting procedure can be completed as swiftly and efficiently as possible while minimizing human mistakes. Overall, this article presents an exhaustive development of mechanization for the automatic machine.

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