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Android-based Automatic Steak Grilling Tool

Irma Salamah[1)*], Yunita Syaniah[2)], Irawan Hadi[3)]
[1,2,3)]Politeknik Negeri Sriwijaya
[1)]irma.salamah@yahoo.com, [2)]nitakk2823@gmail.com, [3)]irawanhadi657@yahoo.com

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Abstract: In an era of rapid technological development, technology is increasingly accessible and easily applied by humans. One of the significant developments is the Internet of Things (IoT), where physical devices such as sensors, equipment, and vehicles are equipped to communicate and interact via the Internet network. The application of IoT has expanded to various sectors, including culinary. In this regard, preparing and presenting food, especially steaks, becomes an exciting focus. There are multiple types of steaks, such as sirloin and tenderloin, and cooking involves various techniques, such as searing and grilling. However, suitability for maturity and risk during cooking is challenging for steak makers and connoisseurs. To overcome this, the application of IoT is needed in an automatic steak roaster to be a promising solution. This research is also equipped with real-time monitoring via an Android application. This aims to ensure proper doneness and consistent results in the steak cooking process. This research makes an automatic steak grill with a success rate of 83%, which shows that the tool's performance and functionality align with expectations. This tool also has an Android application to monitor and control the device remotely efficiently. This research gives confidence that this can be a solution that has been developed and provides significant benefits in roasting steaks with automatic monitoring and operation.
Keywords: Android, IoT, Steak, Sirloin, Tenderloin

INTRODUCTION

Semakin hari perkembangan teknologi mengalami pertumbuhan yang sangat cepat. Hal yang sama berlaku Day by day, the development of technology is experiencing swift growth. The same thing applies to humans as technology users who also develop along with these developments. Technology has become accessible everywhere (Sumadi, Putra, and Firmansyah 2022). One of the most developed technologies is the Internet of Things (IoT). Internet of Things (IoT) is a concept in which various physical devices, such as sensors, equipment, vehicles, and others, are equipped to collect, send and receive data over the Internet network. The goal is to enable these devices to communicate and interact with each other and systems or applications connected to the internet to provide more innovative, efficient, and connected functionalities (Febrianti, Adi Wibowo, and Vendyansyah 2021)The Internet of Things (IoT) application is used in various industrial fields, including the culinary field (Yayasan and Karim 2023).

One of the exciting aspects of the culinary industry is the preparation and serving of food, including steaks. Steak meat is a large piece of beef consisting of various types, such as Sirloin and Tenderloin, which are steak cuts well-known in Indonesia (Dapur 2010). For the manufacturing process, meat steaks can be classified into two main techniques: searing and grilling. The searing technique is a relatively simple method. In this method, the meat is cooked over high heat for 1-2 minutes on each side, with butter and crushed garlic added to flavor the steak. At the same time, the Grilling technique is cooking meat on a grill with fire that does not come into direct contact with food. In this case, it gives a marking on the surface of the meat; after it is visible, the cooking process can be continued using the oven (Dapur 2010).

However, in the application of these two techniques, there are risks that may arise. For example, when a customer wants a meat steak with a certain level of doneness, the chef may be inaccurate in applying the steak cooking technique, resulting in a discrepancy between the customer's expectations and the end result of the dish. In addition, when cooking with the searing technique the need to turn the steak over the meat can cause splashes of hot oil or butter and endanger the chef (Apriadji 2007). Therefore, it is necessary to apply the Internet of Things (IoT) to simplify the process of grilling steaks with the aim of achieving the desired level of doneness and avoiding oil splashes that could harm the chef.

In the previous study (Rangkuti 2019) produced a consultation system for tenderloin maturity through camera photos using the Static Feature Extraction Method. In another study (Theodossy and Huvat n.d.) in the form of designing an automatic grill tool using the Quality Function Deployment (QFD) method, the roasting process was faster than before, namely 20-26 minutes to 10-18 minutes faster with the same meat capacity.

*name of corresponding author

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In this study, the implementation of the Internet of Things (IoT) was carried out in making an automatic roaster to optimize the process of cooking steaks to the desired level of steak maturity. This technology is also equipped with real-time monitoring using an android application to ensure steaks are cooked evenly with the right level of doneness and consistent results.

LITERATURE REVIEW

The doneness technique of steak meat plays a significant role in determining the satisfaction of culinary connoisseurs. The level of doneness of steak meat can be divided into several categories, each with different characteristics and length of cooking time; to achieve the "Rare" or medium rare level of doneness, the steak meat is grilled for about 4-6 minutes on each side. This results in a pink inside with a touch of sizzle. For the "Medium Rare" level, the steak is grilled for 6-8 minutes on each side, resulting in a pinkish-warm inside with a hint of juices. At the "Medium," medium-rare level, the steak is cooked for 8-10 minutes on each side, with the inside remaining pink. To reach the level of "Medium Well," almost perfectly cooked, the steak is grilled for 10-12 minutes on each side, with a thinner center pink layer. Finally, at the "Well Done" level, the steak is cooked on each side for 12-14 minutes, resulting in thoroughly cooked meat with no red coating. By understanding the level of steak doneness and the corresponding cooking duration, restaurants can provide a culinary experience that matches customer preferences (Dapur 2010).

This automatic steak grill uses the Node MCU ESP8266 component as a microcontroller that will connect to the internet. Node MCU is an Internet of Things (IoT) platform with an open nature. This platform consists of hardware that uses the ESP8266 system on chip, developed by Espressif Systems (Jyostsna Vanaja et al. 2018). Node MCU packs ESP8266 into a board integrated with various microcontroller-like features and can access Wi-Fi networks and communication chips from USB to serial (Wijayanti 2022).

As a controller, the sensors used are controlled using Arduino Uno. Arduino Uno is a popular and versatile microcontroller development. Arduino Uno is designed to make it easier for developers and is open source (Arrahman 2022).

This tool is also equipped with a DS18B20 temperature sensor to monitor the temperature in the open space, which will be displayed on the LCD. The DS18B20 temperature sensor is a temperature sensor that has a digital output. DS18B20 has a reasonably high accuracy level of 0.5 ° C in the temperature range of -10 ° C to + 85 ° C, so it is widely used for temperature monitoring system applications (Murdiyantoro, Izzinnahadi, and Armin 2021).

The motor driver drives the steak meat to cook evenly in the oven. A motor driver is an electronic device specifically designed to control the movement and rotation of an electric motor. This device links the controller (such as a microcontroller or computer) and the motor itself (Sintaro et al. 2022). The motor driver regulates the current and voltage supplied to the motor, ensuring proper motor movement according to the instructions given by the controller (Richardo 2022).

A liquid crystal display (LCD) was used to display the sensor information. LCD stands for "Liquid Crystal Display," or, in the known language, is a type of visual display technology that uses liquid crystals that can be controlled to produce images or text (Asy'ari and Haqibillah 2022). This tool is monitored using an Android application which is an operating system that provides an open platform for developers to create their applications. In addition to the essential functions of the operating system, Android also has middleware that helps applications interact with hardware, the application is made using android studio (Mulyati and Wardono 2019).

METHOD

In this study, two stages of implementation were carried out, namely the hardware design stage and software design in the form of applications such as monitoring the automatic steak grill used. The research framework can be seen in Figure 1.

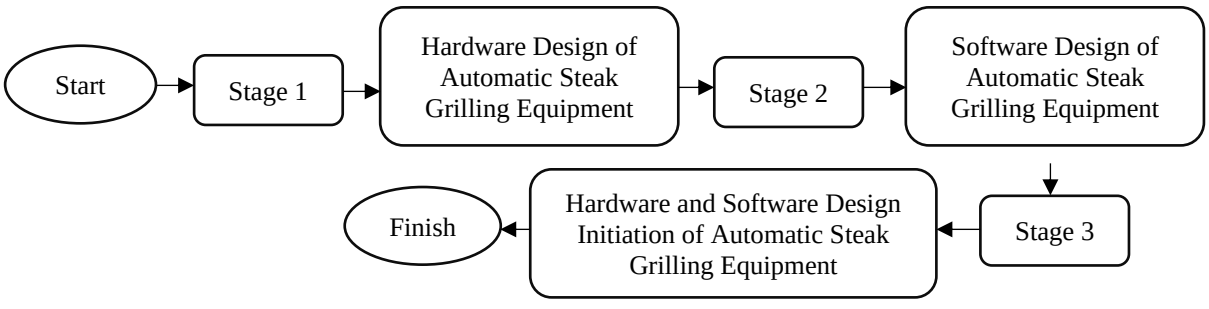

Figure 1 Research Online
(Source:Researcher Property)

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Based on the research framework above, the first step is to design the automatic steak grill hardware. The hardware components connected can be seen in the following layout image.

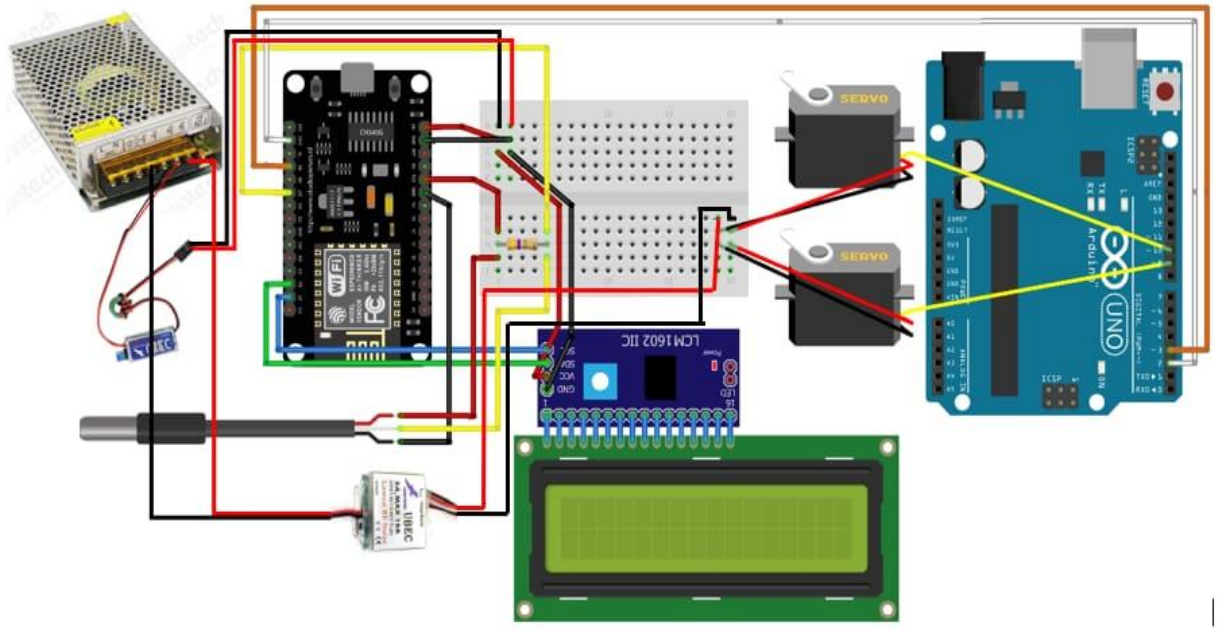

Figure 2 Layout dan Wiring Hardware

(Source:Researcher Property)

In the picture above, the Power Supply provides electric current to the NodeMCU with the help of UBEC to directly reduce the voltage of the electric current. Then the DS18B20 Temperature Sensor is responsible for reading the oven room temperature, displayed on the I2C LCD.

Furthermore, Arduino is also given a source of electricity through the Power Supply with the help of UBEC. Arduino is useful for turning on and off the stove and commanding the grill in the oven to rotate automatically according to the time set through the database. The working system of the automatic steak grill tool is in Figure 3.

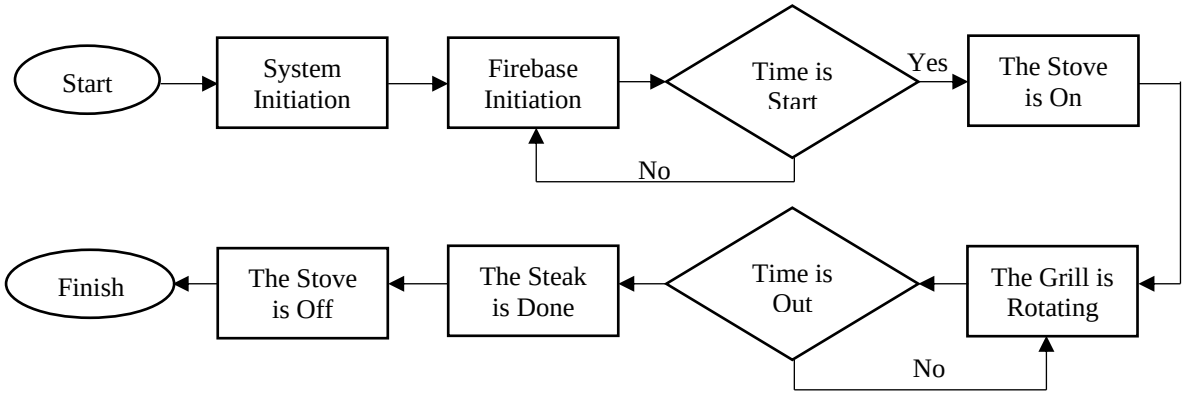

Figure 3 Flowchart of the automatic steak grill system
(Source:Researcher Property)

Figure 3 shows the stages of using an automatic steak grill. When starting, the system will initiate by turning on the connected device or tool. The firebase will be activated, followed by setting the cooking time, and the stove will automatically turn on then the steak grill starts. After the steak is cooked, the roasting time stops, and the oven automatically turns off, indicating the process is complete.

After the hardware design stage or the device components are assembled and assembled, of course, it cannot be separated from the software design, namely, using an application with the following work system.

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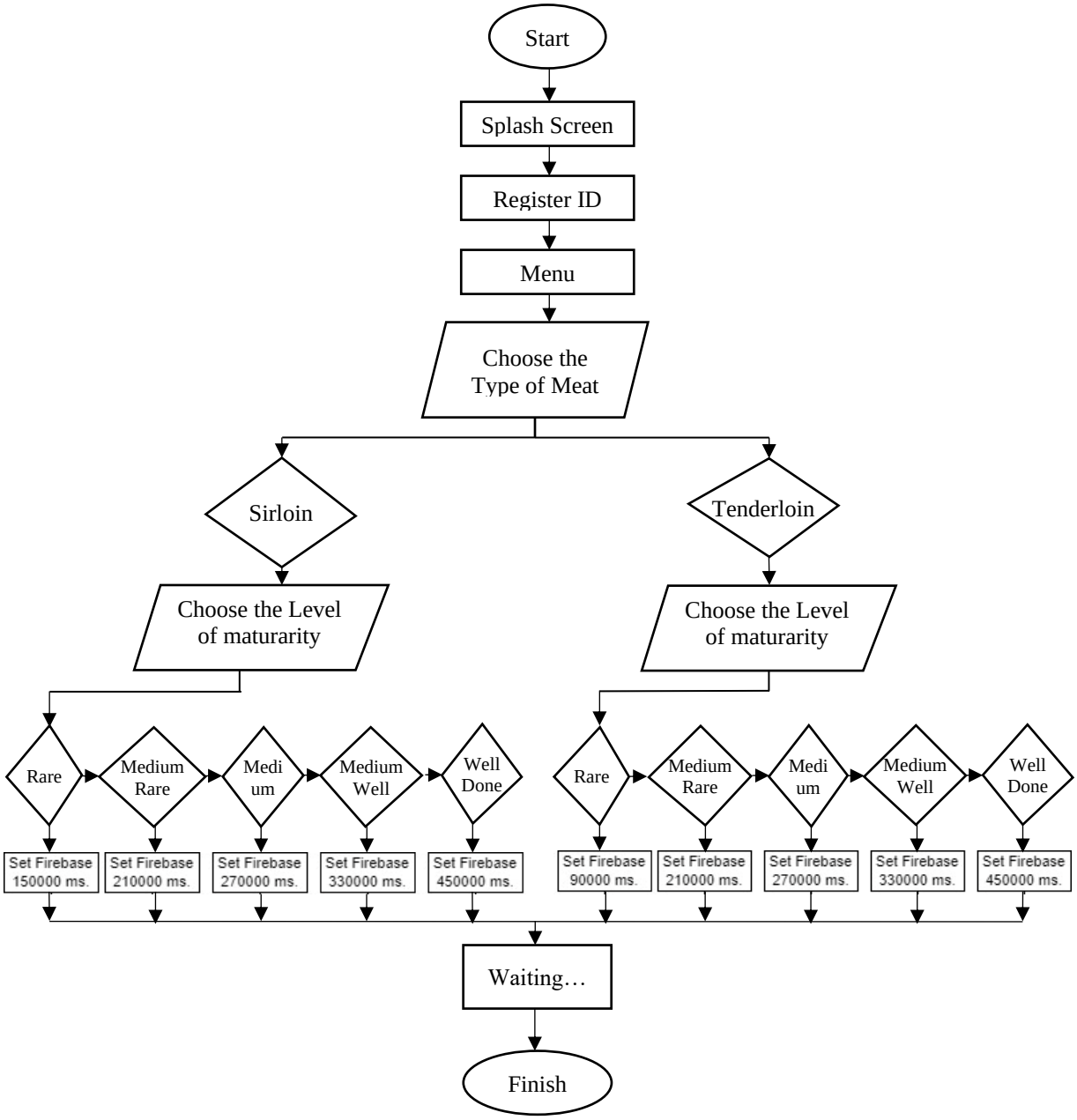

Figure 4 Flowchart of Automatic Steak Grilling Android App
(Source:Researcher Property)

Figure 4 is the Android application's working system for monitoring the tool's steak grilling process. The process begins with a splash screen display which will then be directed to the register display, where it is requested to register the user ID. After successful registration, the user is directed to the application's main menu, where the user is given the option to choose the type of steak meat between sirloin and tenderloin. After selecting the type of steak meat, choose the level of doneness of the dish with the time that has been stored in the firebase, then confirm and wait until the process is complete.

RESULT

The results of the hardware design of an automatic steak grill in the form of an oven-shaped prototype and a stove as a heater, where in this tool, there is a temperature sensor to monitor the temperature in the oven, which is displayed on the LCD and there is a nodeMCU so that this tool can be integrated into the internet or android application and uses a microcontroller in the form of Arduino UNO. Picture of the prototype of an automatic roaster in Figure 5.

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Figure 5 Automatic steak griller
(Source:Researcher Property)

After making an automatic steak grill, testing is carried out to determine whether the tool is functioning correctly and correctly; the test results can be seen in Table 1.

Table 1 Device testing results

No.	Type of the Meat	Level of the Maturity	Time	Results
1.	Sirloin	Rare	4 minute	Successfully
			5 minute	Successfully
			6 minute	Successfully
		Medium Rare	6 minute	Unsuccessfully
			7 minute	Successfully
			8 minute	Successfully
		Medium	8 minute	Unsuccessfully
			9 minute	Successfully
			10 minute	Successfully
		Medium Well	10 minute	Unsuccessfully
			11 minute	Successfully
			12 minute	Successfully
		Well Done	12 minute	Successfully
			13 minute	Successfully
			14 minute	Successfully
2.	Tenderloin	Rare	10 minute	Successfully
			11 minute	Successfully
			12 minute	Successfully
		Medium Rare	12 minute	Unsuccessfully
			13 minute	Successfully
			14 minute	Successfully
		Medium	14 minute	Unsuccessfully
			15 minute	Successfully
			16 minute	Successfully
		Medium Well	16 minute	Successfully
			17 minute	Successfully
			18 minute	Successfully
		Well Done	18 minute	Successfully
			19 minute	Successfully
			20 minute	Successfully

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The results of designing software or Android applications to monitor the use of automatic grills remotely, with the following display.

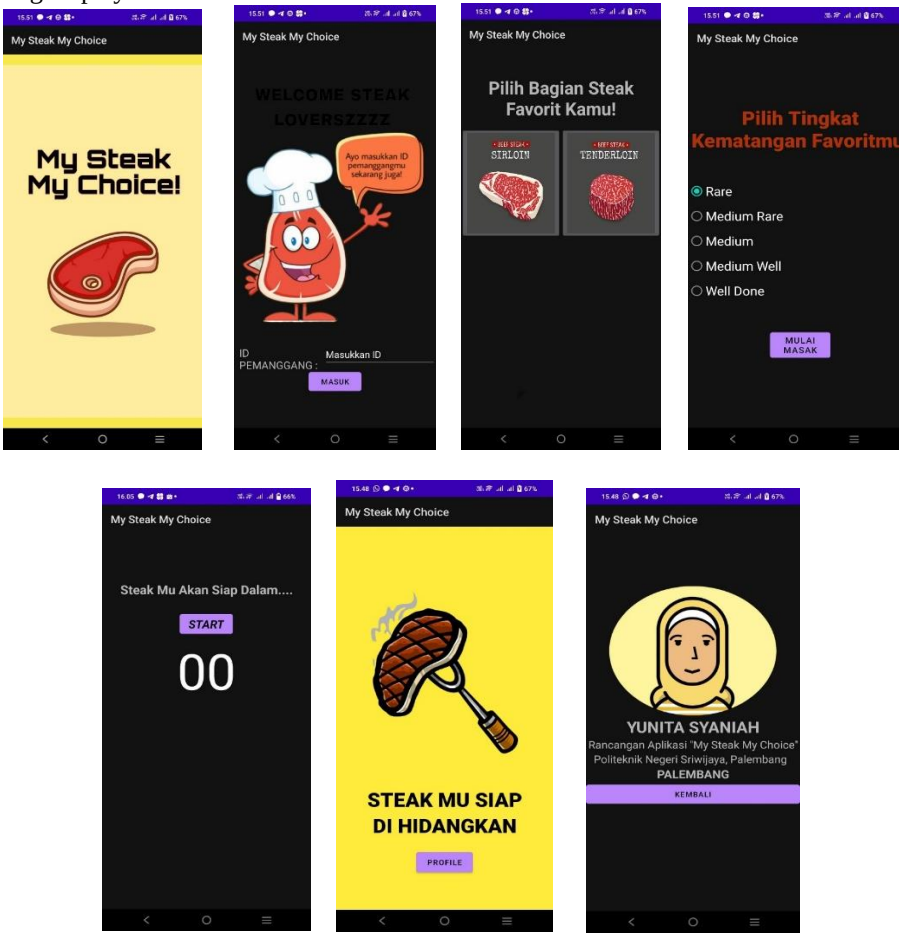

Figure 6 Android Application Display
(Source:Researcher Property)

After making the Android application, it is necessary to test whether it functions appropriately and correctly according to the author's wishes. Table 2 shows the results of black box testing of the Android application used.

Table 2 Black Box Testing

No	Testing Section	Tested Functions	*Inputs*	*output*	Test results
1	Registration page	Login button after entering the user ID	Click Button	Enter the system and display the page to choose the type of meat	Succeed
2	The page selects the type of meat	Image of Beef Steak Sirloin	Click Button	Go to the page to select the maturity level	Succeed
		Beef Steak Tenderloin Picture	Click Image	Go to the page to choose the maturity level	Succeed

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3	The page selects the maturity level	Radio Button Rare	Click Radio Button	Enter the display to start cooking	Succeed
		Radio Button Medium Rare	Click Radio Button	Enter the display to start cooking	Succeed
		Radio Button Medium	Click Radio Button	Enter the display to start cooking	Succeed
		Radio Button Medium Well	Click Radio Button	Enter the display to start cooking	Succeed
		Radio Button Well Done	Click Radio Button	Enter the display to start cooking	Succeed
4	Display starts cooking	Start Button	Click Button	The time display indicates the length of time the steak has been grilling	Succeed
5	Appearance Steak is done	Profile Button	Click Button	Displays the user profile page	Succeed
6	User Profiles	Back button	Click Button	Return to the appearance of the steak is done	Succeed

DISCUSSIONS

After testing, based on Table 1, the test was carried out three times at each maturity level on the types of sirloin and tenderloin meat. It is known that the maturity levels of rare and well done in the kind of sirloin steak are all successful, and the maturity levels of rare, medium well, and well done in the type of tenderloin are all also successful. Tests on sirloin steaks with medium rare, medium, and medium well maturity levels all experienced two successes and one failure, while testing on tenderloin steaks with medium rare and medium experienced two successes and one loss.

After analyzing the successes and failures that occurred in achieving the desired level of doneness in testing the automatic grill tool, these factors include the thickness of the meat, which affects the roasting time, temperature fluctuations that can occur in the roasting process, and the initial condition of the meat, such as temperature and humidity before cooking and the length of time to roast according to the level of doneness. All of these factors can cause variations in the final roasting result. The final result of roasting can be known as the percentage of the success rate of the automatic steak grill tool according to Table 1 in the following calculation:

$$Percentage\ of\ success\ rate = \frac{\text{Total number of successful grills}}{\text{Total amount of grills}}\ x\ 100\% \quad (1)$$

$$Percentage\ of\ success\ rate = \frac{25}{30}\ x\ 100\%$$

$$Percentage\ of\ success\ rate = 83\ \%$$

Based on these calculations, it is known that the success rate of the steak grill tool is 83%, indicating that most of the grilling experiments have been carried out successfully. However, 17% of trials have not reached the desired level of doneness, where the time in cooking the steak at each level dramatically affects the success of the desired steak roasting.

Android applications monitoring automatic grills can also run well, as evidenced after testing through Table 2, where all features tested in the application produce the appropriate output or can be declared successful.

CONCLUSION

From the research that has been done, it can be concluded that the automatic toaster successfully toasts with a success rate of 83%. It is obtained that the performance results and functionality are in line with expectations. Although there are 17% of unsuccessful experiments, in this case, the role of cooking time at each maturity level is proven to have a significant effect on the success of grilling. All the features designed and implemented in the Android application run well, allowing users to monitor and control the grill effectively with the remote. No significant problems or errors interfered with normal Android application use in this test. This gives confidence that the solution that has been developed can provide real benefits in monitoring and operating the grill automatically.

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