

# DESIGNATION AND IMPLEMENTATION OF 150 LITRES AUTOMATIC GRILL USING WOOD PELLET

Vo Cong Anh<sup>1</sup>, Tran Duc Hanh<sup>1</sup>, Nguyen Thi Kim Anh<sup>1</sup>

<sup>1</sup>Faculty of Engineering and Food Technology, University of Agriculture and Forestry, Hue University,  
Thua Thien Hue, Vietnam

## ABSTRACT

*This study presented the design and the implement of an automatic grill using wood pellet in order to maintain and ensure product quality. The developed machine involved the interconnection between the hardware components and the software to allow for full autonomous control of temperature and time. Temperature and time control are important in the process of grilling meat and smoking ingredients. This grills vary in operating method and fuel used. A barbecue oven using wood pellets is a closed cube-shaped oven that uses heat energy from wood pellets to cook the meat inside the oven. From there, it helps consumers get quality, safe food to ensure their health. The resulting prototype demonstrate an accurate and reliable operating system. This grill can be installed in a household or small restaurant. Further development could be focus on a program optimization for different ingredients, additional components and functionalities.*

**Keyword:** Automatic grill, Wood pellet, BBQ

## 1. INTRODUCTION

Grilling and smoking foods has a long and rich history. Although the way food is prepared remains the same, cooking techniques, equipment and types of fuel used have evolved [1]. Grilling meat is a very important and time-consuming action for any home user. In commercial restaurants, this is a tedious activity that requires greater skill due to the handling of many ingredients and the process control involved in flipping and keeping track of time. Several methods and equipment for grilling meat have been innovated to reduce manual work. In conventional grilling methods, results such as high wait times, increased exposure of workers to unwanted smoky air, improper time/heat management, and unsafe operations are observed. for workers when heat waves escape from manual grills. Of these meat products, a large portion is grilled on gas and charcoal stoves. To meet this need, many times cheaper, low quality and unhygienic methods are used. The development of the food industry is a leading factor for the sustainability of any country regarding health, economy, and entertainment, ...[2]. Therefore, there is a need for efficient processing of foods and products used directly or indirectly by humans. Temperature and time control are important in the process of grilling meat and smoking ingredients [3]. Controlling the time and temperature during grilling in broilers is important in improving the efficiency of these machines, which increases food quality by retaining food ingredients and requiring less energy. amount (of fuel) per baking unit (1 kg) of food.

Grills vary in size, operating method and fuel used. On the basis of heat source, grills are classified into gas, charcoal, solar, electric and wood pellet grills [4]. Thus, a meat grill using wood pellets is a closed cube-shaped oven that uses heat energy from wood pellets to cook the meat inside the oven. From there, it helps consumers get quality, safe food to ensure their health. Therefore, automation applied to products helps improve the quality of life and ensure safety for users more and more. Applying automation to ovens is a frequently researched issue to increase product quality and reduce labor.

## 2. METHODOLOGY

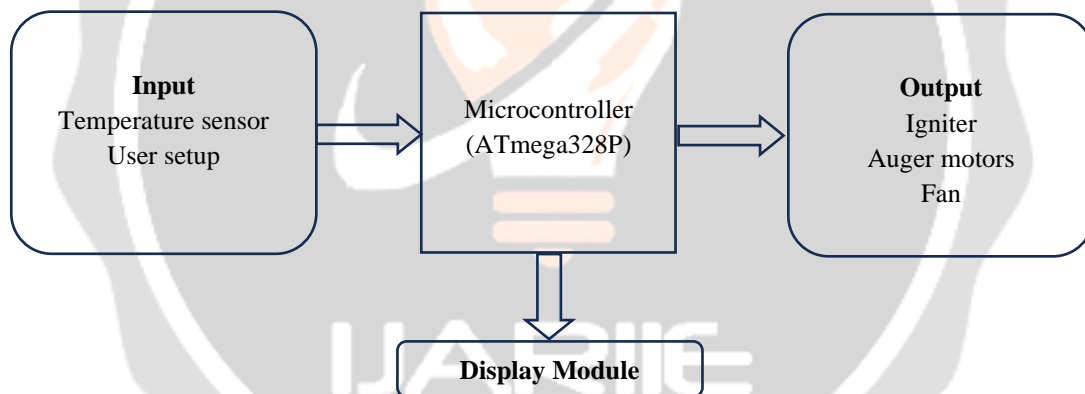
The operating principle of a pellet oven is based on the process of burning wood pellets to create fire and baking temperature. The main steps in the operation of a pellet oven include [5]:

- Providing pellets: Users pour pellets into the pellet compartment of the oven. Pellets are supplied externally through a pellet feeding system.
- Combustion system: The pellet grill has an automatic combustion system, including a fan and a combustion chamber. When the user sets the desired temperature, the oven will automatically supply pellets into the combustion chamber and the fan will create airflow to burn the pellets.
- Temperature control: The pellet oven is equipped with an intelligent controller to adjust the amount of pellets burned and the amount of air supplied, thereby maintaining a stable temperature. The controller can be set to maintain a specific temperature throughout the baking process.
- Grill food: When the fire and temperature are stable, users can place food on the grill in the oven. The heat from the pellet will continue to grill the food from the bottom up, creating an even baking effect and a characteristic aroma.

With its simple operating principle and precise temperature control, pellet ovens have become a popular baking technology in the world. It provides convenience and high baking quality, while also imparting a unique flavor to food. This has attracted user interest and created a growing market for pellet ovens globally.

### 2.1 System Block Diagram

The schematic diagram of an automatic grill using wood pellets is showed in Figure 1



**Fig -1:** The overall of an automatic grill

Automatic grill temperature control system based on Atmega328P microcontroller. PT100 will collect temperature data inside the oven to the microcontroller through sensor nodes based on programming algorithms for the microcontroller. Set the temperature on the LCD screen. At this time, the push button is connected to the microcontroller to adjust the parameters to increase/decrease the oven temperature to a certain value. When the temperature drops low, the microcontroller will send a signal. for drilling motor. When the temperature in the oven increases and generates heat after 6 minutes, the oven burner will turn off. When the required temperature is reached, the motor will automatically shut off to maintain the best heat level. For example, we set the oven temperature to 200°C. Initially the temperature in the furnace will be 36°C, the starting system pushes the ingredients into the combustion chamber, at the same time the burning rod will operate continuously for 6 minutes and the fan blows to supply oxygen to make the pellets burn, helping the temperature increase. When it reaches 200°C, the system stops. Wood pellets will continue to burn and transfer heat until the temperature drops below 200°C, then the system will run again. However, from this moment on, the burning rod will stop working, and the pellets pushed in will be burned thanks to the amount of heat left by the previous pellets.

And, the most widespread devices implemented on this project are fan for providing oxygen, auger motor for adjusting pellet level, hot rod for igniting the grill. These actuators are shown in Figure 2.

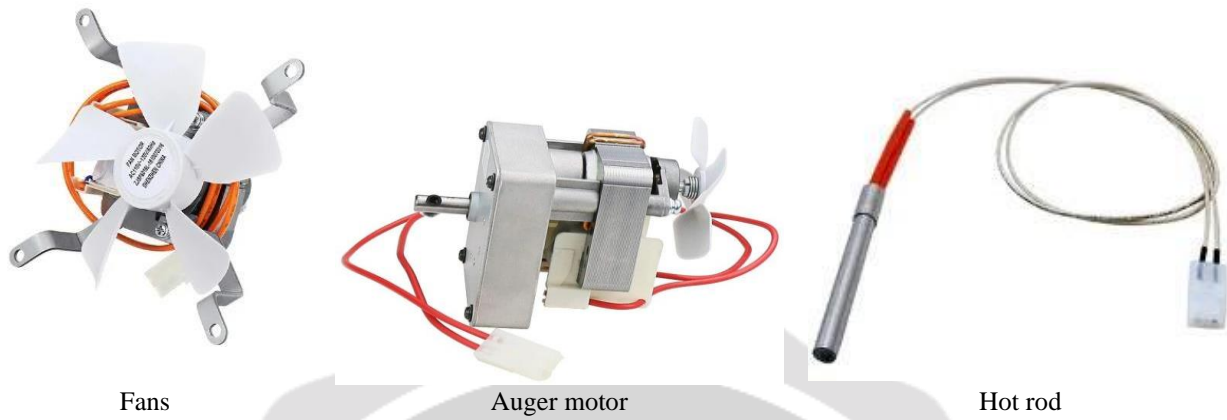


Fig-2: The actuators used in this study

2.2 System Implementation

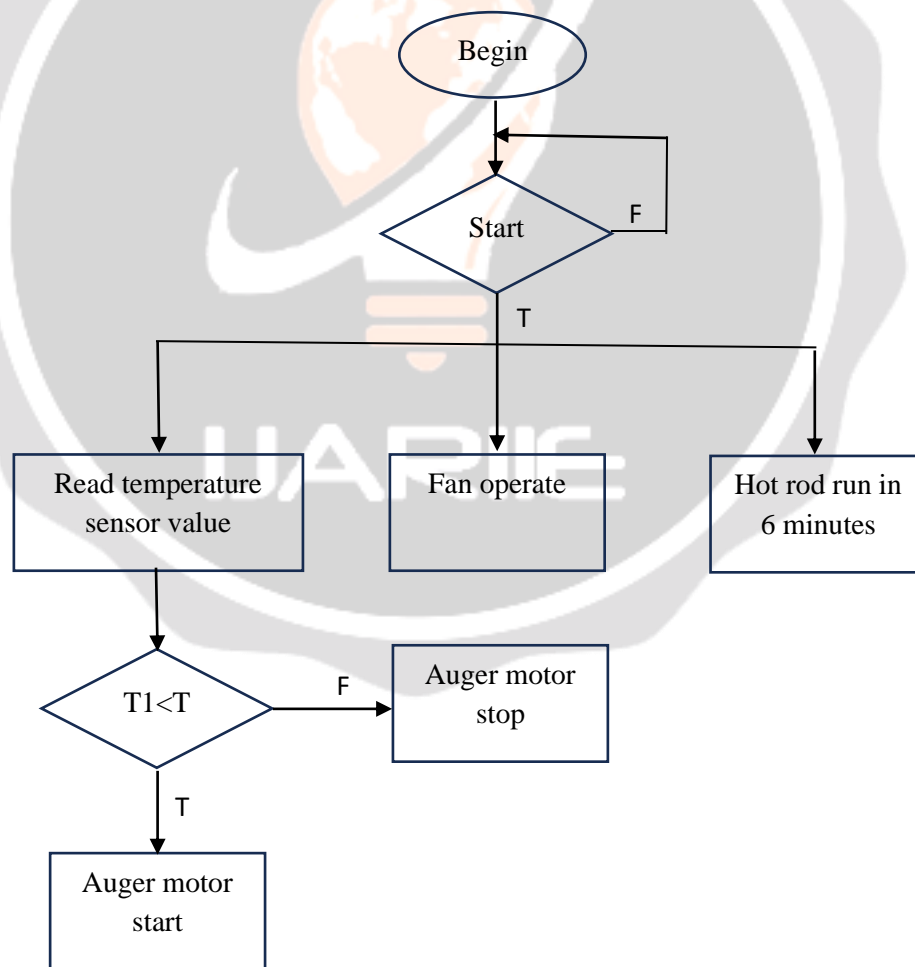
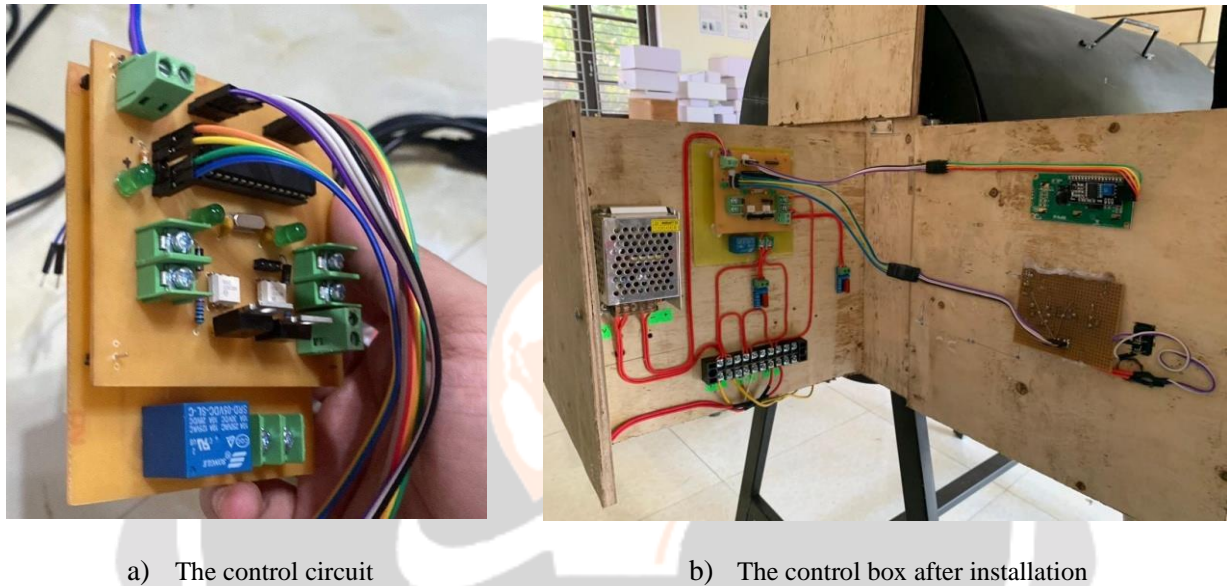


Fig-3: Flow chart of an automatic grill

When you start pressing the star button, the fan, hot rod, and temperature sensor operate. If  $T_1 < T$  then the feed motor runs. If  $T_1 > T$  then the feed motor stops. In there:  $T_1$  is the temperature measured by the sensor,  $T$  is the set temperature.

### 3. RESULTS AND DISCUSSION

The automatic grill using wood pellet was designed and implemented successfully in this study. The initial operation of the circuit was performed for adjusting parameters as required. After the calibration is complete, the circuit is inserted into the control box to connect the test model. These processes were shown in the figure 4. The developed automatic grill using wood pellets was shown in figure 5.



**Fig-4:** The control system of an automatic grill



**Fig-5:** The developed automatic grill and the experiment processing

Test results have shown that the pellet grill has operated correctly according to the initially proposed process, but there are still some problems that need to be overcome in the near future. Besides, some advantages of pellet grill have been shown during the experiment: Low manufacturing cost compared to current pellet grills on the market; easy to operate; high performance due to the ability of wood pellets to burn completely and produce large amounts of heat, helping the oven reach high temperatures quickly and maintain a stable temperature; save fuel costs because the price of wood pellets is much lower than other fuels such as coal or gas; multifunctional because this machine can smoke or grill many different types of foods. Although there are many advantages, some disadvantages still exist as follows: fuel limit because the oven needs to use pellets as fuel, which can make it difficult for users to find

because it is not popular. like gas or coal; depends on the power source because if there is a power outage, the oven will not be able to work.

#### 4. CONCLUSIONS

The automatic grill was designed and implemented in this study. Tests show that the developed oven operates stably over a long period of time. The temperature of this grill is automatically maintained relatively stable. This grill has a lower price than other professional grills on the market. Therefore, it is an option for restaurants or small shops with low initial investment costs. In the future, this oven will be further researched to optimize the grilling chamber and integrate the IoT system into the control circuit.

#### 5. REFERENCES

- [1]. J. Auchmutey, Smokelore: A Short History of Barbecue in America. University of Georgia Press, 2019.
- [2]. R. F. Moss, Barbecue: The History of an American Institution. University Alabama Press, 2020.
- [3]. M. Dodge Jr and S. Melo, "BBQ Grill Temperature Uniformity Study," 2016.
- [4]. S. Raichlen, "New Kid on the Block: Pellet Grills," Barbecue! Bible, 2015.
- [5]. A. Schloss and D. Joachim, Mastering the Grill: The Owner's Manual for Outdoor Cooking. Chronicle Books, 2010.

