

Monitoring the Charcoal Furnace Control System of Coconut Shell Waste Treatment Becoming Charcoal with ATmega 328P Microcontroller

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ABSTRACT

Coconut plants is the one of potential commodities that are classified as strategic hard/annual plantation commodity. Demand of the coconut plants tend to increase each time along with development of science and technology that increase rapidly these days, especially in the computerized technology field that is real with the existing of computer device which is working automatically then will be designed with integrated control using microcontroller.

The testing result on the control system of the charcoal furnace indicates that the system works by the design. Testing control of servo motor to setting up the size of flame on the gas stove set by servo motor to open/close the regulator on LPG gas.

The testing on the charcoal furnace control Thermocouple Type K signal sensor detects temperature on the charcoal furnace during the combustion of the coconut shell then processing by microcontroller and will be displayed on LCD and monitoring on PC with LabView application program.

Testing process with the coconut shell that burned in the charcoal furnace for 23 kg produce charcoal for 8.75 kg, meanwhile the room temperature average during the testing process is 30.46°C and the maximum temperature of charcoal furnace is 215°C.

General Terms

Personal Computer, Control System and LabView.

Keywords

Charcoal Furnace, Microcontroller, servo motor, Sensor Thermocouple

1. INTRODUCTION

Indonesia is the country that has coconut wide plantation number one in the world. The Indonesia coconut wide plantation is about 3.712 million hectare (31.4% of the wide coconut plantation in the world) with the produce coconut for more or less 12.915 billion pieces (24.4% of world production). The weight of coconut shell reach about 12% of coconut weight. By the average weight of a piece of coconut 1.5 kg, then Indonesia coconut shell potential reach about 2324.7 million tons/year (Ditjenbun, 2007). [4,7,10]

The increase of oil fuel price especially the kerosene make people look for another alternative to cook. One of the choice as fuel is charcoal from coconut shell. [1,7,10]

In the North Sulawesi, coconut shell to make charcoal can find easily because in this region there are many coconut plantation. The charcoal of coconut shell is the product that is

produced from incomplete combustion of coconut shell. As a fuel the charcoal is more profit than firewood. The charcoal produce higher combustion heat and less smoke until the cook process become faster. [4,5]

Besides for being used directly, the charcoal of coconut shell also can be pounded then condensed back and printed become briquet in various shape. Briquet is obviously more practice and use easily than firewood. Charcoal can be further processed to be active charcoal or as material charger and dyes in rubber and plastic industry. The big potential business of the charcoal of coconut shell is one of the business opportunity which has fine prospect for small trade.[6,9]

2. LITERATURE REVIEW

2.1. Microcontroller ATMEGA 328P

Arduino Uno microcontroller ATMEGA 328P is an electronic circuit that is open source, and have the hardware and software that is easy to use. Arduino can recognize the surrounding environment through a variety of sensors and can control lights, motors, and various other types of actuators. Arduino has many types, including Arduino Uno, Arduino Mega 2560, Arduino Fio, and others. [2,3]

2.1 LabVIEW (Laboratory Virtual Instrument Engineering Workbench)

LabVIEW is a graphical programming language using the icon that is connected by a line (wire) to create a LabVIEW application.

LabVIEW or Laboratory Virtual Instrument Engineering Workbench is a graphical programming language that has been used by industry, academia, and government lab as a standard for data software aqisisi and control instrumentation. LabVIEW is ideal for the application of science and engineering.[3,8]

LabVIEW program is called Virtual instruments or VI's, because of the shape mimics the look and operation of the physical form of an instrument such as an oscilloscope and multimeter. Every VI uses functions use interface or input from other sources and display the information or move it to other files or other computers. [2,8]

LabVIEW includes various additions and improvements to mathematics, signal processing, and analysis than previous LabVIEW.[8]

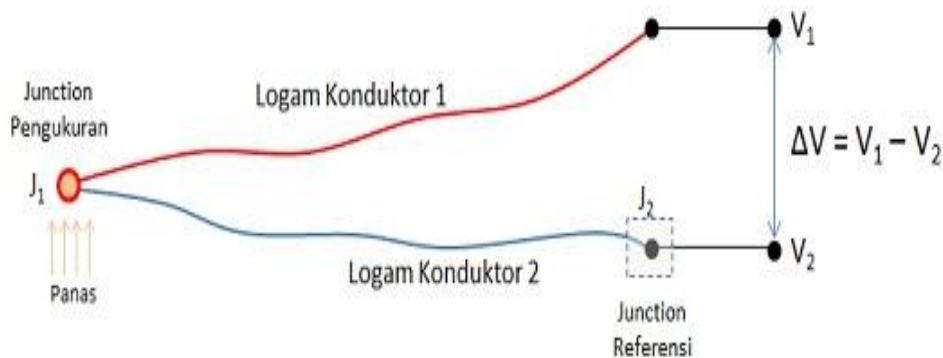
2.2 Thermocouple Sensor

Thermocouple consists essentially of a pair of hot and cold transducer connected and merged together, where there are

differences that arise between the connection with the reference junction which serves as a comparison.

Basically thermocouple consists of two metal wire conductors of different types and coupled ends. One type of metallic

conductors contained in Thermocouples will serve as a reference to a constant temperature (fixed) while the other one as metallic conductors that detect heat. [5,6]



Pic 1. How it Works Thermocouples

Based on pic 1, when the two intersections or Junction have the same temperature, then the potential difference or voltage electricity through the two intersections is "ZERO" or $V_1 = V_2$. However, when the intersection is connected in series given the hot temperatures or connected to the measurement object, there will be a temperature difference between two intersections which then produces an electric voltage whose value is proportional to the temperature of the heat it receives or $V_1 - V_2$. Electricity generated voltage is generally about $1 \mu V - 70 \mu V$ at each degree Celsius. [4,5,6]

3. METHODOLOGY

In this research use the design method, which started from make a charcoal furnace prototype with the size 600 mm length, 600 mm width, and 1000 mm height, then make the temperature control system and servo motor control to adjust the regulator on the LPG gas tube with the requirements in the process of charcoal furnace. After the system made complete

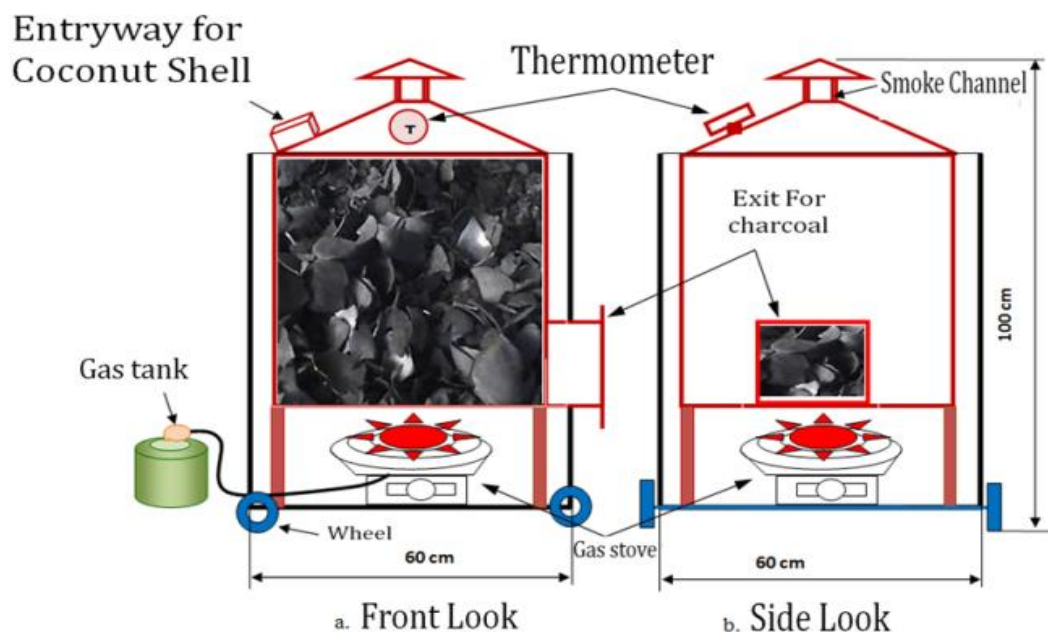
then the coconut shell to be put into charcoal furnace, then do the process of combustion of coconut shell become charcoal and taking the temperature data by monitoring on PC use the LCD and LabView.

4. RESULT AND DISCUSSION

4.1 Draft Research Model

Design of control system monitoring covers: prototype design of charcoal furnace, software and hardware. Design system will forming a control system of temperature and servomotor. The controlling is done by controlling the size of temperature and regulator on the LPG tube.

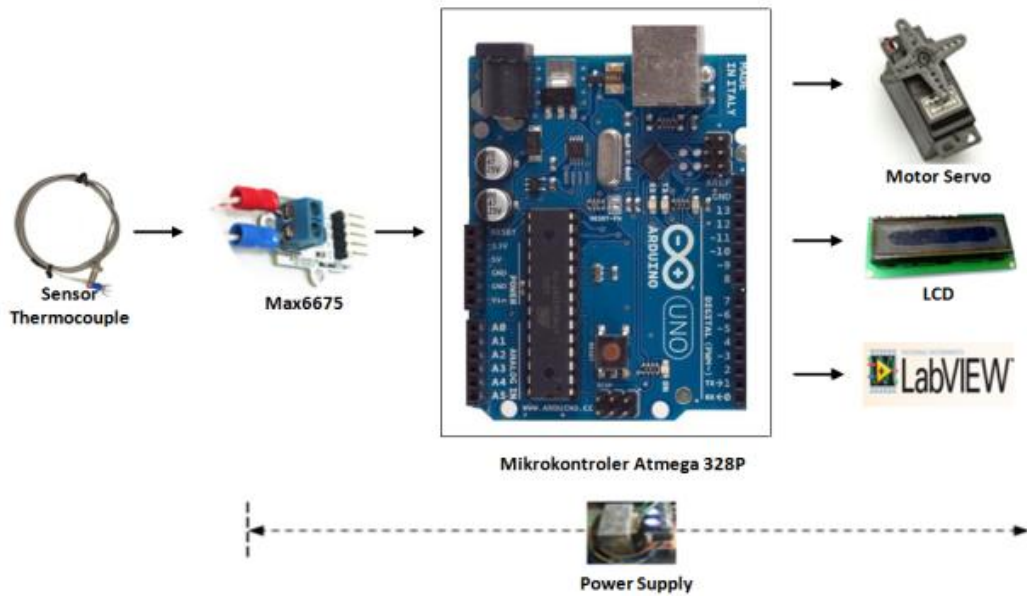
The prototype that will be made is the prototype from monitoring control system for charcoal furnaces. The prototype that will be made as the Picture 2.



Pic.2 Design prototype of Charcoal Furnaces

4.2 Diagram Block System

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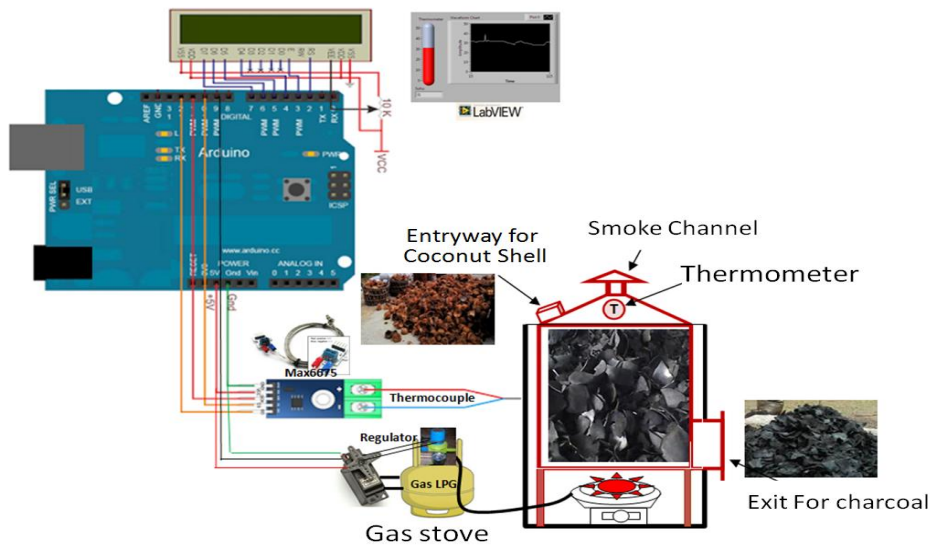


Pic. 3 Diagram Block the control system of charcoal Furnaces

Note:

1. The power supply to supply Input / Output equipment and control device of microcontroller Atmega 328P with the voltage 5 Vdc.
2. Thermocouple sensor and driver Max6675 as the microcontroller input to detect temperature in the charcoal furnaces.
3. Microcontroller Atmega 328P as control centre of the charcoal furnaces control system receive the signal that has given, processed then the output to display LCD, PC Monitoring with LabView.
4. Servo motor as the flame control of gas stove by adjust regulator on the LPG gas tube.
5. The LCD as output display of temperature signal.
6. Laptop / Desktop use for system monitoring with LabView.

4.3 Control System Draft of Charcoal Furnace with LCD and LabView



Pic.4 Monitoring Control System of Charcoal Furnace

On picture 4, Thermocouple sensor signal Type K will detect the temperature on the Charcoal Furnace when the combustion of coconut shell will be processed by microcontroller then will be displayed on LCD and monitoring on PC with the LabView application program.

The size of flame on the gas stove adjust by servo motor to open/close the regulator on LPG gas.

4.4 System Testing

The test is done to find out system performance of design result is it working well in accordance with system

specification that planned. The data of testing result will be analysed to use as reference for make conclusion. On the system test, *hardware* and *software* are integrated in one system. The testing is done by integrating *hardware* parameter then run through the *programmable* system. When the system is run, controller will initialize the address and function of each supporting parameter then do the process of *set point* charging through *Front Panel LabView*. Testing method on each control system variable and system testing unified integrated in Charcoal Furnace. (Picture 5).



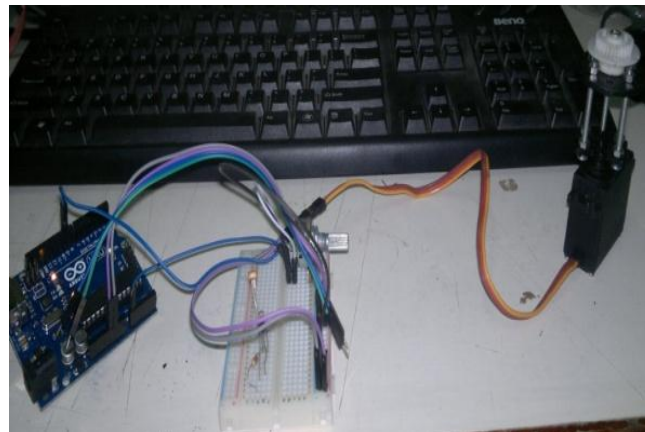
Pic. 5 Control System Furnaces Charcoal



Pic.6 Testing Thermocouple Sensor and LCD

Figure 6. Shows Testing Process And Data retrieval termocouple Temperature sensor, Process Testing Where do

heat sensor is with way termocouple then the results are displayed On LCD.



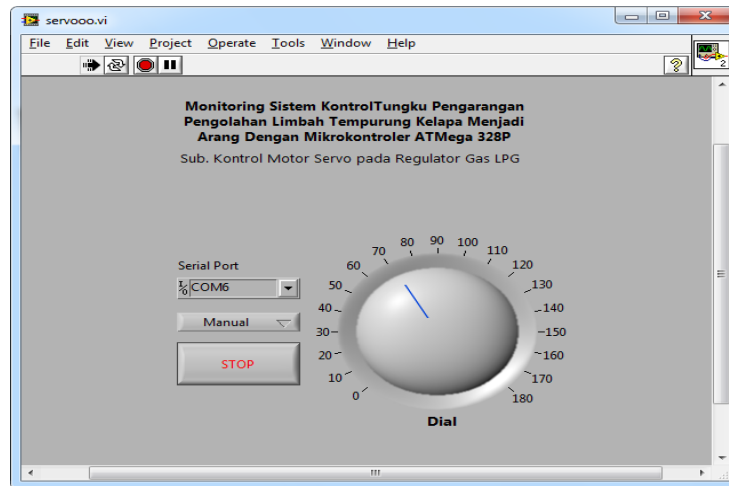
Pic 7. Testing servo motor for set Regulator Gas LPG

Figure 7. Shows the process of testing a program built into the microcontroller arduino uno, for setting the servo motor, servo motor control where the process is done with a slew via potentiometer.

After the stages of hardware and software design has done then tested the control system of charcoal furnace and system monitoring on PC as follows:

A. Monitoring Testing Control Servo Motor

When it is run we twist the Dial to the left or right to stir servo motor that connected to LPG gas to adjust the size of flame during the combustion process of coconut shell becoming charcoal. Monitoring Control Servo Motor with LabView displayed with Figure 8.

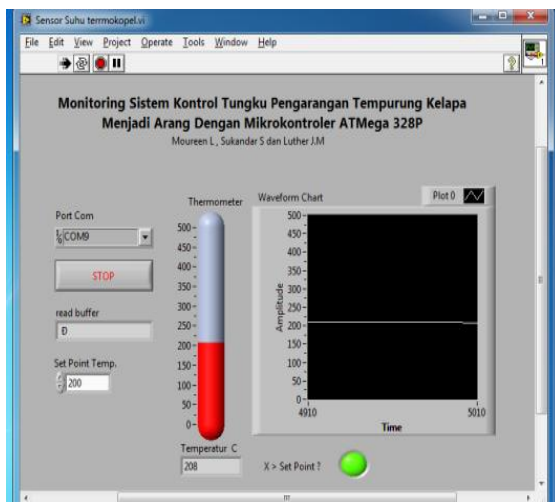


Pic.8. Monitoring Control Servo Motor with LabView

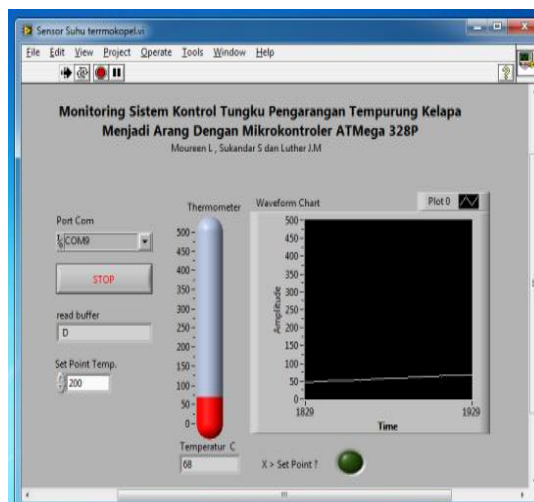
B. Monitoring Testing Thermocouple Sensor

When it is run the temperature sensor will detect the charcoal furnace temperature when the Set point that inputted = 200 °C on the Front Panel LabView, and when the temperature

parameter that detected exceed the temperature set point then led indicator will light. Temperature Monitoring With LabView displayed with Figure 9.



Pic. a. Temperature 68 °C



Pic. b. Temperature 208 °C

Pic. 9. Temperature Monitoring With LabView

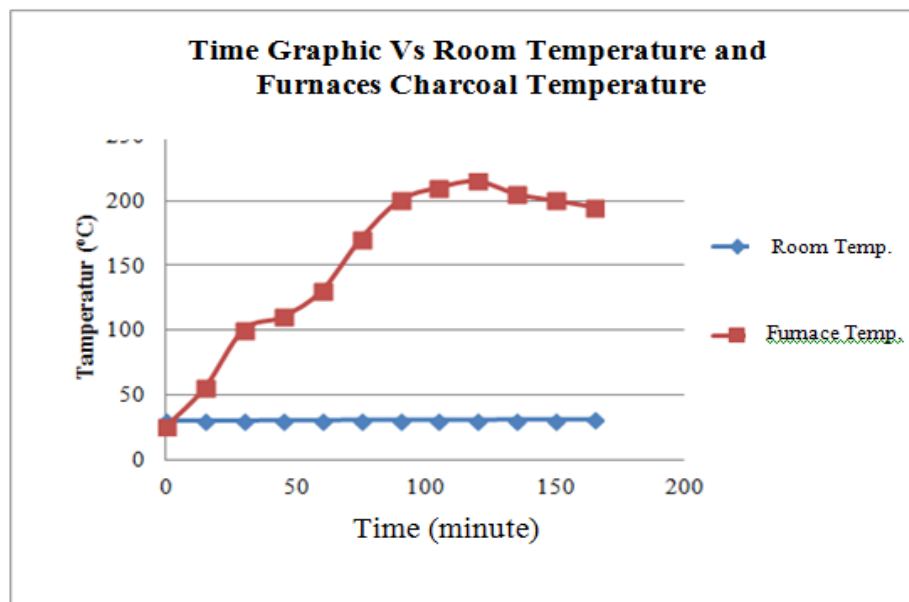
5. ANALYSIS TEST RESULTS

From the observations of researchers to observe and record the test results and gain the data listed in Table 1 and a comparison chart between room temperature with the temperature in the furnace shown in Figure 10, which is a representation of Table 1. From the results of tests performed, as shown in Table 1, data showed that the process of burning

coconut shells at the time of surgery for 150 minutes, to room temperature 30.7°C and the temperature in the furnace at 200°C (as setting the temperature set point), obtained comparable data density shell oil before and after the combustion process. Where at the time prior to combustion, density is 23 kg coconut shell and after the combustion process (after being charcoal), obtained weighs 8.75 kg.

Table 1. Measurement data of room temperature and charcoal furnace temperature on the testing tools.

No	Time (minute)	Room Temp. (°C)	Furnace Temp. (°C)	Massa coconut shells (kg)	Massa coconut shell charcoal (kg)
1	0	30.1	25	23	8.75
2	15	30.1	55		
3	30	30.2	100		
4	45	30.3	110		
5	60	30.4	130		
6	75	30.5	170		
7	90	30.5	200		
8	105	30.6	210		
9	120	30.6	215		
10	135	30.7	205		
11	150	30.7	200		
12	165	30.8	195		



Pic. 10. Time Graphic vs Room Temperature and Furnaces Charcoal Temperature

The combustion process of coconut shell on the charcoal furnace increased the temperature for each multiple time 15 minutes and linear approach and decrease of temperature when the combustion process is completed.

6. CONCLUSION

From the results of tests performed, it can be concluded that control system producing charcoal capable of producing charcoal through the process of burning coconut shells through the medium of the furnace with reference to ambient temperature furnace at 200 C, obtained the data that the operating time of 150 minutes for the temperature of the room for 30.7 C and the temperature in the furnace at 2000 C, data types coconut shell weight ratio before and after the combustion process, obtained by the difference gravity of 14, 25 kg. In the future the system created can be used for home industries to yield more optimal production resulting from the processing of charcoal produced conventionally.

7. REFERENCES

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