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Utilization of Arduino as Incinerator Control Using Temperature Sensor

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Abstract

The waste problem is part of the dynamics of human life. Every human activity must produce waste. Garbage is a pollution that interferes with the health and comfort of the community. Solid waste management is a challenge for developing countries, mainly due to the increase in waste generation. Garbage results in high city budget costs related to its management. One of the impacts of urban development is an increase in the volume of waste. This requires improvement of facilities and infrastructure against limited land. For this reason, good and efficient waste management is needed. In general, waste disposal that does not meet environmental health requirements can result in, among other things, breeding grounds and nests of insects and rats, becoming a source of pollution and contamination of soil, water and air, becoming a source and a place to live. live germs that endanger health. Based on this, the researchers made a tool in the form of a furnace that can be used for waste treatment and burning garbage. From the results of the overall tool testing, to obtain optimal combustion results in the mass of waste (4 Kg) and the combustion temperature setting (200 ^{o}C- 300 ^{o}C) is fixed, the minimum burning time is 30 minutes.

Keywords: *rubbish, microcontroller, thermocouple*

1. Introduction

The waste problem is part of the dynamics of human life. Waste is indeed the result of every human activity. Undoubtedly, waste will never be separated from pollution which is currently always disturbing people's health and comfort. Solid waste management is a challenge for developing countries, mainly due to the increasing landfill waste, the burden placed on municipal budgets as a result of the high costs associated with its management, the lack of understanding of the diversity of factors that influence the various stages of waste management and the linkages required to enable the entire system handling works. One of the impacts of urban development is the increasing volume of waste, it is necessary to improve facilities and infrastructure against limited land. For this reason, good and efficient waste management is needed. In general, waste disposal that does not meet environmental health requirements can result in, among other things, a place to grow and nest for insects and rats, become a source of pollution and contamination of soil, water and air, and become a source and habitat for germs that endanger health. Based on these problems, researchers aim to solve solutions. One solution to overcome these problems, then made an incinerator system for waste treatment and waste incineration. Automatic process control to keep the temperature in the range of 200^{o}C to 300 ^{o}C.

2. Research Metodology

2.1. Research Forms and Data Collection Techniques

The first step is to collect literature related to the object to be studied. The design of this study was based on the experimental method, namely testing and experimentation on

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each system. The data collection method was carried out by means of experimentation. Testing tools to obtain the data needed to analyze whether the tools are made as planned or not.

2.2. Theoretical basis

Arduino Uno is a microcontroller board based on ATmega328 (datasheet). It has 14 input pins from digital output where 6 input pins can be used as PWM outputs and 6 analog input pins, 16 MHz crystal oscillator, USB connection, power jack, ICSP header, and reset button. To support the microcontroller so that it can be used, it is enough just to connect the Arduino Uno Board to a computer using a USB or power cable with an AC-to-DC adapter or battery to run it [1].

A thermocouple is a temperature sensor that converts the temperature difference into a voltage change, this is due to the difference in density possessed by each metal which depends on the density of the metal. Similar to other sensors that can be used as input to a control system, the thermocouple sensor, apart from being able to read changes in temperature, can also act as an analog input to a control system [2].

The keypad is an important part of an electronic device that requires human interaction. The keypad functions as an interface between electronic devices (machines) and humans or known as HMI (Human Machine Interface) [3].

Buzzer is an electronic component module of the transducer category, which works by converting an electrical signal into a sound wave. The buzzer is usually used as an alarm signal. Usually implemented in research projects as an indicator of a condition [4].

I2C/TWI LCD, is a module that is used to reduce the use of feet on the LCD. This module has 4 pins that will be connected to Arduino. Arduino uno already supports I2C communication with the I2C lcd module, so it can control 16x2 and 20x4 Character LCDs using only 2 pins, namely Analog Input Pin 4 (SDA) and Analog Input Pin 5 (SCL) [5].

Relay is a switch (Switch) which is operated electrically and is an Electromechanical component consisting of 2 main parts, namely Electromagnet (Coil) and Mechanical (a set of Switch Contacts/Switch). Relays use the Electromagnetic Principle to drive the Switch Contacts so that with a small electric current (low power) they can conduct higher voltage electricity. For example, a relay that uses 5V and 50 mA Electromagnets is able to move the Armature relay (which functions as a switch) to conduct 220V 2A electricity [6]. A direct current motor is a device that functions to convert direct current (DC) electric power into motion or mechanical power in the form of motor rotation [7].

Servo motors are motors that are capable of working in two directions, servo motors work with a closed feedback system where the position of the servo motor will be informed back to the control circuit in the servo motor. The servo motor consists of 19 Infotel Journal Vol. 5 No. 2 November 2013 a motor, a gear circuit, a potentiometer, and a control circuit. The potentiometer on the servo motor serves as a determinant of the angle limit of the servo rotation. Servo motors usually only move to a certain angle and not continuously. However, for some purposes the servo motor can be modified to move continuously [8].

The solenoid valve is a control element that functions to open and close the gas flow, so that if there is a gas leak, the valve on the solenoid valve will move to open or close according to the instructions from the microcontroller. Solenoid valve consists of two types, namely single coil and double coil both have the same way of working. Solenoid valve offers fast and safe switching [9].

Fan DC 12 V Fan is to adjust the volume of hot air so that the room does not experience hot temperatures and can circulate air normally. In general, fans are used for air conditioners, air fresheners, ventilation (exhaust fans), or dryers (generally using heat-generating components). There are two types of fans based on the direction of the wind produced, namely centrifugal fans (wind flows in the direction of the fan shaft) and axial fans (wind flows parallel to the fan shaft). [10].

3. Results and Discussions

3.1. Block Diagram

In the design of this tool, a block design is made, which is then combined from the block design into a whole set of tools The workings of the block diagram of the incinerator system is that when the tool works, the lighter will spray fire and the motor basket will rotate the garbage drum. The lighter will spray fire continuously until the temperature condition in the garbage drum reaches 300 ^{o}C. When the temperature in the garbage drum reaches a temperature of 300 ^{o}C oC, the lighter will stop, at the same time the fan motor will work until the temperature reaches 200 ^{o}C. this system will work automatically until the specified time limit. When the time limit has been reached, the buzzer will light up.

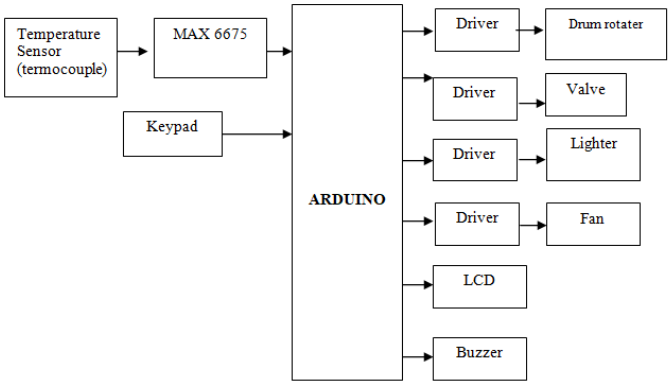

Figure 1. Overall Tool Block Diagram

3.2. Thermocouple Design

The design of the thermocouple sensor here is used as an input which functions to detect changes in temperature during the combustion process. The cable connection between the MAX 6675 amplifier module and the Arduino module can be made as shown in table 1.

Table 1. MAX 6675 Pin Configuration

Pin Arduino	MAX 6675
4	SO
5	CS
6	SCK
VCC	VCC
GND	GND

For the circuit relationship between Arduino and the thermocouple, it is as shown in Figure 2.

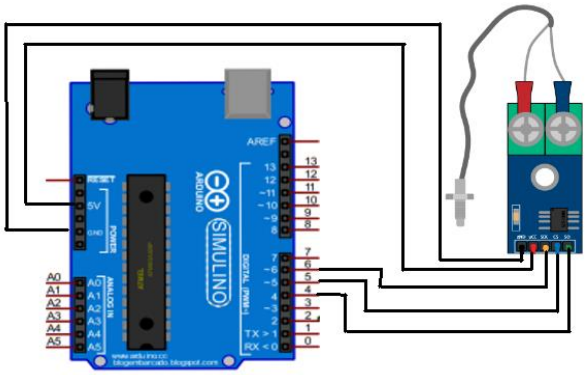

Figure 2. Thermocouple Sensor Design

3.3. Keypad Design

In the keypad design here using a 4x3 keypad is used as input which functions to type the desired time. For the keypad design, the relationship between the keypad pins and the Arduino is as shown in table 2:

Table 2. Keypad Pin Configuration

Kaki Arduino	Keypad
7	1 (column 1)
8	2 (row 0)
9	3 (column 0)
10	4 (row 3)
11	5 (column 2)
12	6 (row 2)
13	7 (row 1)

While the pin relationship between Arduino and the keypad is as shown in Figure 3.

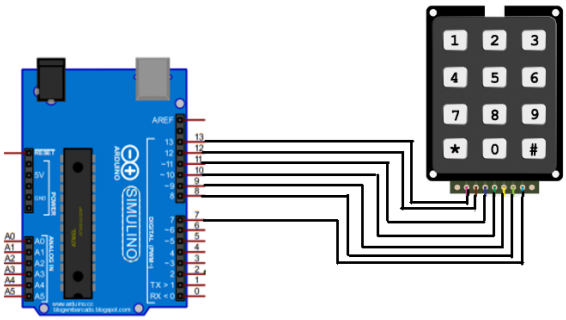

Figure 3. Keypad Design

3.4. Buzzer Design

Buzzer design is used as a sign to notify that the combustion process has been completed. The buzzer design is done by making a connection between the buzzer pin and the Arduino pin as shown in table 3.

Table 3. Buzzer Pin Configuration

Arduino pins	Buzzer
3	Red wire
GND	Black wire

While the relationship between the Arduino pin and the buzzer pin is as shown in Figure 4.

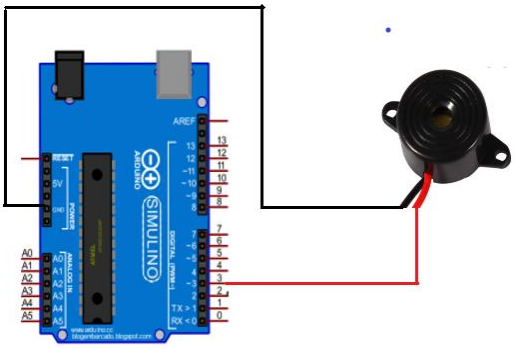

Figure 4. Buzzer Design

3.5. LCD Design

The LCD component (Liquid Crystal Display) used in the design of this system is an I2C LCD with a size of 20X4, this LCD consists of 4 lines with each line containing 20 characters. In this system, the LCD is used as monitoring the sensor results that are read. The relationship between LCD pins and Arduino pins is as shown in table 4.

Table 4. LCD I2C 20X4 Pin Configuration

Arduino pins	LCD I2C 20X4
A5	SCL
A4	SDA
VCC	VCC
GND	GND

While the picture of the relationship between Arduino and LCD is shown in Figure 5.

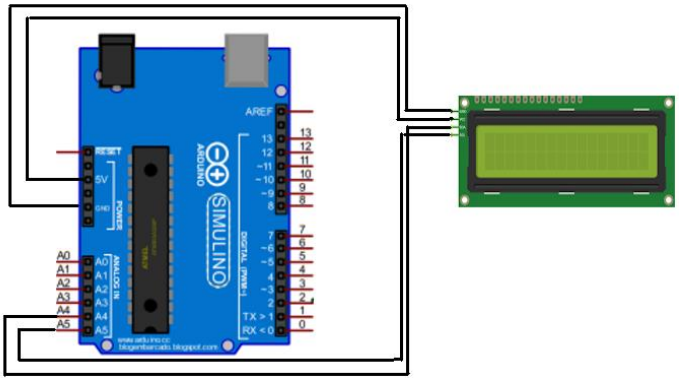

Figure 5. LCD Design

3.6. Temperature Sensor Test

The purpose of this test is to find out whether the temperature sensor can work well in controlling the temperature in the incinerator. To test the temperature sensor, we will use a comparison test between the temperature sensor and the themometer. Furthermore, it will be proved the temperature sensor voltage output with a thermometer. Table 5 shows the results of the test.

Table 5. Comparison Between Thermocouple And Thermometer

No	Thermocouple (mV)	Termometer (^{o}C)
1	0,1	41
2	0,2	48
3	0,3	50
4	0,4	59
5	0,5	66
6	0,6	70
7	0,7	74
8	0,8	75
9	0,9	78
10	1,0	80
11	1,1	81
12	1,2	84
13	1,3	86
14	1,4	88
15	1,5	89
16	1,6	90

No	Thermocouple (mV)	Termometer (°C)
17	1,7	93
18	1,8	101
19	1,9	106
20	2,0	109

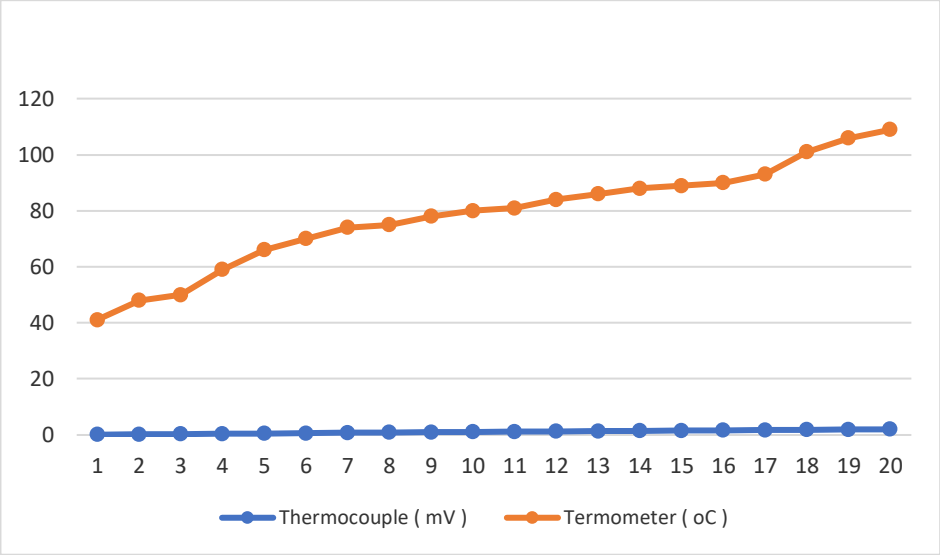

Figure 6. Comparison Graph of Temperature Sensors and Thermometers

From the results of testing the temperature sensor, it can be seen that the higher the output of the thermocouple, the higher the temperature of the thermometer. It can be seen in the graph that the output of the thermocouple and the thermometer is directly proportional.

3.7. Valve Circuit Test

Valve testing here aims to determine whether the valve circuit is as planned. The test results are as written in table 6.

Table 6. Valve Circuit Test Results

No	Arduino (V)	LED Relay	Valve (V)
1	0	No flame	0
2	4,98	flame	220

From the valve test, it can be seen that if the output of the Arduino is high then the valve will be on, otherwise if the output of the Arduino is low then the valve will be off.

3.8. Overall Circuit Test

After doing the circuit design and testing per block on the temperature control system in the incinerator. The next stage is a thorough analysis of the test results of the tool to determine the overall performance of the tool. The temperature control working system aims to make the temperature in the incinerator according to the design made. In this test, the burner is carried out by providing heat to the thermocouple continuously. After the heat on the thermocouple reaches the desired limit it will give orders to the blower to lower the temperature. If the temperature reaches the lowest limit, the burner will work to heat the incinerator. And so on if the burning is complete it will command the buzzer to sound. Table 7 is the overall test result.

Table 7. Overal. Test Results

No	Garbage weight	Time Setting	Temperature Settings	Garbage Condition
1	1 Kg	10 minutes	200-300	Burned Out
2	2 Kg	15 minutes	200-300	Burned Out
3	3 Kg	20 minutes	200-300	Burned Out
4	4 Kg	30 minutes	200-300	Burned Out

From the overall test results obtained for setting a temperature of 200 ^{o}C- 300 ^{o}C with a waste weight of 4 Kg, the time setting is 30 minutes so that the waste burns out.

4. Conclusion

After designing and testing the tool, the following conclusions can be drawn that the higher the temperature measured using a thermometer, the higher the output voltage of the thermocouple. The heater and blower will work alternately automatically so that the temperature remains between 200 ^{o}C- 300 ^{o}C. From the test results obtained for setting a temperature of 200 ^{o}C- 300 ^{o}C with a waste weight of 4 Kg then the setting time is 30 minutes so that the waste burns out. The garbage bin rotating motor is used so that the combustion in the garbage bin is evenly distributed.

References

[1] Zulkarnain Lubis, Kontrol Mesin Air Otomatis Berbasis Arduino dengan Smartphone, Buletin Utama Teknik Vol. 14, No. 3, (2019).
[2] Dewi Permata Sari, Kendali Suhu Air dengan Sensor Termokopel Tipe-K Pada Simulator Sistem Pengisian Botol Otomatis, Jurnal Ampere, Volume 3 No 1 (2018).
[3] Toni Dwi Tindak Hidayanto, Rancangan Kontrol Pintu Ruang Science Art Music Studio di Sekolah Tinggi Penerbangan Indonesia, Jurnal Ilmiah Aviasi Langit Biru Vol. 10 No.3, (2017).
[4] Givy Devira Ramady, Rancang Bangun Model Simulasi Sistem Pendeteksi Dan Pembuangan Asap Rokok Otomatis Berbasis Arduino, Jurnal Teknik Komputer AMIK BSI, Volume VI, No.2, (2020).
[5] M. Natsir, Implementasi IOT Untuk Sistem Kendali AC Otomatis Pada Ruang Kelas di Universitas Serang Raya, , Jurnal PROSISKO Vol. 6 No. 1, (2019).
[6] Rita Dewi Risanty, Rancang BAngun Sistem Pengendalian Listrik Ruangan Dengan Menggunakan ATMEGA 328 dan SMS Gateway Sebagai Media Informasi, Jurnal Sistem Informasi, Teknologi Informatika dan Komputer, Volume 7, Nomor 2.
[7] Husein, Rancang Bangun Sistem Monitoring Motor DC Menggunakan Matlab Berbasis Arduino, Jurnal Teknik Elektro. Volume 08 Nomor 01, (2019).
[8] Rinaldy, Pengendalian Motor Servo Yang Terintegrasi Dengan Webcam Berbasis Internet Dan Arduino, Jurnal Infotel Vol.5 No.2, (2013).
[9] Fahrullah, Rancang Bangun Kompor Gas Pintar Berbasis Mikrokontroler Arduino, Seminar Nasional, Dinamika Informatika, Universitas PGRI Yogyakarta (2021).
[10] Rachmat Aulia, Pengendalian Suhu Ruangan Menggunakan Fan dan DHT 11 Berbasis Arduino, , CESS (Journal of Computer Engineering System and Science), Vol. 6 No. 1, (2021).