Cakalang Fufu Fish processing system using Arduino Uno microcontroller

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Abstract. The fisheries sector is one of the strategic sectors in national development. Traditional fisheries in Indonesia are relatively large, so that community economic increases. In this research, a control device for Cakalang Fufu Fish processing will be made to help businessman, especially in Manado. Usually, the business is done by the community using simple equipment with coconut shell fuel and firewood which causes environmental pollution from smoke that is used for processing and burning eyes. This system includes hardware consisting of temperature sensors, Arduino Uno servo motor microcontrollers, Liquid Crystal Display (LCD), driver relay circuits and fans. While the software on this system uses C Language. The system will work based on the hot smoke generated by Cakalang Fufu Fish smoking process who detected by a temperature sensor that is inputted to the microcontroller to be displayed on the LCD. The temperatures are set in range of 80 to 100 degree C for a specified time of 60 minutes. After the time finished, the alarm/buzzer will sound to indicate that Cakalang Fufu Fish is cooked. As a motor cooler, the fan must turn on to reduce excessive heat so that the fuming is evenly distributed.

1. Introduction
Smoked fish is one of the traditional processed fishery products that is highly favoured by the people of Indonesia. Various types of fish can be processed into smoked fish such as Manyung Fish (*Arius Thallasinus*), Frigate Tuna (*Auxis Thazard*), Stingray (*Dasyatis Bleekeri*), Milkfish (*Chanos Forsk*), Skipjack (*Katsuwonus Pelamis*), and Tuna (*Thunnus Albacares*) [1-3]. The traditional fumigation business is a business that is often done by the community, using simple equipment, namely houses in the form of para-para (open system) with fuelwood. This type of fumigation is less effective because the heat and smoke released is wasted more in the direction of the wind than concentrated in the tuna fish. The weakness of this method is that the quality of the products produced is still largely not in compliance with national standards (SNI) and has the potential to produce carcinogens and cause environmental pollution due to smoke used for processing [4-6].

An Android-based smart room control will be designed to control the temperature and humidity of the room, via a smartphone, which is the new remote-control alternative solution [7-9]. This study aims to make Temperature Control Monitoring in Cakalang Fufu Fish processing using a combined circuit of a microcontroller and relay for ON/OFF electrical equipment of DC motor, fan, alarm and LCD [1], [4], [10].

1.1. Arduino uno microcontroller
Arduino Uno microcontroller is an electronic circuit that is open source and has hardware and software that are easy to use. Arduino can recognize the surrounding environment through various types of sensors and can control lights, motors, and various other types of actuators [5, 6].

1.2. DC electric motor
DC Electric Motor is a device that converts electrical energy into kinetic energy or movement (motion). This DC motor can also be referred to as a Direct Current Motor. As the name suggests, DC motors have two terminals and require direct-current voltage or DC (Direct Current) to be able to move it [2, 5].

1.3. Temperature sensor
Temperature sensors use LM35, where the output of LM35 can provide a 10-bit output (0 to 1024) of data that states the changing conditions of the ambient temperature. Every time there is a change in temperature, there will be a change in the output data generated, where the change is in the form of a difference in the voltage produced [5, 9].

1.4. Liquid crystal display (LCD)
LCD is a screen part of a display module that displays the desired character. The LCD screen uses two sheets of material that can polarize and liquid crystal between the two sheets. The electric current that passes through the liquid causes the crystals to be evenly distributed so that light cannot pass through each crystal, so such a light regulation determines whether light can pass or not. So that it can change the shape of the liquid crystal to form the display of numbers or letters on the screen [1, 3].

2. System planning
The design realized in the form of a block diagram as shown in Figure 1 shows a general description of the Cakalang Fufu Fish processing control system and temperature monitoring with LCD (Liquid Crystal Display).

2.1. Block diagram control system
Figure 1 describes how the Block Diagram System works which as follows. When the system is active (the Start button is pressed), the indicator light is on. The DC motor will move the Cakalang Fufu Fish burner and the temperature sensor will detect the heat of the combustion result which will be processed by the microcontroller to be displayed on the LCD. When the temperature reaches 70ºC or more, the fan will be active. The temperature is set to a range of 80ºC to 100ºC for a specified time of 60 minutes. After the time is over the alarm/ buzzer will ring to indicate Cakalang Fufu Fish fumigation has done.

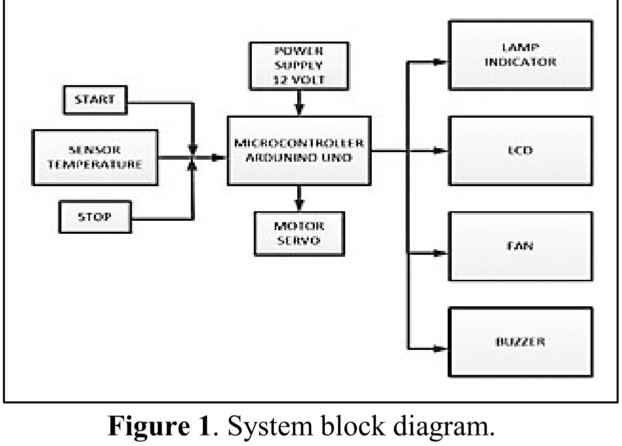

Figure 1. System block diagram.

At the same time, the microcontroller will activate the DC motor which will rotate until a predetermined time (60 minutes), to rotate or flip through the Cakalang Fufu Fish during the smoking process. To turn off the system, stop button is pressed then the indicator light goes out.

2.2. Control system design series

Figure 2 shows a series of control systems design Cakalang Fufu Fish processing. When the Start button is pressed, the DC motor will work, and the Indicator Light will turn on. Along with that, the temperature sensor will detect the temperature in the Cakalang Fufu Fish processing system and display the value on the LCD. When the temperature has reached 60ºC, the fan will work to cool the control system with the indicator light turns on. When the Stop button is pressed, the control system will stop.

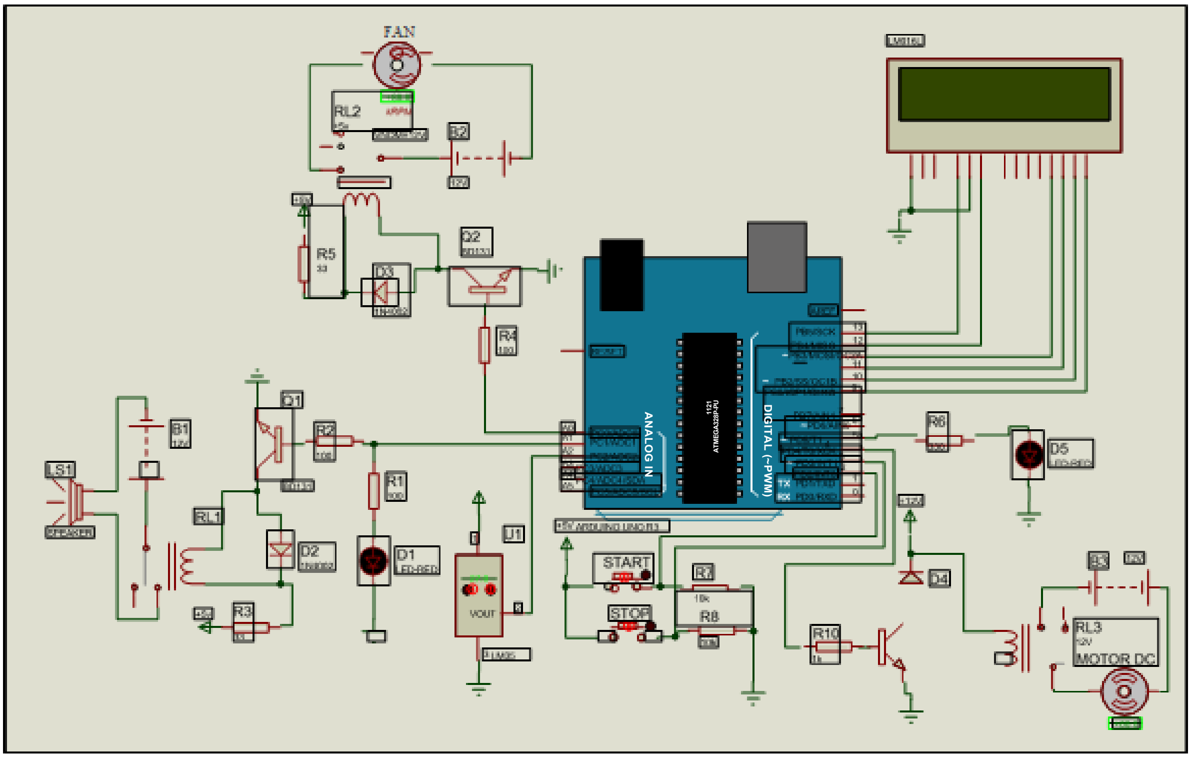

Figure 2. Cakalang Fufu Fish processing control system design series.

2.3. Control system design flow chart

Explanation of Figure 3 flowchart Control System is as follow: start, push button is pressed to active the control system, read temperature sensor data. Data Processed, temperature values displayed on LCD and DC Motor Driver ON (active). If the temperatures are over 70ºC, then the fan is active and if not, then the process reads the data again. If the process runs for 60 minutes, the alarm will ring. The stop button will then be pressed to stop the control system.

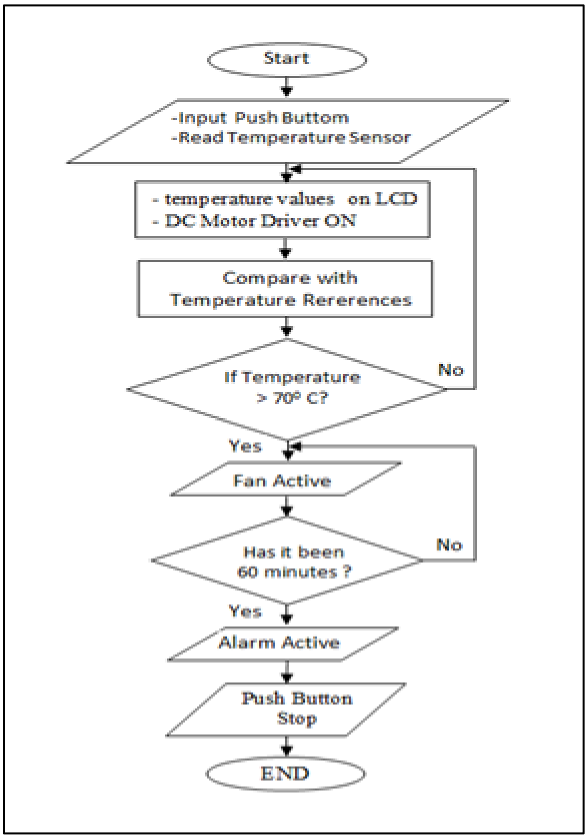

Figure 3. Control system flowchart.

3. Control system test

Testing is conducted to find our whether the system works in accordance with the results of the design.

3.1. Start and stop circuit testing

Start and Stop Button circuit Testing is performed on the simulation control if the Cakalang Fufu Fish processing system. When the Start button is pressed, the indicator light (DC Motor) will light up. When the stop button is pressed, the system will be off and the indicator light (DC Monitor) will be inactive. Figure 5 show a test of the Start/Stop control circuit on the indicator light.

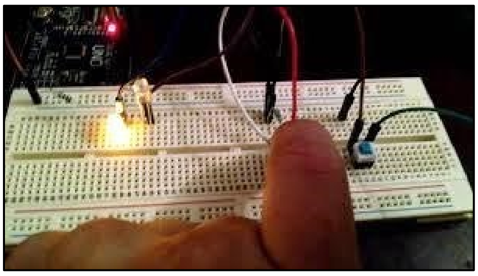

Figure 4. Start/stop circuit testing

3.2. Temperature sensor circuit testing

Temperature sensor circuit testing is performed on each change in the output voltage of the LM 35 temperature sensor, where the voltage change depend on the temperature circuit is show in Figure 5.

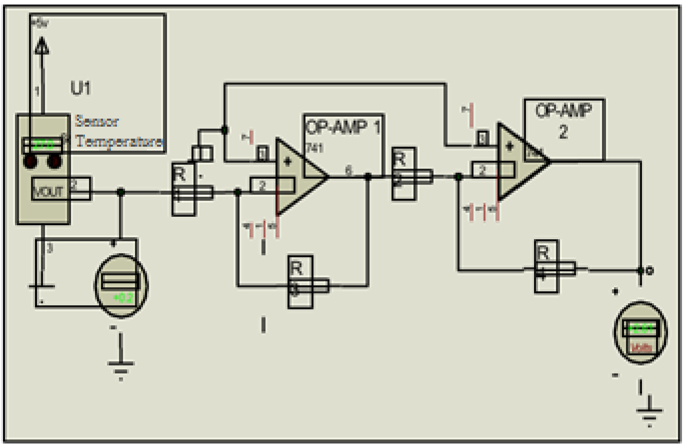

Figure 5. Testing of the temperature sensor circuit.

From the results of tests conducted, the data obtained concluded that each increase of 15°C, the measured output voltage through V1 is 0.15 V. After passing through the amplifier circuit, where the gain is 10 times, the magnitude of measured voltage through V2 is equal to 1.5V. The result of testing the temperature sensor circuit are shown in Table 1.

Table 1. Testing the temperature sensor circuit.

Temperature LM 35 (°C)	Output V1 (Volt)	Output V2 (Volt)
15	0.15	1.5
18	0.18	1.8
20	0.2	2
24	0.24	2.4
25	0.25	2.5
27	0.27	2.6

Figure 6. Temperature sensor monitoring testing.

3.3. Fan relay on/off driver testing

Relay driver testing for fan on/off is done to test the amount of input voltage, base current and relay voltage when the circuit is active. Figure 7 shows the test of relay driver circuit for on/off fans.

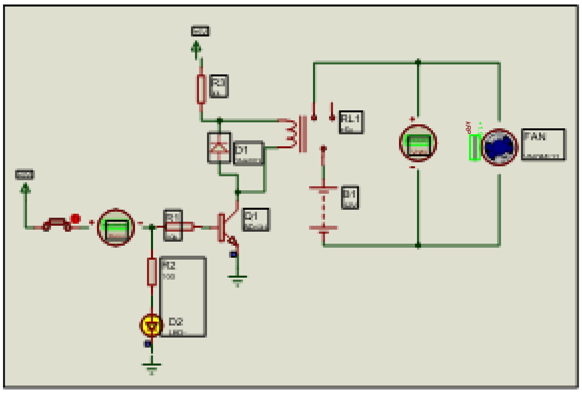

Figure 7. Testing of relay drivers for fan on/off.

The test result of the relay driver circuit is shown in Table 2. From the result obtained in Table 2, it shows that the input voltage entering the base terminal Q1 generated through the pin A0 output of the microcontroller is 5V. The amount of current obtained is 2.0mA. When the base Q1 receives a current of 2.0mA, the circuit will be active so that a voltage of 12.0 volts is obtained at feet A1 and A2 of the relay. Theoretically, the amount of current flowing to the base terminal of TRI is as follow:

$$I_B = \frac{V_{in-}V_{BE}}{R_B} \quad (1)$$

Where: I_B Base Current, V_{in} Input Voltage (5 Volt), V_{BE} Base-emitter voltage (0.6), R_B Base 0 resistance (1KΩ). So, from the equation 1 we got I_B 0.0042 Ampere. The amount of current flowing in the LED is:

$$I_{Led} = \frac{V_{cc}}{R} \quad (2)$$

I_{Led} is led current, VCC is source voltage (4.9 volt), R is resistance (300 Ω). From the Equation 2, we got I_{Led} about 0.0163 A.

3.4. Control system testing

Test on Cakalang Fufu Fish Processing control system as shown in Figure 8. Where when the Start button is pressed the DC Motor will work and the Indicator Light will turn on, along with that the temperature has reached 60°C then fan will work to cool the control system with the indicator lights will turn on. When the stop button is pressed the control, system stops.

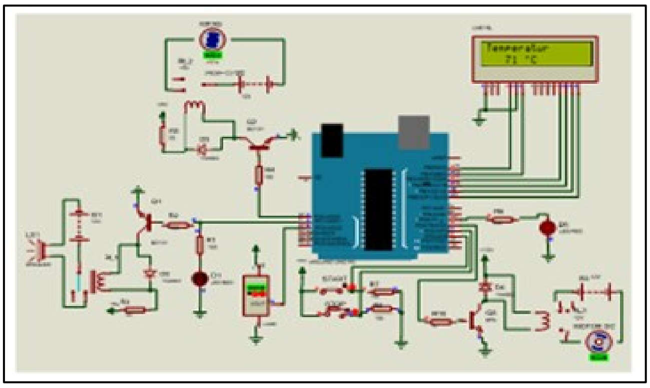

Figure 8. Testing the Cakalang Fufu Fish processing control system.

4. Conclusions

From the results of tests performed, it can be concluded that the control system of Cakalang Fufu processing using an Arduino Uno microcontroller can control DC motors, temperature, fan and alarm. Temperature sensors in monitoring via LCD. Simulation system is done through the interface on the application of Proteus 7 Professional.

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