IoT Application through WiFi Access for Processing a Wood Vinegar by Burning an Organic Waste

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***Abstract*—Internet of Thing (IoT) technological development through WiFi access has provided a sophisticated service by connecting an object physically or virtually based on information exchange technology. In this paper, the IoT application for controlling the device of burning an organic waste through WiFi access is proposed for processing a wood vinegar. The device for burning an organic waste is configured by burning component, flame sensor, and servo motor which are controlled by an ATmega2560 microcontroller equipped with buzzer and LCD as indicator and triggered through a WiFi module of NodeMCU. The prototype of burning device was realized and tested in the laboratory for experimentation. It has been carried out for 3 times of burning process with the result of wood vinegar of 16.8 ml for the average time of each burning around 10 minutes. The process for resulting a wood vinegar from an organic waste is conducted by using high speed internet access of 72 Mbps through smartphone.**

***Index Terms*—burning device, Internet of Thing (IoT), smartphone, WiFi access, wood vinegar**

I. Introduction

The control system that uses WiFi access based on Internet of Things (IoT) application is very advantageous due to its capability to serve the high speed data capturing for wide area as well as for dangerous area [1]. Basically, the IoT is the network of "things" or objects in which those are embedded with hardware, software and network connectivity and enables to collect and exchange data between them as well as without other network [2]. As a consequence, in the IoT the objects allow to be controlled and sensed through the network remotely or across existing network infrastructure [3]. Hence, this will be creating more opportunities to directly integrate the object in physical world, e.g. hardware, with the network system based on computer [4]–[5]. Further, it will be affecting in enhanced accuracy and efficiency, as well as in economic advantages [6]. In addition, each object in the network is then uniquely identifiable through its embedded computing system and even remotey interoperable within the existing infrastructure of network [7].

In recent times, the IoT has widely penetrated and provided new ideas for the control research community [3]. In fact, automotive cars, moderns buildings, industrial systems, and medical devices function to the power and maturity of control system. It is well known that the communication networks in control systems are generally assumed to be deterministic and reliable. This is necessary since the realtime operating-system platforms rely on predetermined, static schedules for communication system [7]. As the development of network connectivity, some control is now occurring over the internet. However, it is still at a supervisory level for some applications such as industrial treatment plants, commercial buildings, and power-grid distribution systems [6], [8]. In this case, the closed-loop automation, hence, requires onsite endtoend control system which is dedicated for the system.

In this paper, a WiFi access based on IoT is used to control an automatic burning process remotely. The control device of burning mechanism for organic waste is configured by using ATmega2560 microcontroller with sensors that support the technology of burning process. Meanwhile, the proposed technology is intended to solve the issue of organic waste accumulation [9]. The control device for burning organic waste through WiFi access is designed to process a wood vinegar. To built the burning process system, the control device is driven by an ATmega2560 microcontroller which is equipped with a flash of 256 KB, clock speed of 16 MHz, WiFi module of 2.4 GHz, servo motor angles of 40^o and 90^o, water and flame sensors. The proposed burning process system is then realized for laboratory experimentation.

II. Brief Overview of Burning Process System

The control device of burning process for organic waste controlled using ATmega2560 microcontroller is generally divided into 2 parts, namely hardware and software. As shown in Fig. 1, the schematic circuit of hardware system is designed using an ATmega2560 microcontroller which is configured with power supply, 16x2 Liquid Crystal Display (LCD), servo motor MG995, WiFi module of Node MicroController Unit (NodeMCU), flame sensor, water sensor, buzzer, Light Emitting Diode (LED), and supporting devices. The ATmega2560 is a microcontroller based on Arduino that uses an ATmega2560 chip. This microcontroller has many I/O such as digital I/O pin of 54, PWM signal pin of 14, analog input pin of 16, and UART (serial port hardware) pin of 4. The chip is also featured with oscillator of 16 MHz, USB port, DC power port, ICSP header, and reset button [10].

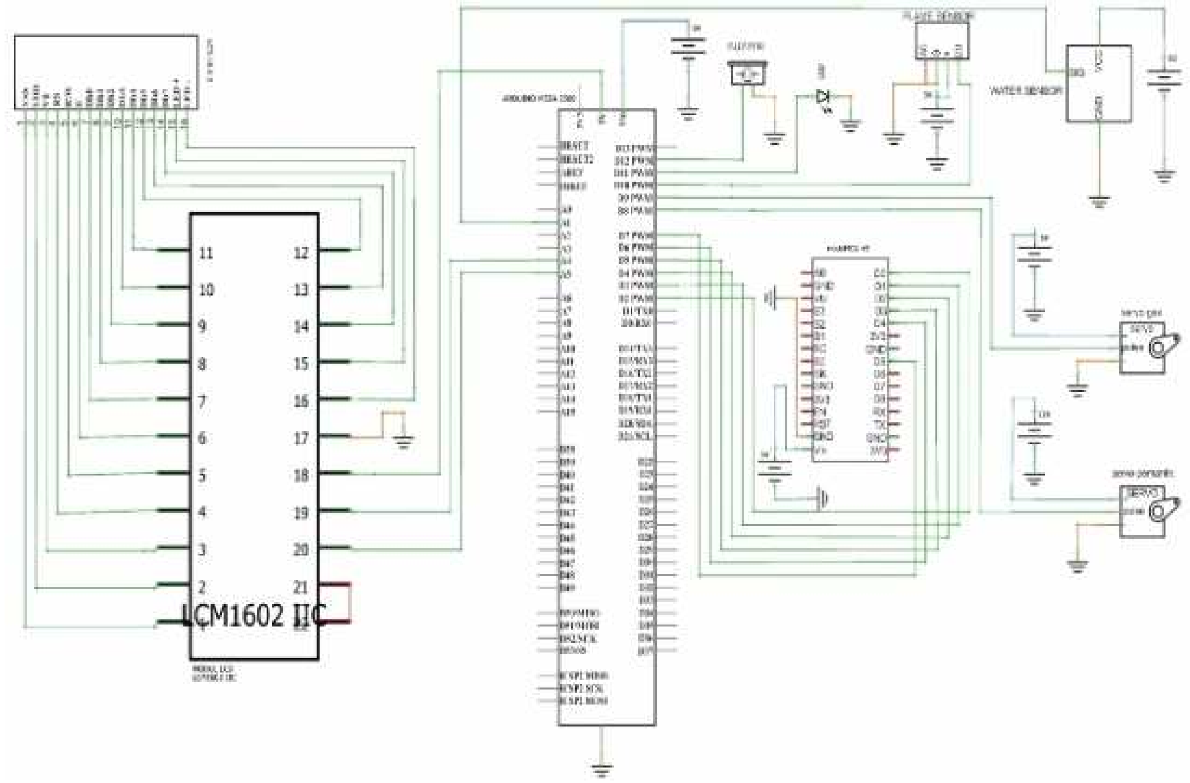

Fig. 1. Schematic circuit of hardware system of burning process.

Meanwhile, the diagram block of control device of burning process for organic waste with a NodeMCU is shown in Fig. 2. An LCD as the indicator of processing indicator is connected to the hardware for providing a control notification which is controlled through WiFi network at the NodeMCU. The ATmega2560 as a controller is connected to a Wifi module of NodeMCU and servo motors. This controller is also equipped with the communications and control systems through Android smartphone which is connectable using WiFi network. The servo motors of MG995 used here is a closed-loop system where the motor position will be re-informed to the control circuit in the internal body. The flame sensor and water sensor are used in the proposed system where the flame sensor detects a flame with a wavelength of 760–1100nm, whilst the water sensor detects a water level which is programmed on Arduino and gives a signal to the alarm circuit. The flowchart of burning process is illustrated in Fig. 3.

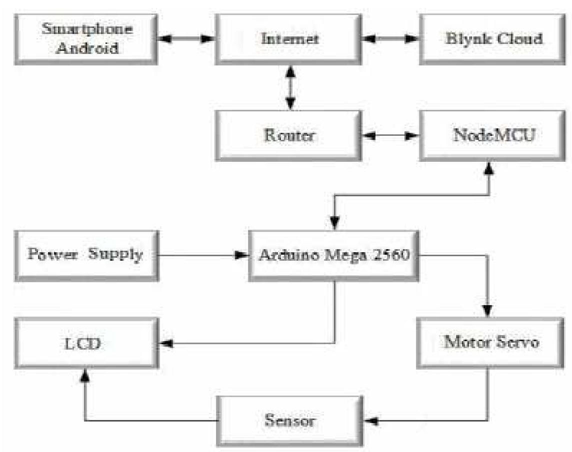

Fig. 2. Diagram block of control device of burning process for organic waste.

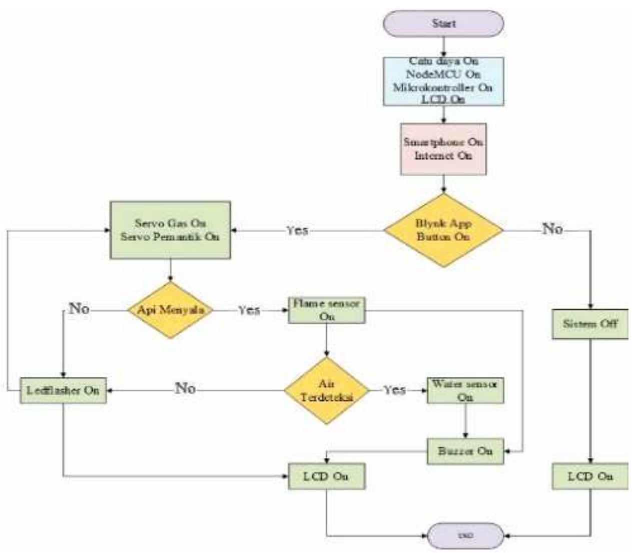

Fig. 3. Flowchart of burning process system.

III. Testing and Result

A. Part-by-Part Testing

The first part-by-part testing is conducted for flame sensor to detect the fire. When the fire is detected, the flame sensor is then activated and send a notification to be displayed on smartphone and LCD as shown in Fig. 4. The flame sensor works properly at a certain distance due to its sensitivity. The result of flame sensor testing is tabulated in Table I.

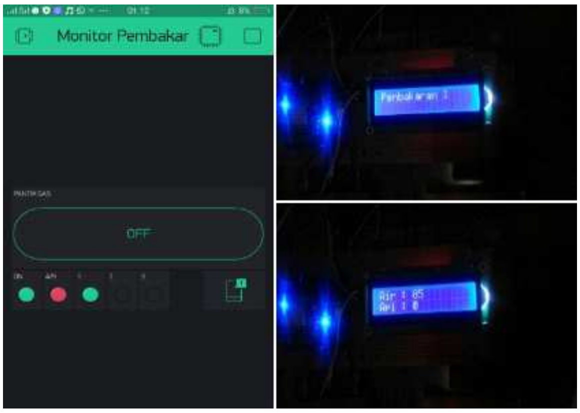

Fig. 4. Notification on smartphone and LCD.

TABLE I
Result of flame sensor testing.

Process	Indicator		Notification on LCD	Condition
	Buzzer	*LED*		
Burning-1	ON	OFF	0	work
Burning-2	ON	OFF	0	work
Burning-3	ON	OFF	0	work

Then, the water sensor is tested by using the program script entered into ATmega2560 microcontroller. The water sensor can be observed whether it works or not. The burning smoke will settle on the water reservoir. This precipitate is a wood vinegar. The result of water sensor testing is summarized in Table II. On the all burning, it can be observed the value of water sensor on the LCD as an analog output. The value of achievement is between 0–1200.

TABLE II
Result of water sensor testing.

Process	Time (minute)	Indicator		Value
		Buzzer	*LED*	
Burning-1	10	ON	OFF	480
Burning-2	10	ON	OFF	491
Burning-3	10	ON	OFF	509

Meanwhile the servo motors with type of MG995 are tested by triggering a pulse into the motors as an input signal. The servo motor can be operated by pulse width of $\pm$20 ms at the frequency of 50 Hz. The result of MG995 servo motors testing is depicted in Table III.

TABLE III
Result of MG995 servo motors testing.

Part	Function	Position	Motor Rotation		Condition
Motor-1	Gas rotator	140^o	180^o	40^o	gas out
Motor-2	Lighters	10^o	100^o	90^o	lighters ON

To observe the wood vinegar result, the organic waste is burned out for 3 times with the average time of each burning around 10 minutes. The analysis result of wood vinegar through the burning out of organic waste is summarized in Table IV.

TABLE IV
Result of wood vinegar through burning out of organic waste.

Process	Time (minute)	Water condition	Fire condition	Wood vinegar capacity (ml)
Burning-1	10	detected	detected	3
Burning-2	10	detected	detected	8.6
Burning-3	10	detected	detected	16.9

B. Overall System Testing

The overall system testing is conducted by running out the overall system. The result of overall system testing is shown in Table V. The burning process is performed to obtain a wood vinegar for 3 times with the time range of 10 minutes for each. The flame sensor works to provide the information to smartphone and LCD when the fire is detected. The water sensor runs out if the value of water level achieves $\geq$ 300.

TABLE V
Result of overall system testing.

Condition	Instruction	Execution
Power supply **ON**	-	WiFi Module, NodeMCU, ATmega2560 microcontroller and LCD.
WiFi Module and NodeMCU **ON**	-	WiFi Module provides the hight frequency to interconnect ATmega2560 microcontroller with internet connection speed of 72 Mbps.
ATmega2560 microcontroller **ON**	Button ON at smartphone is blinking	ATmega2560 microcontroller provides the voltage of 5 volt to interconnect all of devices on the ON position and operates all of support components to act the burning process.
-	Burning-1 **ON** Burning-2 **ON** Burning-3 **ON**	Motor-1 (gas rotator) and Motor-2 (lighters) rotate to fire up and notification is displayed on smartphone and LCD (no notification after burning process).

IV. Conclusion

The IoT application for controlling the burning device of organic waste through WiFi access in processing a wood vinegar has been presented. The burning process of organic waste has been remotely controlled with the high speed internet access up to 72 Mbps through a smartphone. It has been demonstrated 3 times of burning process with the result of wood vinegar of 16.8 ml for the average time of each burning around 10 minutes. In addition, some improvements to simplify the control process is now in progress as well as to secure the burning process.

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