Jurnal E-Komtek
Vol. 6, No. 2 (2022) pp. 174-183
https://jurnal.politeknik-kebumen.ac.id/index.php/E-KOMTEK
p-ISSN : 2580-3719 e-ISSN : 2622-3066

Microcontroller-Based Cigarette Smoke Detector and Neutralizer

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https://doi.org/10.37339/e-komtek.v6i2.1035

Published by Politeknik Piksi Ganesha Indonesia

Artikel Info
Submitted:
19-09-2022
Revised:
21-10-2022
Accepted:
27-10-2022
Online first :
31-12-2022

Abstract

Non-smoking areas in Indonesia are still very minimal, and if any, they may still be violated because the sanctions can be said to be non-existent. Some smokers do not understand the tolerance for the discomfort of passive smokers forced to smell cigarettes smoke: they must inhale the burnt smell of tobacco until they feel short of breath. Some sensitive passive smokers will cough right away. This study aims to design a device that can detect cigarette smoke by neutralizing it. The result of this study is that all tools made worked and functioned as expected, so they are expected to be used as a means of controlling cigarette smoke in a closed space. Raspberry Pi as the main controller is quite efficient because it requires a small power supply source.
Keywords: Cigarette smoke, Tools, Room, Raspbery Pi

Abstrak

Kawasan bebas rokok di Indonesia masih sangat minim, itu pun masih mungkin dilanggar karena sanksinya bisa dikatakan tidak ada. Sebagian perokok tidak memahami sikap toleransi pada ketidaknyamanan perokok pasif yang terpaksa mengisap asap rokok. Perokok pasif harus mencium bau bakaran tembakau sampai merasa sesak napas. Sebagian perokok pasif yang sensitif akan langsung batuk- batuk. Penelitian ini bertujuan untuk merancang sebuah alat yang dapat mendeteksi asap rokok dengan menetralisirnya. Hasil penelitian ini adalah secara keseluruhan, alat yang dibuat dapat bekerja dan berfungsi sebagaimana yang diharapkan, sehingga diharapkan dapat dimanfaatkan sebagai alat pengendali asap rokok dalam ruang tertutup. Raspberry Pi sebagai pengendali utama cukup efisien karena membutuhkan sumber catu daya yang kecil.
***Kata-kata kunci**: Asap rokok, alat, Ruangan, Raspbery Pi*

1. Introduction

Cigarettes are toxic objects that give a relaxing effect and suggest feeling more manly. Behind these tiny uses or benefits of cigarettes are enormous harms for the smokers and people around them. The exposure to cigarette smoke is all chemicals derived from the burning of cigarettes that hit both smokers and non-smokers (passive smokers). Cigarette smoke is a pollutant for humans and the surrounding environment. Cigarette smoke is more harmful to passive smokers than active smokers **[1].** Cigarette smoke contains approximately 4000 chemicals, of which 200 are toxic, and 43 other types can cause cancer. Among the threatening substances are tar, nicotine, and carbon monoxide. A place filled with cigarette smoke pollution is a more dangerous place than a polluted congested highway **[2].**

For cigarette addicts, smoking equals a basic necessity: a day without it, the body feels unwell, the mind is difficult to concentrate, and the mouth feels sour. An addict is even willing to replace their breakfast with only a cigarette and a glass of coffee. Smoking has become a prevalent and widespread habit in society. The dangers of smoking to the health of the body have been researched and proven by considerable people. Smoker patients are also at high risk of complications or difficulty healing wounds after surgery, including plastic and reconstructive surgery, plastic surgery, and surgery involving the lower limbs. In reality, this smoking habit is difficult to get rid of and is rarely recognized by people as a bad habit. Moreover, smokers with a purpose of diverting from stress and emotional stress find it more challenging to break away from this habit than those who have a background in depression. Recent research has also shown the dangers of secondhand smoke, namely cigarette smoke inhaled by people who are not smokers because they are around smokers or can be called passive smokers.

Air pollution conditions due to cigarette smoke affect human health. The prominent influence in the form of disease transmission is airborne diseases. This air pollution will affect the morbidity and mortality rates of various types of disease. To be precise, air pollutants can be a source of viruses, bacteria, and several types of worms that encourage the occurrence of air pollutant diseases, resulting in a person becoming allergic, which subsequently becomes the entrance of bacteria.

Analysis by the WHO (World Health Organization) shows that the adverse effects of cigarette smoke are greater for passive smokers than for active smokers **[3]**. When a smoker burns a cigarette and smokes it, the smoke smoked by the smoker is called the main smoke (mainstream), and the smoke that comes out of the tip of the cigarette (the burned part) is called

side smoke (side steam). This side smoke is evident to contain more tobacco combustion results than the main smoke. This smoke contains five times greater Carbon Monoxide, three times greater Tar and Nicotine, 46 times Ammonia, three times Nickel, and Nitrosamine (a cancer-causing substance), of which levels are up to 50 times greater than that of in the main smoke. Likewise, other toxic substances with higher levels are in side smoke.

In Indonesia, smokers are relatively free to smoke cigarettes anywhere. The area free of cigarettes in this country is still very minimal, and if any, it is still possible to violate it because the sanctions can be said to be non-existent. Some smokers do not understand the attitude of tolerance to the discomfort of passive smokers forced to smell cigarette smoke: they must inhale the burnt smell of tobacco until they feel short of breath. Some sensitive passive smokers will immediately cough.

As one way to reduce cigarette smoke so as not to make other people who do not smoke inconvenient, especially in rooms that do not have a smoking area, a tool is made that can help clean the air in the room and against cigarette smoke pollution. In this study, an application was designed that functions as a monitoring of the tools made.

What makes the tool stands out is that in addition to neutralizing cigarette smoke, it can also detect the source of smoke in a 3-room simulation. The control process employed a python programming language, a 2 x 16 LCD display, a Raspberry Pi, and an AF30 smoke sensor to detect cigarette smoke as the AF30 smoke sensor has a high level of sensitivity to gases considered to represent cigarette smoke, as well as the addition of cameras and interfaces or applications as a tool to monitor the situation in a room simulated with three rooms. As cited by **[4]**, Raspberry pi (also known as RasPi) refers to an SBC (Single Board Computer), a credit card-sized computer developed by the Raspberry Pi Foundation in the United Kingdom (UK) with the intention of triggering the teaching of basic computer science in schools. A research study was conducted by **[5].**

on Upwelling Detection and Early Warning Systems. This study aims to build an upwelling detection and early warning system that can provide information about the occurrence of upwelling phenomena. The system made has the main components, namely a Raspberry pi tool as a control system and 2 sensor components used to measure temperature parameters in the water layer.

Previously, [6] had made a Cigarette Smoke Detector Using the AT89S8252 Microcontroller, the TGS 2600 smoke sensor and the Assembler language, and the 2x16 LCD as the display.

Design is a process of selection and thinking that connects facts based on assumptions relating to the future by describing and formulating certain activities believed to be necessary to achieve particular goals and outlining how they are achieved [7]. Making is the process, the way, and the deed of making [8]. A detector is a device for finding or determining the existence or reality of something; tracking [8]. Some of the ingredients contained in cigarettes are as follows in Figure 1:

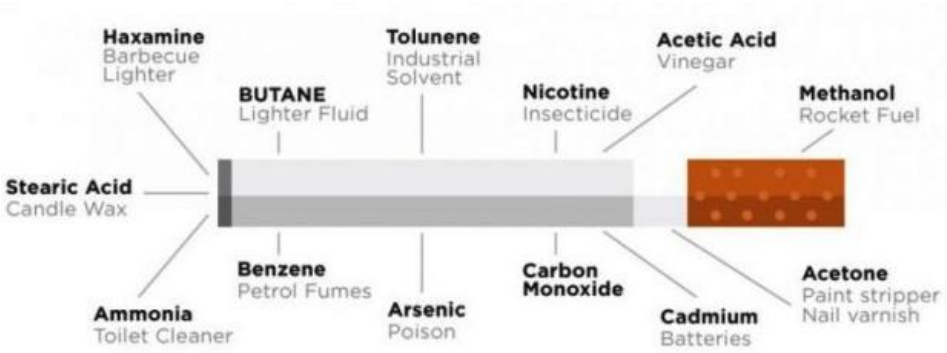

Figure 1. Content of Substances in Cigarettes

2. Method

a. Types of Research

This research is quantitative. This method is used to examine a specific sample or population [11].

b. Stages of Research

In this study, the stages of research were performed to achieve systematic goals so that the research was more directed and well structured. The Figure 2 depicts the stages of this research:

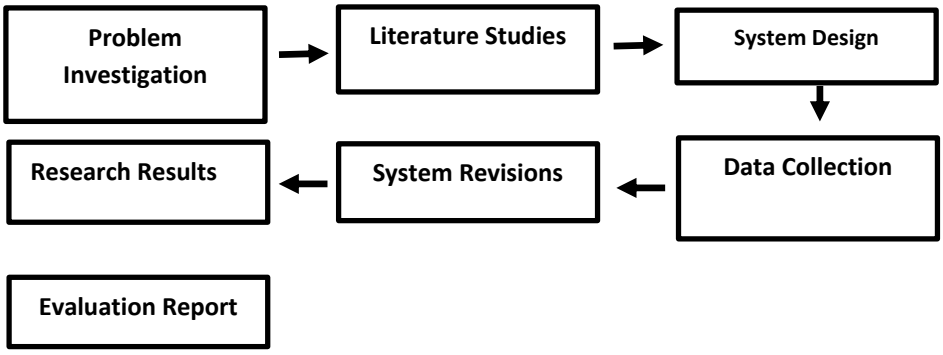

Figure 2. Stages of the Research

3. Results and Discussion

From the designing and testing wireless medical devices with Android and iOS-based multisensors, the results of hardware design and test data from several patients were obtained. They are elaborated as follows.

a. Hardware Design Results

The **Figure 3** is a simulation of the microcontroller-based cigarette smoke detector and neutralizer, which is simulated with three rooms, of which each room is equipped with an AF30 smoke sensor to detect the presence of smoke or gas in the room, LED as an indicator of indoor smoke concentration, and exhaust fan to neutralize indoor smoke. This tool is based on Raspberry Pi as the control of all tool activities. Besides that, this tool is also equipped with an LCD to display the concentration of smoke in each room, a buzzer as an alarm that goes off when the sensor detects smoke above the set standards, and a serial port as a data communication between the microcontroller and the interface or smoke detection monitoring software.

Figure 3. Cigarette Smoke Detection Tool Simulation

The picture below is a detailed simulation of one room of cigarette smoke detector and neutralizer. In this room simulation are sensors, exhaust fans, and LED indicators. The sensor detects the presence of smoke or gas in the room, the exhaust fan functions to emit smoke in the room, and the LED indicator indicates the level of smoke or gas content in the room.

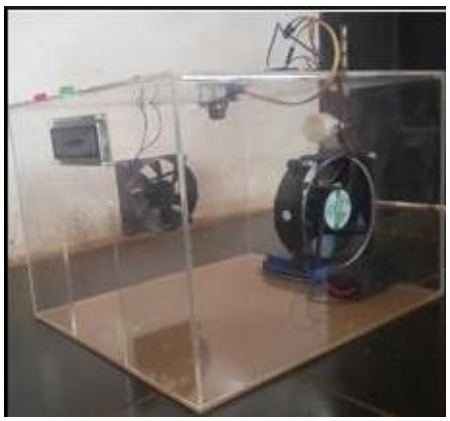

Figure 4. Front View of the Tool

b. Discussion

1) System Test Results

System testing is carried out to find out whether the system can function effectively and can produce output as expected. Testing began with testing the component or module separately. After that, testing of the system as a whole was carried out. The **Figure 5** shows the system testing technique.

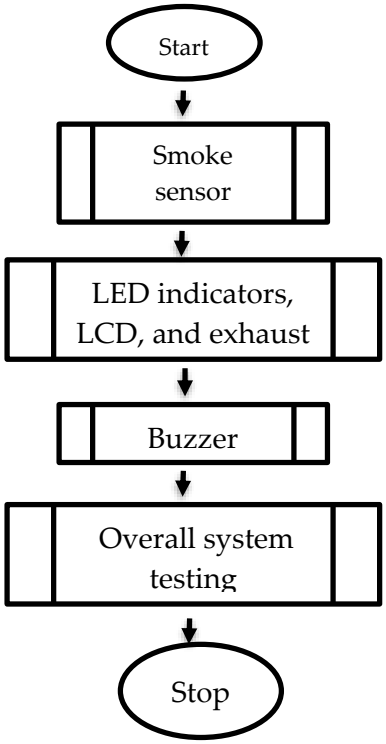

Figure 5. System Testing Steps

a) Smoke Sensor Testing

Smoke sensor testing was carried out by providing cigarette smoke or smoke containing ethanol and hydrogen, which are considered to represent cigarette smoke, so that the sensor detects. **Table 1** shows the results of the smoke sensor measurement test against smoke concentrations.

Table 1. Smoke Sensor Testing Result

Objek	Values Displayed on the LCD	
	Normal Circumstances	Detect
Cigarette Smoke	34 ppm	205 ppm
Gas	40 ppm	190 ppm
Smoke Paper	35 ppm	52 ppm
Mosquito Repellent Smoke	34 ppm	55 ppm

b) LCD, LED Indicator, and Exhaust Fan Testing

LCD and LED testing were carried out by providing inputs on smoke sensors with cigarette smoke objects. The LCD displays a specific value according to the input value of the sensor. The values affect the LED indicator flames. Based on the predetermined value, for the range value ≤60, the green LED is ON; for the range value ≥61 and ≤100, the yellow LED is ON; for the range value ≥101 and ≤150, the orange LED is ON; for the range value ≥151 and ≤200, the red LED is ON; and for the range value ≥201 and ≤255, the yellow LED is ON. The exhaust fan reacts to the color of the LED that is ON: if the green color LED is ON, the fan does not rotate, while if the Yellow, Orange, Red1, or Red color LED is ON, the fan rotates.

Table 2. LCD, LED, and Fan Test Tables

Condition	Cigarette Smoke		
	LCD	LED	Fan
Usual	34	Green	Quiet
Detect	67	Yellow	Spinning
Warning	113	Orange	Spinning
Dangerous	178	Red1	Spinning

c) Buzzer Testing

For buzzer testing, it was carried out by following the color of the LED that is ON: if the green, yellow, or orange LED is ON, the buzzer is silent. Meanwhile, the buzzer will go off if the red1 and red LEDs are ON.

Table 3. Buzzer Testing Table

	Indicator	
AF30 Sensor Value	LEDs	Buzzer
<= 60	Green	Quiet
>= 61, <=100	Yellow	Quiet
>= 101, <=150	Orange	Quiet
>=151, <=200	Red1	Beeps delay
>=201. <=255	Red2	Long beeping

d) System-Wide Testing

Testing the entire system was carried out to determine the value of smoke concentration in a room detected by a smoke sensor, of which results will then appear through the LCD. Testing begins with the introduction of cigarette smoke in each room. If the sensor detects a smoke concentration exceeding the predetermined value limit, the device will send a signal or warning tone using the buzzer. In addition, to minimize the excessive concentration of smoke in the room, this system uses an exhaust fan equipped with an LED indicator to determine the concentration

of smoke in each room. The system was also made using 3-room samples, each with an AF30 smoke sensor, LED indicator, and exhaust fan. Meanwhile, the LCD and buzzer are placed in a monitoring room equipped with an application to monitor smoke concentrations and indoor conditions.

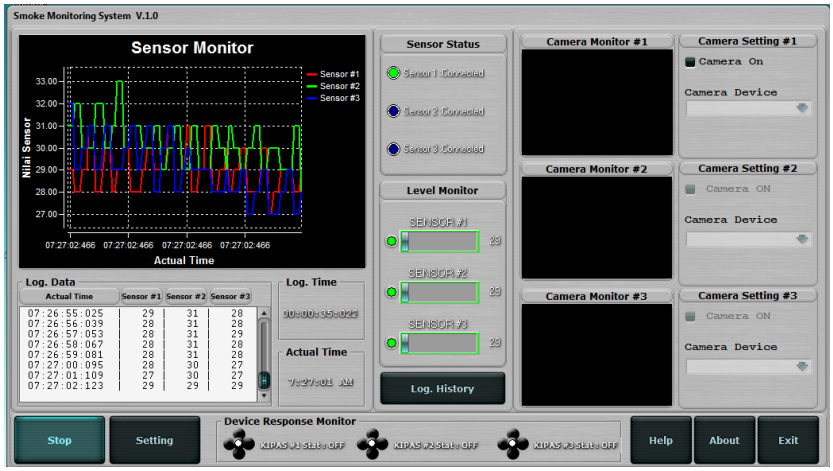

Figure 6. Monitoring Software When Not Detecting Smoke

In **Figure 6**, it can be seen that the cigarette smoke monitoring application is working; each sensor is in a normal state or not detecting it on a graph that shows a number below 60 ppm on each sensor, which can also be seen in the data log. Likewise, the monitor level shows a green indicator with the same value in the chart, and the status fan also indicates a normal state.

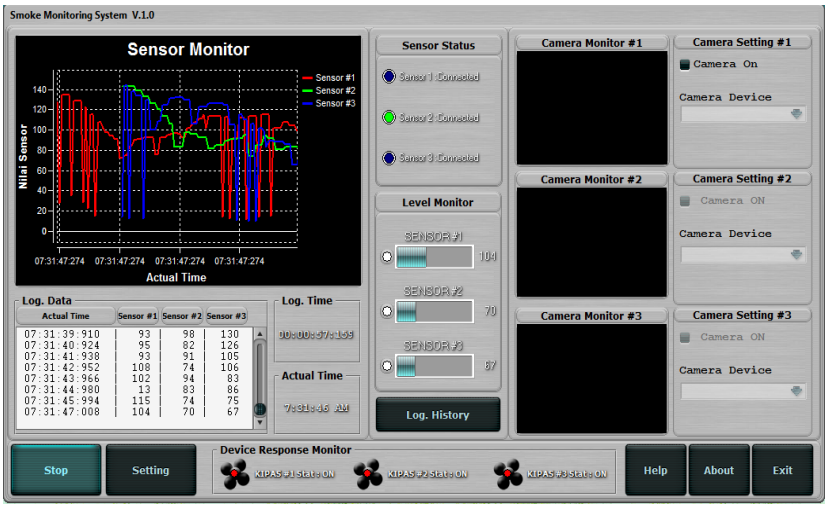

Figure 7. Monitoring Software When Detecting

In **Figure 7**, you can see the cigarette smoke monitoring application at work; each sensor in the detecting state on the graph showing a number above 60 ppm, sensor 1 shows a value of 104 ppm, sensor 2 is worth 70, while sensor 3 shows a value of 67 at a time of 07:31:47:008, which can also be seen in the data log. The monitor level shows that the indicator is detecting by showing

the value equal to the chart value and log data, as well as the status of the fan that is ON with the red indicator.

Table 4. Overall System Testing

	Object											
	Cigarette I			Cigarettes II			Cigarettes III				Gas	
Seconds to -	0	5	27	0	2	10	0	2	7	23	0	11
Sensor 1	46 ppm	68 ppm	112 ppm	48 ppm	67 ppm	111 ppm	47 ppm	67 ppm	109 ppm	167 ppm	47 ppm	170 ppm
Sensor 2	47 ppm	67 ppm	110 ppm	49 ppm	65 ppm	110 ppm	48 ppm	69 ppm	112 ppm	165 ppm	48 ppm	167 ppm
Sensor 3	48 ppm	65 ppm	115 ppm	48 ppm	69 ppm	113 ppm	49 ppm	65 ppm	110 ppm	168 ppm	49 ppm	169 ppm
Fan	Quiet	Spinning	Spinning	Spinning	Spinning	Spinning	Spinning	Spinning	Spinning	Spinning		Spinning
Buzzer	Quiet	Quiet	Quiet	Quiet	Quiet	Quiet	Quiet	Quiet	Quiet	Sound	Quiet	Sound
LED	Green	Yellow	Orange	Green	Yellow	Orange	Green	Yellow	Orange	Red 1	Green	Red 1

1. Analysis of Test Results

From **Table 4**, it is evident that the sensor has a normal effectiveness value or is not in the detecting state of an average of 48 ppm; the sensor takes an average of 2 to 3 seconds to detect smoke or gases in the room. For sensors 1, 2, and 3 with cigarette smoke object III, it takes 23 seconds to detect smoke above the determined standard so that the buzzer activates. As for gas objects, the sensor takes 11 seconds to detect the presence of gas above the predetermined normal standard so that the buzzer activates.

2. Real Implementation

For the real implementation or application in large-scale rooms, this tool can be used because, in addition to being able to detect cigarette smoke and the presence of gas in the room, this tool can also be used as a tool to detect early the potential for fire hazards and can also take initial actions in handling fires so that they do not spread. In addition, this tool is also quite efficient because it requires a small power supply source for its operation. With a large room-scale size, we should add sensors in every corner of the room so that detailed results can be obtained or by using a large smoke sensor according to the size of the room. The supporting application of this device is software or application to monitor the concentration of smoke contained in the room that works in real because this application provides us with information or an overview of the cigarette smoke detection device.

4. Conclusion

The electronic devices needed in this series of cigarette smoke control are AF30 smoke sensor, Raspberry Pi, Carbon Fiber, LED Indicator, Exhaust Fan, and Buzzer. This tool was made

by assembling electronic devices into a system that can detect cigarette smoke and neutralize it automatically. The sensor has an average normal effectiveness value of 48 ppm and is quite sensitive to cigarette smoke and gases. The sensor takes an average of 2 to 3 seconds to detect smoke or gases in the room. Overall, the tools made can work and function as expected, so they are expected to be used as a means of controlling cigarette smoke in an enclosed space. Raspberry Pi as the main controller is quite efficient because it requires little hardware and the need for a small power supply resource.

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