

E-WS: A Novel Smart Information System Towards Smokers for the Outdoor Canteen Environment

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ABSTRACT

The most critical component of the environment for living things is air. Poor air quality influenced by carbon monoxide (CO) gas. Cigarette smoke is one of the best contributors to carbon monoxide today. The habit of smokers does not heed the sign of no smoking in many places, for example, the Canteen (cafeteria). This research presents a new intelligent information system to prevent smokers in the outdoor cafeteria environment. We provide this case solution as an Early Warning System (E-WS), by utilizing the MQ gas sensor and buzzer. In this case, the MQ gas sensor is used to detect CO gas coming from cigarette smoke. The proposed system is implemented directly for CO gas from cigarette smoke, grill smoke, burnt smoke, and vehicle fumes for E-WS validation. The value of air quality (PPM) is determined based on parameters Good (0-50), Medium (51-100), and Danger (> 101). The PPM value displayed in the Dot Matrix DMD P10 Display as air quality information and active buzzer marker. The test data shows that the E-WS successfully detected CO gas with different PPM values. And the buzzer is active when the ppm value is in the moderate to dangerous category.

Keywords: air pollution, carbon monoxide (CO), E-WS, MQ sensor

Introduction

The most critical environmental component for living things is air. To be able to enjoy the fresh air, it is necessary to consider the quality of the air itself. Poor air quality can be influenced by several factors, which are also called air pollution [1]. One of the factors causing the decrease in the level of clean air quality caused by carbon monoxide (CO) gas. CO gas that is often found aside from vehicle fumes is cigarette smoke. CO gas is a type of

odorless gas where the element produced from incomplete combustion of carbon or carbon [2]. But it has gas molecules poisonous to the human body [5, 2, 9]. Each CO gas molecule consists of one carbon atom, which covalently bonded to one oxygen atom [10]. The unit for CO concentration in air is *parts per million* (ppm) [11]. Based on the Air Pollution Standard Index (ISPU) Number KEP107 / KABAPEDAL / 11/1997, article 9 explains that the numbers and categories of air pollution standard indexes for carbon monoxide gas shown in Table 1.

Table 1 CO levels in the Air Pollution Standard Index Categories for Carbon Monoxide Gas [12]

Category	CO (ppm)	Indicator
Good	0-50 ppm	Green Color
Medium	51-100 ppm	Blue
Unhealthy	101-199 ppm	Yellow
Very Unhealthy	200-299 ppm	Red Color
Harmful	> 300 ppm	Black Color

The cigarette is the wrong one major cause of deadly cardiovascular disease [3]. Therefore air pollution that requires special attention is pollution originating from motor vehicle fumes, cigarette smoke, and other particles. Smoker's behavior explained as an act of smoking a tobacco roll that is burned and exhaling the smoke out of the body [13]. Exhaled smoke can be sucked back by smokers and those around them. This can harm health. Cigarette smoke has carbon dioxide gas compounds, water, carbon monoxide, and other toxic compounds. The very high concentration of compounds in cigarette content is carbon monoxide [14]. CO gas concentration can cause death if inhaled continuously for 30 minutes [3].

According to the research conducted by Inayatillah et al., 2014 showed that the average CO level in smokers was 22 ppm while non-smokers amounted to 5.83 ppm [4]. Based on the unit value of this CO concentration (ppm), Lin et al. 2018 explain that CO levels can be monitored using sensors [5]. Air pollution needs to be detected so that the levels of dirty air so as not to become a health risk for humans and other living things. MQ family sensor is a sensor that is usually used to determine the content of ppm levels in the air, to see the quality and condition of the Air. Air pollution is an easy thing for everyone to forget about this issue of air pollution, air pollution is a real problem that threatens the environment and even threatens us, every time and every day [6] [4].

Previous studies have examined the effect of cigarette smoke on the body of smokers in the environment of the Faculty of Computer Science (Fasilkom). From the tests conducted, it can be concluded that active and passive smokers have a considerable influence on air pollution caused in the surrounding environment. Therefore this research has succeeded in developing the MQ gas sensor to detect cigarette smoke in the Fasilkom cafeteria environment to anticipate the occurrence of air pollution from cigarette smoke. This study also uses an alarm as a sign that air has polluted by cigarette smoke and provides information on the level of air pollution around the environment of the Facilitator.

1) Proposed Early Warning System

Overall the proposed E-WS system in this study can be seen in Figure 1. The process of taking and processing the test data is carried out to provide air quality information to the monitoring user.

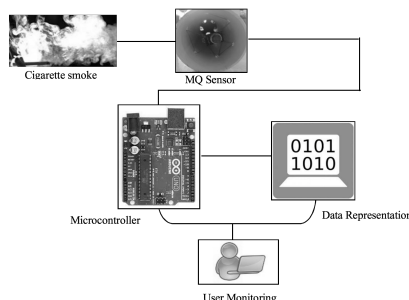


Figure 1. E-WS System Architecture

Based on Figure 1 explains that the sensor detects CO gas in the surrounding environment. Every time there is a CO gas from cigarette smoke that is exposed, the sensor sends

information to the Acquisition Data system to get the sensor data. The process is done to simplify and speed up the work of the microcontroller in processing data received. The output from the microcontroller then represented as data that can be understood by the user. So, in this case, the user can find out air quality information expressed in PPM values.

2) System Hardware

The hardware system in this study consists of three main parts, namely Input represented by an MQ gas sensor, Processor represented by an Arduino microcontroller and output represented by an indicator light, Alarm, and DMD Display. For more details can be seen in Figure 2.

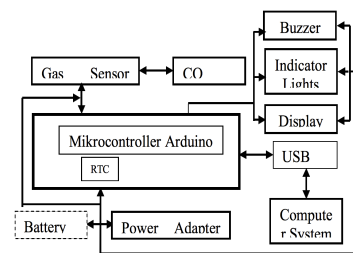


Figure 2. Gas Sensor Hardware System in E-WS

Gas sensor hardware system is simulated using proteus using one MQ-2 sensor as input, Arduino Uno as a processor, LED as an indicator of air quality, LCD 16x2 as a PPM information viewer, and alarm as a danger marker. The simulation is done first to test the system designed to minimize the possibility of errors that occur before it implemented. For more details, can be seen in Figure 3 below.

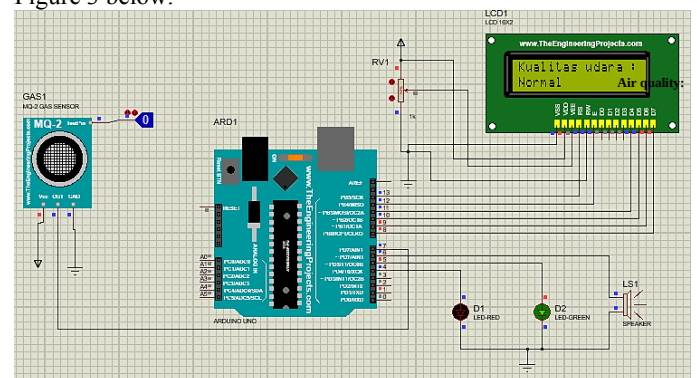


Figure 3. Simulation of the MQ sensor circuit in Proteus

3) Result

In this section, we will focus on the success rate of the E-WS system in detecting cigarette smoke pollution in the surrounding environment. Air pollution has taken from the location of the outdoor cafeteria on the Fasilkom Unsri campus. The data presented generated from five different days with different sample times.

PERFORMANCE EVALUATION OF THE E-WS SYSTEM IN THE OUTER ENVIRONMENT

Based on the design shown in Figure 2 explains that the installation of this monitoring system is very precisely installed in the position, as shown in Figure 4. This monitoring proves that visitors very quickly see the air display in the cafeteria because it is in the center position from the cafeteria. The installation of the sensor on one of the dining tables in the cafeteria is because more visitors sit at this table for reasons of a comfortable position, there are electrical plugs and have wide air circulation from the left and right. The survey results of determining the location of the device carried out for five days during the campus activity hours, starting from 8:30 until 17:00.

Following table cafeteria visitor data as shown in Table 2

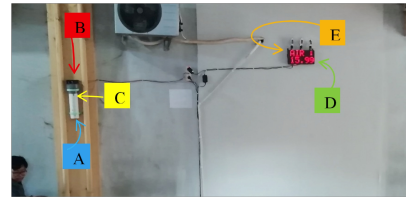


Figure 4. Results of the implementation of the E-WS system; incoming airflow through the sensor MQ (A), the fan as a vacuum to speed up the detection process (B), the pipe box as a place for air circulation to the sensor (C), the value of the surrounding air quality in PPM units (D), air display information (E).

Table 2 Data Visitor Diner on hours and days of active lectures

Day	Time	Number of Visitors (People)	Total seating position in a location sensor (people)
Monday	Morning	10	3
	Afternoon	15	8
	Evening	7	3
Tuesday	Morning	2	2
	Afternoon	23	10
	Evening	11	7
Wednesday	Morning	5	3
	Afternoon	17	12
	evening	16	11
Thursday	Morning	3	3
	afternoon	8	5
	evening	5	5
Friday	Morning	6	1
	afternoon	7	7
	evening	12	10

Based on Table 2 explains that when the survey divided into three parts, Morning (8:30 to 12:00), afternoon (12:00 to 15:00), and in the evening (15:00 to 17:00). This survey

is done to determine the population of visitors more in the morning, afternoon, or evening. The average cafeteria visitor based on samples taken for five days shows that

the seat position of the sensor installation is more a favorite of cafeteria visitors. The number of visitors in the five days seated is 147 people with the quantity per day sitting in the sensor installation position is 90 people.

E-WS SYSTEM TESTING RESULTS OVERALL

Testing is carried out in a few days in the cafeteria environment. The results data displayed in this study taken for three days on 10 - 12 September 2019. The testing time was carried out from 8.35 to 17.00. The division of time categorized into three parts, namely Morning, Afternoon, and Evening, as described in Table 2. One of the results of tests that have been carried out for three days of testing is on 10 September 2019. Divided into two parts, as shown in Table 3 and Table 4.

Table 3. Test results on September 10, 2019 (Morning to Afternoon), the condition consisted of smoke and no cigarette smoke

Number	Environmental Conditions Cafeteria	Air Quality (PPM)	Indicator Light	Remarks
1.	No smoke	40	Green Light	Normal
2.	No smoke	51	Yellow Light	Medium
3.	No smoke	49	Green Light	Normal
4.	No smoke	75	Red Light	Danger
5.	Cigarette Smoke	120	Red Light	Danger

Table 4. Test results on September 10, 2019 (Afternoon to Evening), the condition consisted of smoke and no cigarette smoke

Number	Environmental Conditions Cafeteria	Air Quality (PPM)	Indicator Light	Remarks
1.	No smoke	90	Yellow Light	Medium
2.	No smoke	105	Red Light	Danger
3.	There is smoke	50	Green Light	Normal
4.	No smoke	110	Red Light	Danger
5.	Cigarettes Smoke	110	Red Lights	Danger

Air PPM data from the test results shown in Table 3 and Table 4 concludes that the air quality monitoring system in the Fasilkom cafeteria environment, especially for cigarette smoke, has been successfully implemented. The data shown in Table 3 shows that from the 5 test samples taken, the system was able to correctly detect air quality when there was smoke in the test environment. In point 4, the system detects that the air PPM value is 75 with an indication of danger. Yet when testing conducted, there

was no cigarette smoke around the test environment. Based on this data, the researchers concluded that the system created not only detects cigarette smoke. So it can be assumed that the monitoring system detects the presence of combustion products other than cigarettes: example, smoke from the burnt cafeteria or smoke from motor vehicles around the parking lot. The data test was shown in Table 4 in points 2, 3, and 4.

CONCLUSION

Based on the results of the tests that have been done and explained in the previous chapter and sub-chapter, this research resulted in several conclusions that have been reached in accordance with the desired research objectives, including is an air quality monitoring system in the Fasilkom cafeteria environment successfully implemented to detect smoke pollution not only from cigarette burns but smoke from burnt grills, vehicles, garbage including forests using MQ sensors. Air quality in the form of PPM also displayed on a display that can be seen easily not only by cafeteria visitors but the entire academic community of Fasilkom. PPM value generated is divided into 3 parts, namely 0-50 (normal), 51-100 (medium), and >100 (unhealthy).

With the air monitoring system that can be seen directly through the displayed display, it is expected to increase the awareness of the Fasilkom academic community not to smoke in the cafeteria environment, especially in the campus environment in general. It also hoped that this system would be able to provide harmful information on health through the levels of pollution detected, so that visitors are ready to protect themselves, for example, with masks and others.

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