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Design Virtual Instrumentation System of a Cigarette Smoke Detector

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A B S T R A C T

The contributor to air pollution today is cigarette smoke because almost every public facility is provided with a special room for smokers and a non-smoking room. However, the level of awareness of active smokers is not only harmful to themselves but also to secondhand smoke, especially in smoke-free environments. Along with the development of technology, we can take advantage of the development of a cigarette smoke detector based on the Arduino with the MQ-2 gas sensor. Therefore, this tool will make it easier to monitor a crowded room for cigarette smoke. The system uses the MQ-2 gas sensor to detect cigarette smoke in a room. By using a buzzer alarm as a sign that there is cigarette smoke inside a room. The ppm value obtained from the sensor is 550 ppm on the cigarette sensor to detect cigarette smoke

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INTRODUCTION

The government has enacted a regulation on smoking prohibition in public places because it has a dangerous impact on the surrounding environment. From a health perspective, cigarette smoke is very dangerous for the health of the body. Cigarette smoke contains 4000 dangerous chemical toxins and 43 of them are carcinogenic (stimulate the growth of cancer). These dangerous substances include tar, carbon monoxide (CO), and nicotine. The impact of cigarette smoke produced by active smokers also affects the health of passive smokers. When exposed to secondhand smoke, nonsmokers or passive smoker will inhale twice as much toxins as cigarette smoke. Carbon (C), Hydrogen (H), Oxygen (O), Nitrogen (N), Sulfur (S), and other elements are used to make cigarettes produced from dried tobacco leaves, paper, and flavoring ingredients. Both active and passive smokers may cause pain and suffer health consequences as a result of this. Dangers to your body can lead to cancer, damage to internal organs, lungs, impotence, fetal disorders, facial wrinkles and so on. Meanwhile, the dangers to secondhand smoke or the environment can cause air pollution caused by inhaled cigarette smoke. In fact, many of our neighborhoods who are smoking in public places are then reprimanded but cannot accept their mistakes even though the smoker knows that the place is a smoking-free area. Based on these problems, an Arduino-based cigarette smoke detector was designed using the MQ-2 gas sensor. In this design, in a smoke-free room a cigarette is detected, the buzzer will light up, but if cigarette smoke is not detected, the buzzer will not light up. This will be an automatic warning for smokers in public places designed to detect the presence of cigarette smoke and accompanied by a warning system for active smokers in smoke-free areas. With this tool, it is hoped that the supervision of active smokers can be carried out automatically and can increase the level of discipline for smokers to smoke in special smoking areas.

This research will discuss the development of a cigarette smoke detection instrumentation system to determine air quality that is free of air pollution based on LabVIEW and a microcontroller as an interfacing by combining LabVIEW as data acquisition and processing, then the Arduino UNO microcontroller as the interface hardware between the MQ-2 sensor and software namely the LabVIEW program. The previous research has been conducted by sabar using LabVIEW to monitor water level (Seeed. Growthe difference, 2015) and to measure water quality (Sabar, Hariyanto, et al., 2021)

METHOD

In designing this instrument system consists of several steps, namely the General Design of the System, Hardware, Software which contains an algorithm to carry out the measurement data acquisition process..

A. Design System

In this design consists of two devices, namely hardware and software The hardware design in this study consists of some of the parts of the components. It is an integration of several mutually exclusive series related to one another controlled by microcontroller. The concept of this tool is where the

microcontroller will give a signal to the buzzer if there is an incoming signal from the MQ-2 sensor. While the software used is with using LabVIEW

A.1. Cigarette Smoke Detector

Detection is a process for checking or examining something by using certain methods and techniques. The purpose of detection is to solve a problem in various ways with the methods applied to produce a solution.

A.2. MQ-2 Gas Sensor

The MQ-2 sensor is a monoxide gas sensor serves to measure the pollutant gas compounds present in air, such as carbon monoxide, hydrocarbons, nitroxides', butane, methane, LPG, propane, alcohol, hydrogen, PPM carbon smoke and used fire system detection(Chen et al., 2007)(Hanwei Electronics, 2018)(Gharge et al., 2014). There have been many on the market circulating semiconductor gas sensor sensing. Of the course differentiated by the sensitivity of each sensor. The more expensive the higher the sensitivity, and the concentration of gas, the lower the resistance. Lots once the type of gas sensor that is on the market at a price lace like a sensor to detect LPG gas, a sensor detects alcohol gas and sensors to detect smoke cigarettes are type AF30. (Seeed. Growthe difference, 2015)(Hanwei Electronics, 2018)

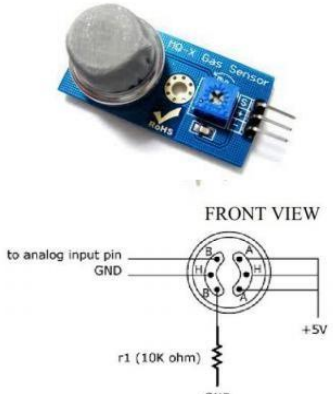

Figure 1. Schematic of MQ-2 Gas Sensor

A.3. Buzzer

Buzzer is a component that functions to convert electrical vibrations into sound vibrations. The working principle of the buzzer is similar to a loudspeaker, the buzzer consists of a coil attached to the diaphragm and then the coil is energized so that it becomes an electromagnet. So that the coil is drawn in or out depending on the direction of the current and its magnetic polarity, the coil is attached to the diaphragm, so each movement of the coil will move the diaphragm back and forth, resulting in a sound from vibrating air.

Figure 2. Buzzer Module

A. Microcontroller

Arduino is an electric kit open-source electronic circuit board in which there is a main component, namely a chip based on a microcontroller with the AVR type from the ATM company. Arduino itself has many types, and one of the types used in this study is the Arduino Uno. It is an open-source single-board microcontroller based on the wire platform, which was created to make it easier to deploy electronics in the various applications. Arduino uno has a different board with the previous Arduino. Arduino Uno does not use the FTDI (Future Technology Device International) USB to serial driver chip. Meanwhile, the features of Atmega16U2 (Atmega8U2 to R2 version) are programmed to change USB to serial. In opensource IDE software that is used to develop microcontroller applications based on the Arduino platform. In hardware, it has a single board microcontroller which opensource hardware developed for microcontroller architectures AVR 8 bit and ARM 32 bit.

Figure 3. Microcontroller

B. Hardware Design

The hardware in this study utilizes a microcontroller as an acquirer and data processor as the study have be conducted in the paper(Sabar, Wijaya, et al., 2021)(Hariyanto, 2019). The hardware design for the instrumentation system in this study is to connect the sensor with a jumper cable to the microcontroller and then from the microcontroller to a computer using a USB port as serial communication data. But before designing this instrument, we can build a simulation the system using thinker cad platform. To ensure the hardware can work well. The design of the hardware microcontroller circuit can be run before prototype would be built. For thinker cad simulation result of instrumentation system can be seen figure 4. The advantages of thinker cad platform are accessible, open source, user-friendly and having many features. In addition this instrument can be developed by adding machine learning to build a prediction system(Sabar et al., 2019b, 2019a).

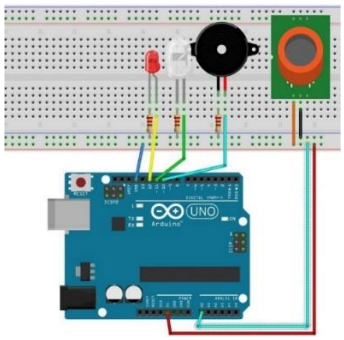

Figure 4. Thinker Cad Sketch of Simulation System

Overall for Schematic of hardware at this system model uses the Arduino UNO. The input of this system model is in the form of an MQ-2 gas sensor which detects cigarette smoke. The control of this system uses an Arduino and uses a buzzer as an output when smoke is detected by the MQ-2 gas sensor. The full schematic can be seen figure 5.

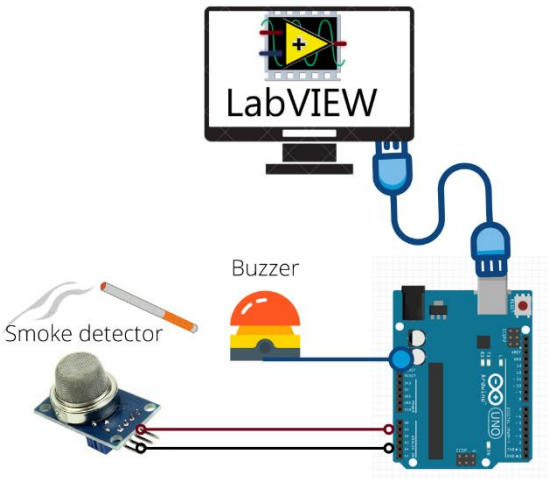

Figure 5. Design Schematic of Instrumentation System

In establishing software of virtual instrument consists of software design on the cigarette smoke detector system model. The software used in this paper was LabVIEW from NI-VISA and Makerhub as a communication link that can run between Arduino and LabVIEW. In Figure 7 illustrates a sketch of the flow of the tool circuit system that is made and then the modeling is carried out interface with LabVIEW as in Figure 5 which illustrates the structure of the research diagram with LabVIEW. The information presented on the panel is in the form of a voltage value resulting from the conversion of the analog sensor value. In the panel program, the value obtained is the value of gas concentration / ppm (*parts per million)*, and the value of the voltage resulting from the conversion of the sensor value. Dangerous alarm is built using a buzzer as a warning. if the voltage value read from the gas sensor is higher, it will produce a sound from the buzzer which has function warning system.

C. Software Design

Software is needed to program the required acquisition data serially from the data logger. The data (speed sensor and scaling functions, internal log, communication protocol, excel, ASCII, flow, etc.) are programmed using software installed on the PC. One of the software used in this research using LabVIEW. The LabVIEW works using the data flow principle where the information in the LabVIEW program, called a Virtual Instrument (VI), VI here is very complex because one VI can contain a number of internal VIs with many configurations. Users can create VI which consists of a graphical user interface (GUI) called a front panel and block diagrams. The front panel is used to create various graphic objects ranging from simple buttons to complex graphics. It can be see figure 6.

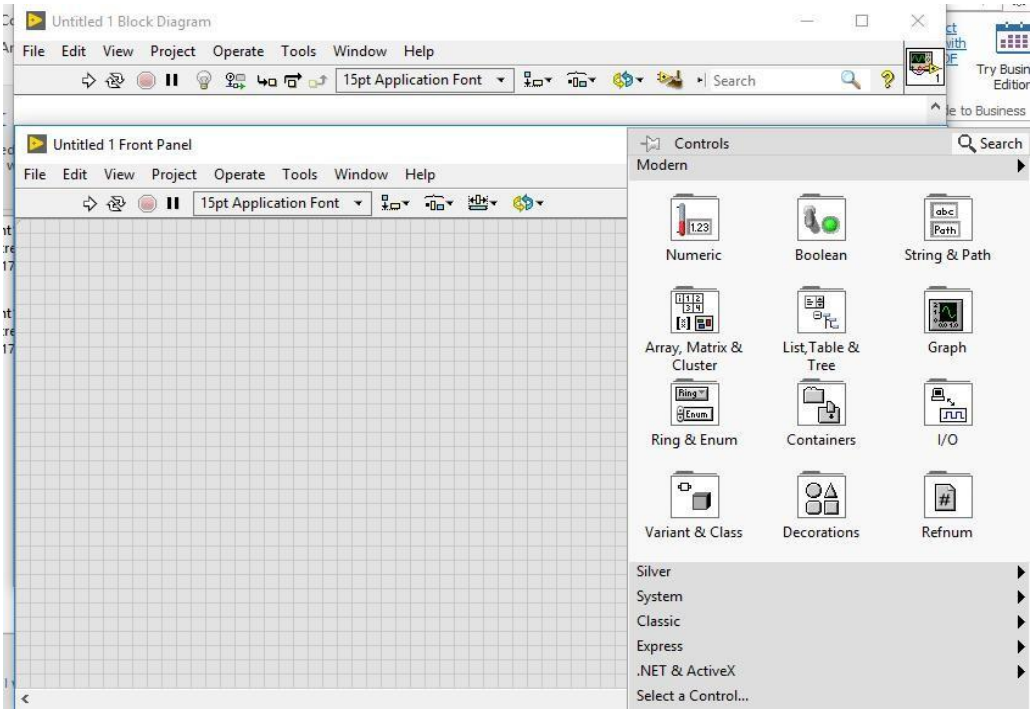

Figure 6. Users

The block diagrams in LabVIEW contain several types of program logic that function to modify data. Inside VI there is a front panel and a connector panel. The front panel consists of the controls and the Control indicators are used to provide input and display the output indicators. The block diagram consists of a graphic source code. Block diagram are shown in Figure 7.

Graphic source code in this system has one while loop and three sequences and uses a maker hub as a serial hardware input. In writing code program using block diagram, we are easy to understand and analysis whether the program can work. We can see the line of block diagram having various colour as indicator type data and functions.

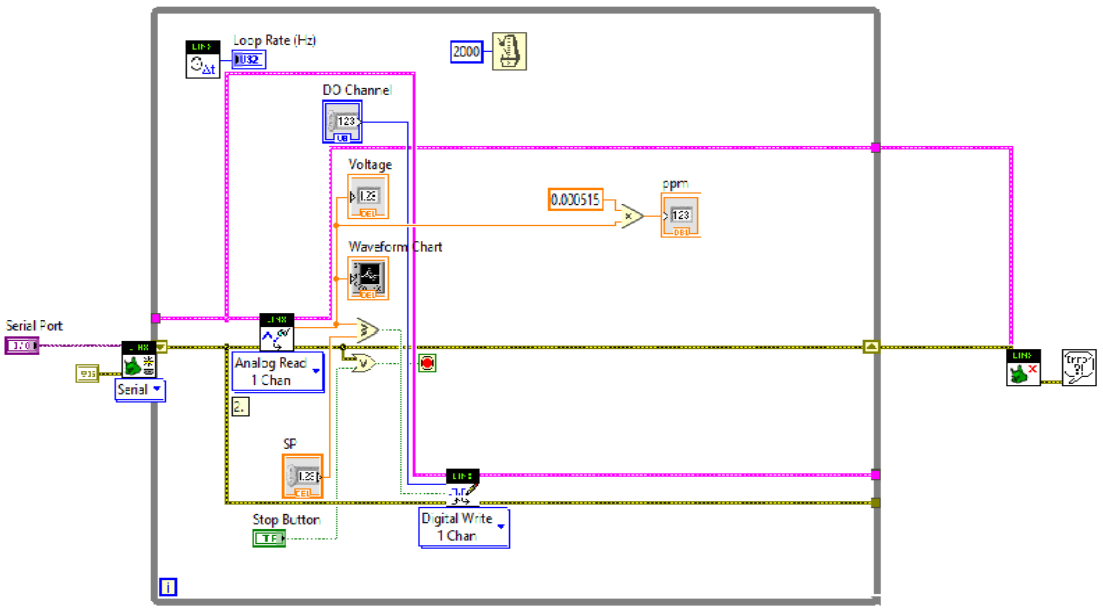

Figure 7. Block Diagram

RESULTS AND DISCUSSION

The results and discussion obtained in this study are virtual instrumentation system using the MQ-2 sensor with the Digital display of virtual instrument in Figure 5 based on LabVIEW and a microcontroller which is able to retrieve air pollution data in the form of cigarette smoke any time or real time. This instrumentation system is activated by pressing the "Run" button on the toolbars, the program will start monitoring and retrieving air quality data based on the smoke spread in the room through the MQ-2 sensor and the buzzer will give the signal if the sensor detects smoke in the room. Furthermore, the data is displayed in digital form such as graphs. The data is displayed in the control panel can be adjusted depending on the needs. Digital Display established by control panel is shown in Figure 8:

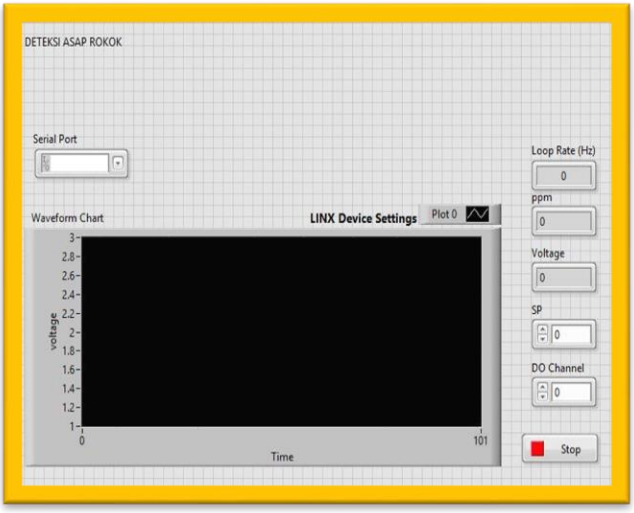

Figure 8. Digital Display of the System Built from Control Panel

The next step is implementation system, first make sure the Arduino is confirmed. It is mean that it is connected to the components in LabVIEW. After that, the experiment was carried out by identifying the smoke in the environment using the MQ-2 gas sensor and producing an output in the form of a gas concentration value. So that the observed data is gas concentration data. In this study would be 3 variations carried out. First we measure the cigarette smoke, mosquito rapellant, and lighter gas. Second the instrument system is placed in a room with size 1x1x1 meter to detect cigarette smoke, then it will be given a notification or alert. In addition the MQ-2 sensor has a notification in the form of an LED light and a buzzer. When the gas sensor detects cigarette smoke, the LED will light up and the buzzer will sound. If the ppm value is > 400, a notification will be given to the buzzer and the LED will be red, but if the ppm value is <300 then the buzzer does not turn on and the LED shows white light. The results of measurements using the virtual isntrument can be exported to Excel files to simplify the numerical calculation analysis. Experiments obtained 100 data on each gas variation could be analyzed where the highest average is from the lighter gas with an average value of the gas concentration is 535 ppm, and in cigarette smoke produces an average value at a gas concentration of 505 ppm, meanwhile the mosquito repellant has the average value concentration at 375 ppm the smallest compared to other variations in this research of experiment. The following is a graph of the experimental results

Finally, the results of measurements using this system can be exported to excel and analyzed for calculations. The experiment obtained 100 data on each gas variation. Where the highest average is from lighter gas, with an average gas concentration value of 535 ppm, and cigarette smoke produces an average value of 505 ppm gas concentration, while in cigarette smoke gas, mosquito repellent gas has the average value at the gas concentration of 375 ppm. Then it is the smallest compared to other variations in this experiment. The result can be seen at table 1 of the measurement result.

Table 1. The Average Results of Measurement

Variation	Ppm
Lighter gas	505
Mosquito repellent	375
Cigarette smoke	535

*The data is obtained from various data for the total every datum is 100 data.

Based on Chart at figure 9, we can see more detail that the different concentration rate of lighter gas is the highest of all. And then the PPM concentration of mosquito repellent gas is the lowest of all. But mosquito repellent gas has the linear regression data better than both. it is likely to show that data constant. On the other hand, for another gas has the rate fluktuative that is difficult for detection by sensor. Based on the concept theory kinetic gas, in the air consists of different million gas. Based on Hingman To and Naikong Fong

said investigation of the performance and improvement of optical smoke detectors if multi-sensor (smoke and heat) detector was used, the accuracy would be over 90%(To & Fong, 2013)

The challenging faced the authors in the research about cigarette smoke detector had been realized and tested. The MQ2 sensor can detect cigarette smoke, but the smoke hit the sensor. The sensor would be more sensitive when it is closer to the source. For the next research, author will use AI (artificial Intelligence) and multi-sensor (heat and smoke) to distinguish automatically between different gases, it is possible to use artificial intelligence to identify the various types of smoke by the sensor or by adding another sensor to compare the accuracy of cigarette smoke readings.

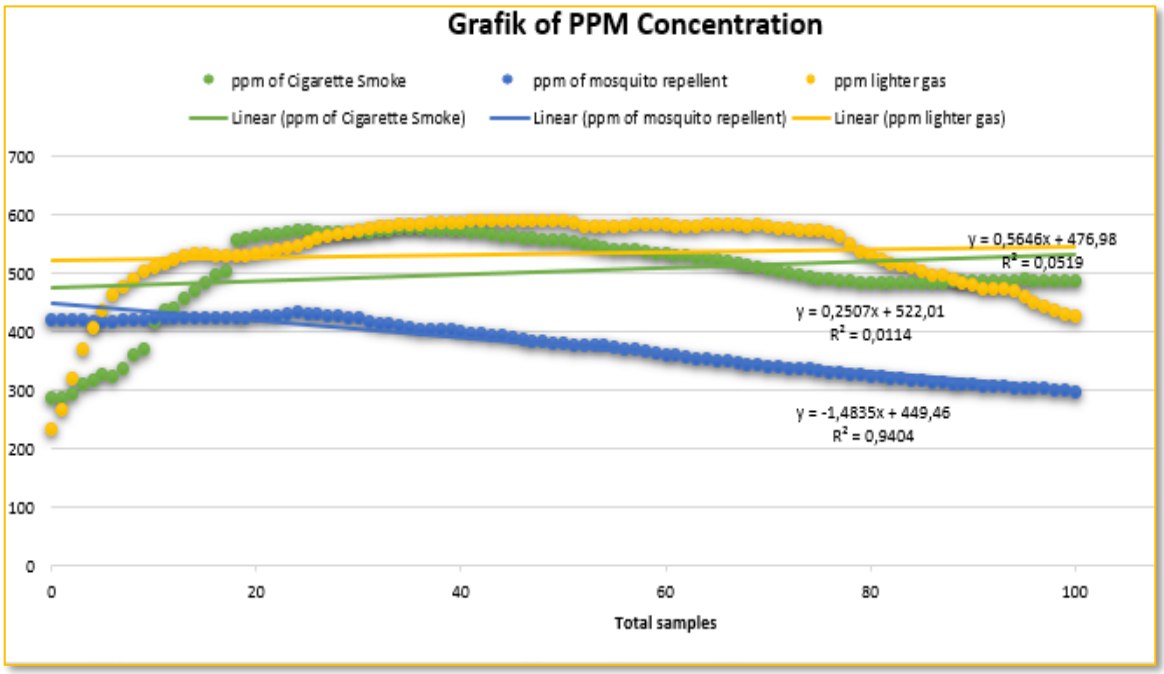

Figure 9. Line Charts of PPM Concentration

CONCLUSION

In this study, we have developed an instrumentation system for detecting cigarette smoke that was developed using an maya instrumentation and a Microcontroller, which has advantages in displaying, processing, and visualizing data in the cigarette smoke detection process. However, further development is still needed regarding the number of sensors that play a role in determining the types of gases in the air.

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