Journal of Technology Informatics and Engineering
Vol 2 No 2 August 2023
e-ISSN :2961-8215;.p-ISSN :2961-9068 Page 18-38
DOI: https://doi.org/10.51903/jtie.v2i3.164

Indoor Air Monitoring and Filtration Using Arduino-Based Plasma Technology

Adi Sofyan
Computer Systems Study Program

Dendy Kurniawan
Computer Systems Study Program

Semarang College of Electronics and Computers
adisofyan29 @gmail.com

ABSTRACT

In public service offices in the government, special areas or rooms are provided for smoking. At the Kendal District Court Class 1B the smoking room or smoking area still uses air ventilation and fans to neutralize cigarette smoke. As a result, the smoke that is exposed to the fan in the smoking room spreads out and disturbs the health of the surrounding community or disrupts the activities of employees at the Kendal Class 1B District Court. In this case, the Kendal Class 1B District Court, especially this smoking area, needs to be handled, namely making a device that can filter cigarette smoke and monitor the condition or level of air quality in the room so that cigarette smoke does not spread outside the room and harm your health. To help the filtration system in smoking rooms, there needs to be an automatic system that is able to work when cigarette smoke in the room is at a certain level. The sensors used to detect levels of CO (carbon monoxidant), CO2 (carbon dioxidant) in cigarette smoke are MQ-7 and MQ-135. The way this tool works, if cigarette smoke in the room reaches the threshold level of gas in the room, the fan will suck it into the filtration room, after which it will be exhaled back into the smoking room and will notify the condition of the room on the LCD monitor display.

Keywords *: Arduino, MQ-135 Sensor, MQ-7 Sensor, Monitoring, Air Filtration, Plasma Technology* **.**

INTRODUCTION

Air is an important factor in life, but with the increasing physical development of cities and industrial centers, air quality has changed. The air that was once fresh is now dry and dirty. Changes in the air environment are generally caused by air pollution, namely the entry of pollutants (in the form of gases and small particles/aerosols) into the air.

Air pollution can be defined as the presence of substances in the air in concentrations sufficient to cause harm to humans, animals, plants or materials. This substance can be gas, liquid or solid particles. There are five types of pollutants in the air, namely particulates with a diameter of less than 10 μm (PM10), sulfur dioxide (SO2), nitrogen dioxide (NO2), carbon monoxide (CO) and lead. Meanwhile, according to PP no. 1 of 1999 Air Pollution itself is the entry or introduction of living things, substances, energy, and/or other components into the ambient air by human activities, so that the quality of the ambient air drops to a certain level which causes the ambient air to be unable to fulfill its function.

Indoor air quality is a problem that needs attention because it will affect human health. The emergence of indoor air quality is generally caused by several things, namely lack of air ventilation (52%), presence of sources of contamination in the room (16%), contamination from outside the room (10%), microbes (5%), building materials (4%), others (13%). Sources of air pollution can also come from household activities in the kitchen in the form of smoke. According to several studies, air pollution originating from the kitchen has made a major contribution to ISPA. (Lanugojaya, 2012)

Sources that cause indoor air pollution include those related to the building itself, equipment in the building (carpet, air conditioning, etc.), building conditions, temperature, humidity, air exchange, and things related to the behavior of the people who live there. indoors, for example smoking. Sources of indoor air pollution can come from synthetic materials and some natural materials used for carpets, foam, wall coverings and household furniture (asbestos, formaldehyde, VOC), can also come from consumer products (furniture polish, adhesives, cosmetics, pesticides/insecticides).

The problem in research at the KENDAL STATE COURT class 1B is that in the smoking room or *smoking area* measuring 2.5 meters x 2 meters and 3 meters high, in a day there are approximately 25 visitors who enter the smoking room to carry out smoking activities, while in terms of room filtration still use air ventilation and fans to neutralize pollution levels from cigarette smoke in the room. Because you still use a fan with air ventilation, the levels of pollutants produced by cigarette smoke can easily spread or escape from the smoking room, causing air pollution outside the smoking room and can disturb people around you. Fans still have shortcomings and are inefficient in terms of neutralizing smoke in a room, because the working principle of a fan is not to filter but to supply wind or blow air to lower the temperature using a wheel or propeller with a motor as the driving force. Fans are still influenced by room temperature. If the temperature is hot, the wind produced will also be hot, whereas if the room temperature is cold, the wind produced will also be cold.

From the explanation above, a problem that arises is the increase in air pollution caused by cigarette smoke or CO2 (carbon dioxide) compounds in the room. This research provides innovation by designing a tool that can read pollution levels in rooms containing cigarette smoke and CO2 and can filter or filter CO2 (carbon dioxide) into O2 (oxygen) by means of ionization from plasma technology, LCD as a display of pollution levels and room conditions as well as LEDs and buzzers as indicators of smoke or pollution in the room.

Based on the problems that have been explained, the author tries to make an indoor air monitoring and filtration tool using Arduino-based plasma technology as a micro controller. This filtration tool uses plasma technology produced from high voltage electric spark that forms a corona discharge or electrostatic discharge caused by fluid ionization. From the corona discharge produced by cigarette smoke that passes through it will bind CO2 (carbon dioxide) molecules to be converted or ionized into O2 (oxygen). It is hoped that the indoor air monitoring and filtration tool with Arduino-based plasma technology will be able to reduce the impact of air pollution in the surrounding environment due to cigarette smoke .

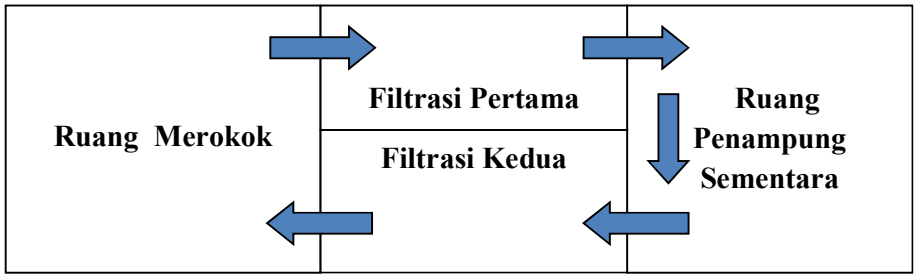

Figure 1.1 Schematic of the Filtration Room

RESEARCH METHODS

1. Filtration

Filtration is the separation of mixtures based on particle size, namely a method of separating substances that have different particle sizes using a porous device (filter). The filter will retain substances whose particle size is larger than the filter pores and pass the solvent through. The result of the filtering is called the filtrate, while the remainder left behind in the filter is called residue (dregs). (Sukajiyah. 2011).

2. Air

a .Air Definition

Air is a mixture of various gases mechanically and is not a chemical compound. Air is a component that makes up the earth's atmosphere, which forms the life zone on the earth's surface. Air consists of various gases in constant levels at the surface of the earth, except methane gas, ammonia, hydrogen sulfide, carbon monoxide and nitrogen oxide which have different levels depending on the region/location. Generally, the concentrations of methane, ammonia, hydrogen sulfide, carbon

monoxide and nitrous oxide are very high in swamp areas or chemical industries. (Gabriel, 2001).

b . Air Pollution Standard Index (ISPU)

Currently, the air quality standard index used officially in Indonesia is the Air Pollution Standard Index (ISPU), this is in accordance with the Decree of the Minister of the Environment Number: KEP 45 / MENLH / 1997 concerning the Air Pollution Standard Index. In this decision, what is used as material for consideration includes: that to provide convenience and uniformity of information on ambient air quality to the public at certain locations and times and as a consideration in making efforts to control air pollution, it is necessary to prepare an Air Pollution Standard Index.

The Air Pollution Standard Index is a unitless number that describes the condition of ambient air quality at a certain location and time based on the impact on human health, aesthetic value and other living things.

The Air Pollution Standard Index is determined by converting measured air pollutant levels into a dimensionless number. The Air Pollution Standard Index range can be seen in the table.

Table 1.1 Information on Air Pollution Standard Index

Index	Category	Color	Information
1 – 50	Good	green	quality level is not have an effect on health human or animal and not effect on plants, building or aesthetic value.
51 – 100	currently	blue	quality level is not effect on health human or animal however effect on plants sensitive and aesthetic value.
101 – 199	not healthy	yellow	Characteristic air quality level detrimental to humans or sensitive animal groups or could cause damage to plants or aesthetic value.
201 – 299	very unhealthy	red	levels that can be detrimental to the health of some exposed segments of the population.
300 – 500	dangerous	black	Dangerous air quality levels which is generally possible serious harm to health in the population.

Table 1.2 Standardization of Gases in Air

Pollutant	Standard	How to calculate
Ozone	0.10 ppm	Maximum assessment 1 hour before the end of 24 hours
Nitrogen Dioxide	0.12 ppm	
Sulfur Dioxide	0.20 ppm	
Carbon Monoxide	9 ppm	Maximum assessment 8 hours before the end of 24 hours
Particles (PM10)	50 ug/m3	Average value 1 hour after 24 hours

3. Plasma Technology

The concept of plasma is the name for ionized gas first proposed by Langmuir in 1928. Plasma naming **This ionized** gas is inspired by blood plasma due to some of the properties of the gas ionized almost like blood plasma.

Early research that led to the discovery of the concept of the third phase four about the material called plasma is Langmuir's research on Atoms and Molecules which he published in 1919. Langmuir continued with his research with Tonks and in 1924. They discovered electron density waves in plasma called Waves Langmuir. Research and study and evaluation of particle dynamics, transport charged particles, thermodynamics and optical properties of cold or frequent plasmas called non-ideal plasma has been done a lot. The results of this research can be provides an understanding of the behavior of matter in the plasma state. Development of research on Plasma from physics, chemistry and assistance aspects Mathematical analytics has been highly developed both theoretically and experimentally. Plasma is not plasma as in the word plasma in biology. The plasma discussed is the fourth substance besides classical substances; solid, liquid and gas

The most common way to make plasma is by utilize electric voltage. For example, face two electrodes in the air free. As we know, air is an insulator, a non-conducting material electricity. However, if the two electrodes are given sufficient electric voltage high (< 10 kV), conductor properties will appear in the air, electricity starts flowing (*electrical discharge*), this phenomenon is also called *electrical breakdown. Electrical breakdown* is a term for electrical failure, breakdown electricity or power failure. This term can mean a disturbance in a circuit electricity. Electrical failure can also mean greatly reduced resistance rapidly in an electrical insulator which causes an electric spark to jump around or along the insulator.

The flow of electric current indicates ionization This results in the formation of ions and electrons in the air between the two electrodes earlier. The greater the electrical voltage applied to the electrode, the more a large number of ions and electrons are formed. The actions - reactions that occur between This large number of ions and electrons creates an air condition between them These two electrodes are neutral, this is the plasma that is formed. We can conclude that plasma is a collection of free electrons, ions and free atoms. An example of the process of plasma formation by nature can be seen in Figure 1.2.

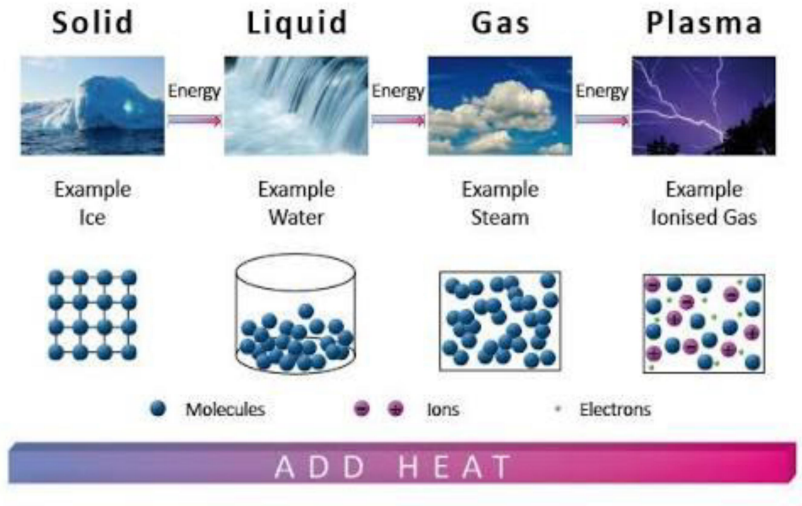

Figure 1.2 Illustration of the fourth phase of matter after the solid, liquid and gas phases

The picture above is that when a solid substance is given heat energy, the substance will change phase to become liquid and given more heat energy, the liquid phase changes to gas, when the gas phase is given heat energy again, the substance changes to plasma.

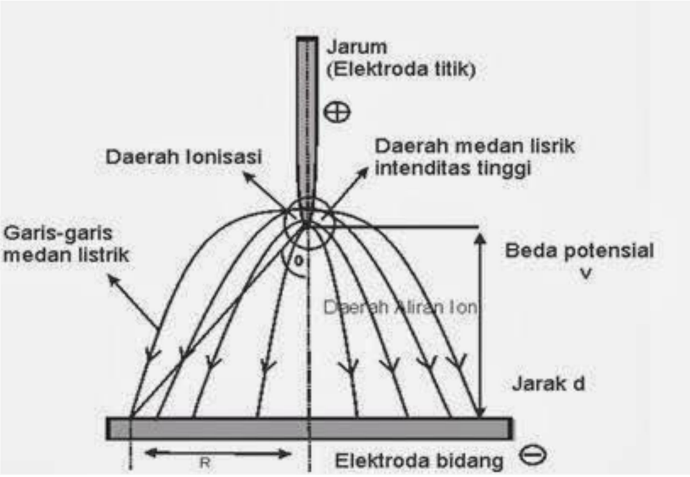

Figure 1.3 Plasma Formation Process

smoke filter device is to produce ozone plasma which will then decompose dangerous contaminants so that the air containing smoke will be clean from dangerous contaminants. Ozone is produced by oxygen passing through an electric shock, causing an excess of electrons in oxygen (O2) and oxygen also becomes plasma ozone (O3).

Types of Plasma:

a. Cold Plasma

Plasma occurs in a state of thermal disequilibrium *(non-thermal equilibrium)* between the temperature of the electrons and the gas. The electron temperature is high but the gas particle temperature is relatively low because the collisions between electrons and gas particles are very small. In cold plasma, ions and neutral atoms or molecules remain at a temperature of around 1000 K. Electrons in this type of plasma have a fairly high temperature of around 50,000 K. Cold plasma is often used in the field of microelectronics, the formation of new materials and cleaning pollutants.

b. Thermic Plasma

This type of plasma is classified as plasma in a state of *non-thermal equilibrium* . Heavy particles in plasma have temperatures higher than 3000 K. Electrons in this thermic plasma have quite high temperatures greater than 10 K. This type of plasma is often used for welding, cutting metal, cleaning pollutants and so on.

c. Hot Plasma

Hot plasma occurs in a state of thermal *equilibrium* . In generating hot plasma, the energy distribution of electrons and gas molecules is close to the same , because the frequency of collisions between electrons and gas molecules is greater. Hot plasma is plasma composed of high temperature gas molecules. This type of plasma has a temperature above 10 K. Hot plasma is used to produce electrical energy.

formation process :

a. Ionization

Plasma is an ionized gas, ionization events always occur plasma formation process. Ionization is defined as the process of removing electrons from an atom or molecule from its bonds. The energy required to remove one or more electrons from their orbits in an atom or molecule can be defined as the ionization energy *E.* The amount of ionization energy is expressed in units of electron-volts (eV).

In a stable state, ionization can occur if the energy of the colliding electron is greater than or equal to the ionization energy of the colliding atom or molecule, which can be written in the equation,

$$\frac{1}{2}m_e v_e^2 \geq eV^i$$

with m is the electron mass, V is the electron speed, e is the electron charge, and V is the ionization potential of the atom or molecule. In the collision process between electrons and gas particles, not only does the ionization process occur but other events also occur. The opposite of the ionization process is the recombination process. Recombination occurs by binding electrons by ions and binding between atoms to form molecules so that they become neutral species or negative ions accompanied by the emission of photons.

b. Dissociation and Excitation

Dissociation is the separation of a molecule into its constituent atoms. These dissociated gas particles can also be ionized into positive ions and negative.

Excitation is an event where electrons are at an energy level lower ones move to higher energy levels by absorbing the energy of the collision with the electron. The opposite event of the excitation is called relaxation or deexcitation and this event is accompanied by the emission of photons. Not all ionized gas is plasma. Plasma must also meet the requirements for density, plasma temperature, Debye length (λ) and energy.

c. Degree of Ionization

The degree of ionization is an important parameter as an internal reference plasma classification. Whatever way to produce plasma, that's great determining the character of the plasma formed is the degree of ionization:

$\alpha\, i = n/(n0 + n)$

with n is the density of charged particles, n is the density particle 0 is neutral. -4

For ionization degrees smaller than 10 , it is classified as a low ionization gas. Above this limit value, the gas can be considered a highly ionized gas.

In low ionized gases, the interactions between particles are binaire interactions. Sometimes due to the lower density of charged particles compared to neutral particles, collisions between charged particles can often be neglected. The dynamics of charged particles is determined by collisions between neutral particle-electrons and neutral-particle ions. In addition, as a result of the mass difference between an electron and a neutral particle, a collision between an electron and a neutral particle without significant energy exchange results in only the direction of the electron's motion changing. So, it can be said that electrons have an equilibrium temperature between each other, namely the electronic temperature T, other ions and neutral particles with almost the same mass have another equilibrium temperature T =T 0 I

In highly ionized gases, interactions between particles play a very important role. Movements of electrons and ions controlled by coulomb forces causing collective effects.

d. Load Balance

Free formation of charge and reduction of charge simultaneously will occur in a gas that is ionized by an electric discharge. In a steady state, the number of N

electrons and N ions is determined by e I by the balance between the two processes above. In ionized gas negative and positive charge densities tend to be the same , so that The entire gas is neutrally charged. Gases that ionize like this are called as plasma, whose charge density can be presented in the following equation:

$\rho \approx \rho e + \rho i$

with ρ is the plasma charge density, ρ is the negative charge density and ρ *e I* is the positive charge density. In a state of equilibrium then $\rho \approx 0$ so $\rho \approx \rho$. *e I* If the electron charge density is the electron charge multiplied by the electron density (*n*) and the positive charge density is the positive ion charge multiplied by *e* positive ion density (*n*) ($\rho \approx en$ and $\rho \approx en$) . If ρ ≈ 0 then $n \approx n$, so that in plasma conditions the electron density *is* the same as the ion density.

Several ways to deal with air pollution:

a. Overcoming Air Pollution Problems With Plasma

Overcoming the problem of air pollution with plasma is nothing new. In 1907 Frederick Cotrell introduced the electrostatic precipitator (EP) to overcome pollution caused by aerosols (airborne waste) from factory smoke resulting from combustion. EP can be used to collect aerosols. The working principle of EP is a combination of the electrostatic field and the ion flow produced by the corona discharge. The working mechanism is that aerosol particles are captured or collected by a flow of ions, then the collection of particles is transported by an electrostatic field and then separated. Now EP is widely used to treat aerosols from factory smoke , including in Indonesia.

b. Electrophoresis

Electrophoresis is the process of separating a particle based on its migration rate in an electric field (Westermier 2004). Technically, electrophoresis is the term given to the speed of charged particles as a result of an electric current being applied. The principle of electrophoresis is that if a charged substance phase is given a potential difference , the phase will move along a continuous medium towards the cathode and/or anode according to the particle charge. This phenomenon is electrophoresis. The basis of electrophoresis is the formation of an inhomogeneity or concentration gradation throughout the system. Electrophoresis is used to separate colloidal particles. Smoke is a type of colloid, namely aerosol, so the molecules can be

separated using this electrophoresis method. Colloids are a form of mixed system whose state lies between solution and suspension (coarse mixture). This colloidal system has distinctive properties that are different from solutions or suspensions. The colloidal state is not a characteristic of a particular substance because all substances, whether solid, liquid or gas, can be made in a colloidal state. The device filters smoke into clean air using an electrophoresis system to separate contaminants such as carbon monoxide (CO) and carbon dioxide (CO2). By flowing electric voltage high will produce ozone plasma. When CO2 passes through ozone plasma, ozone will react with CO2 and bind oxygen molecules to form new compounds, namely ozone (O3) and oxygen (O2), after a few seconds the ozone will turn into oxygen, while carbon undergoes an electrophoresis process. Electrophoresis can also be used to detect the charge of a colloidal system. If the colloid moves towards the positive electrode then the colloid is analyzed as having a negative charge and vice versa, if the colloid moves towards the negative electrode then the colloid is analyzed as a positively charged colloid. (Maironi B, 2017)

4. MQ-7 Gas Sensor

The MQ-7 sensor is a sensor that has high sensitivity to CO gas and the calibration results are stable and long lasting. The MQ-7 sensor is composed of an Al2O3 micro ceramic tube, a sensitive layer of tin dioxide (SnO2), a measuring and heating electrode as a skin layer made of plastic and a *stainless steel mesh surface* . Heating devices (*heaters*) provide the working conditions necessary for sensitive components to work. The heater provides the necessary working conditions for the work of sensitive components. The MQ-7 is made with 6 pins, 4 of them are used to pick up signals, and the other 2 are used to provide heating current. The sensitive layer of MQ-7 sensitive gas component is made of SnO2 with stability, so MQ-7 has excellent long-term stability.

Figure 1.4 Physical Form of the MQ-7 Gas Sensor

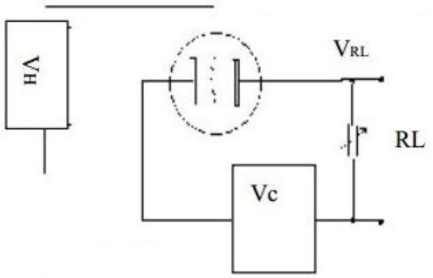

Figure 1.5 MQ-7 Gas Sensor Circuit

As shown in Figure 1.5, the standard measuring current path of the MQ-7 sensitive component consists of 2 parts, the first is the heating current path which has a timer function (high voltage and low voltage work in a circle). The second is the flow path resulting from the signal, this can accurately respond to changes in sensor surface resistance.

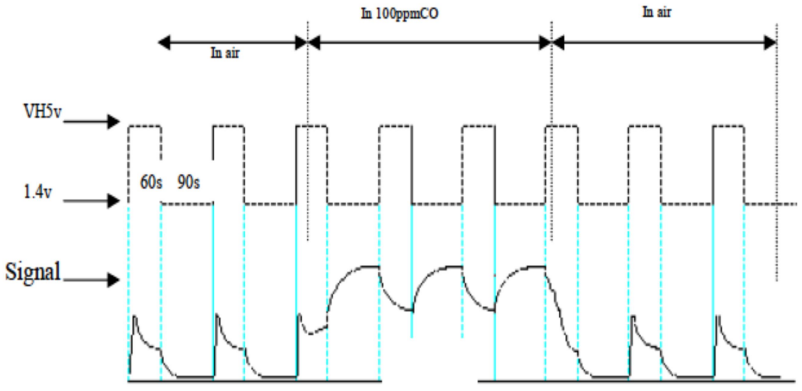

Figure 1.6 Principle of Operation of the MQ-7 Sensor

The surface resistance of the sensor Rs is met through the influence of the resulting voltage signal from the load resistance RL which is wound in series. The relationship between them is described as follows:

$$Rs\backslash RL = (Vc - VRL) / VRL$$

signal when the sensor is shifted from clean air to carbon monoxide (CO), signal measurements are carried out within one or two complete warm-up periods (2.5 minutes from high voltage to low voltage). The sensitive layer of MQ-7 sensitive gas component is made of SnO2 with stability, So, it has excellent long-term stability . The service period can reach 5 years under the conditions of use.

Sensitivity Adjustment The resistance value of MQ-7 is different for different types and different concentrations of gas. So, when using this component, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 200ppm CO in air and use a load resistance (RL) value of approximately 10 KΩ (5KΩ to 47 KΩ). When accurately measuring, the appropriate alarm point for the gas detector should be determined after considering the influence of temperature and humidity. Program Sensitivity adjust:

a. Connect the sensor to the application suite.
b. Turn on the power, keep heating via electricity more than 48 hours.
c. Adjust the resistance load RL until you obtain a signal value that responds to a specific carbon monoxide concentration at the end point of 90 seconds.
d. Adjust another load resistance RL until you get a signal value that responds to the CO concentration at the end point of 60 seconds.

Figure 1.6 shows the situation that can change in the RL signal results measured using the flow path yield signal Figure 1.5 when the sensor is shifted from clean air to carbon monoxide (CO), a measure of the yield signal. (Vega Nataya Kinanti, 2016)

5. Gas Sensor MQ-135

MQ-135 Air Quality Sensor is a sensor that monitors air quality to detect ammonia gas (NH3), sodium-(di)oxide (NOx), alcohol / ethanol (C2H5OH), benzene (C6H6), carbon dioxide (CO2), sulfur gas / sulfur hydroxide (H2S) and smoke / other gases in the air. This sensor reports the results of air quality detection in the form of changes in the analog resistance value at its output pin. This output pin can be connected to pin 6 of the ADC (analog-to-digital converter) on the microcontroller /

analog input pin of the microcontroller by adding just one resistor (functions as a voltage divider).

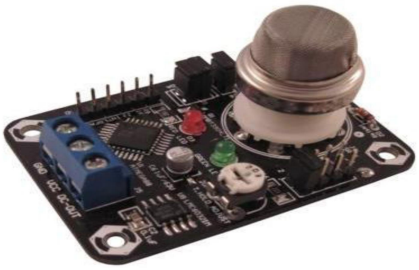

Figure 1.7 MQ-135 Gas Sensor

The following are the MQ-135 Sensor Specifications:

a. The power supply source uses 5Volt voltage.
b. Using ADC with 10 bit resolution.
c. Available 1 control output line ; ON / OFF.
d. Input/Output pins are compatible with TTL and CMOS voltage levels.
e. Equipped with UART TTL and I2C interface.
f. Output indicator instruction signal.
g. Dual signal output (analog output, and TTL level output).
h. TTL valid signal output is low; (low light signal output, which the microcontroller can access the IO port).
i. Analog Output with increasing concentration, the higher the concentration, the higher the voltage.
j. Has long service life and reliable stability. fast response recovery characteristics . (Syahminan, 2018).

RESEARCH METHODS

The author's steps in building a system for detecting and monitoring water turbidity and cleaning water reservoirs using IOT-based Arduino use the R & D or Research and Development method.

Borg and Gall (1983: 772) define research and development. Research and Development is a research method used to produce certain products, and test the effectiveness of these products.

The steps of this process are usually referred to as a cycle R&D, which consists of studying research findings related to the product to be developed, developing the product based on these findings, subjecting it to testing in the setting where it will ultimately be used, and revising it to correct deficiencies discovered in the testing stage. In a program that is stricter than R & D, the cycle is repeated until the test data fields indicate that the product meets the defined behavioral objectives.

The research and development approach is a process used to develop and validate educational products. The research and development approach is often called Research Based Development. Research and development is different from development research (Development Research).

The following is an explanation of the research and development steps according to Borg and Gall:

FOD (*Flowchart Of Document)* System

1. Old System

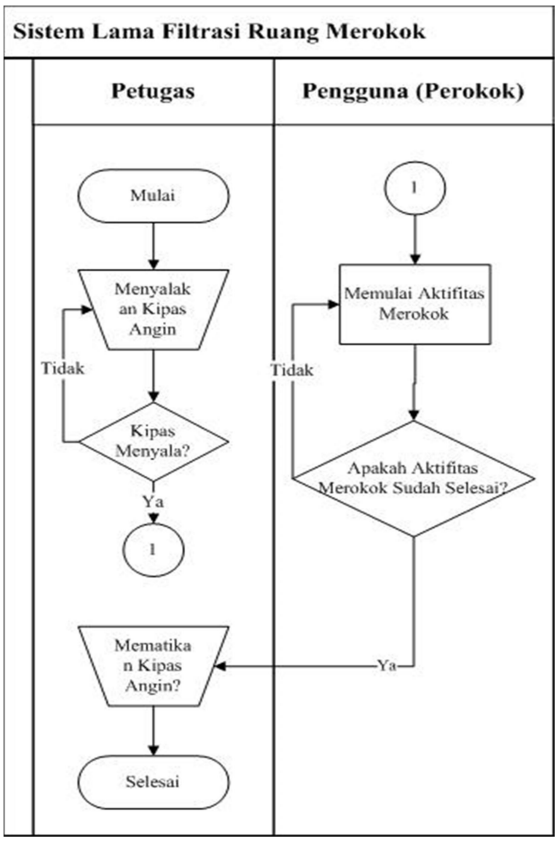

Figure 1.8 *Flowchart Of* Old System Documents

Information:

The officer starts turning on the fan if "YES" the user or smoker starts smoking, if the smoking activity is finished the officer turns off the fan.

2. New System

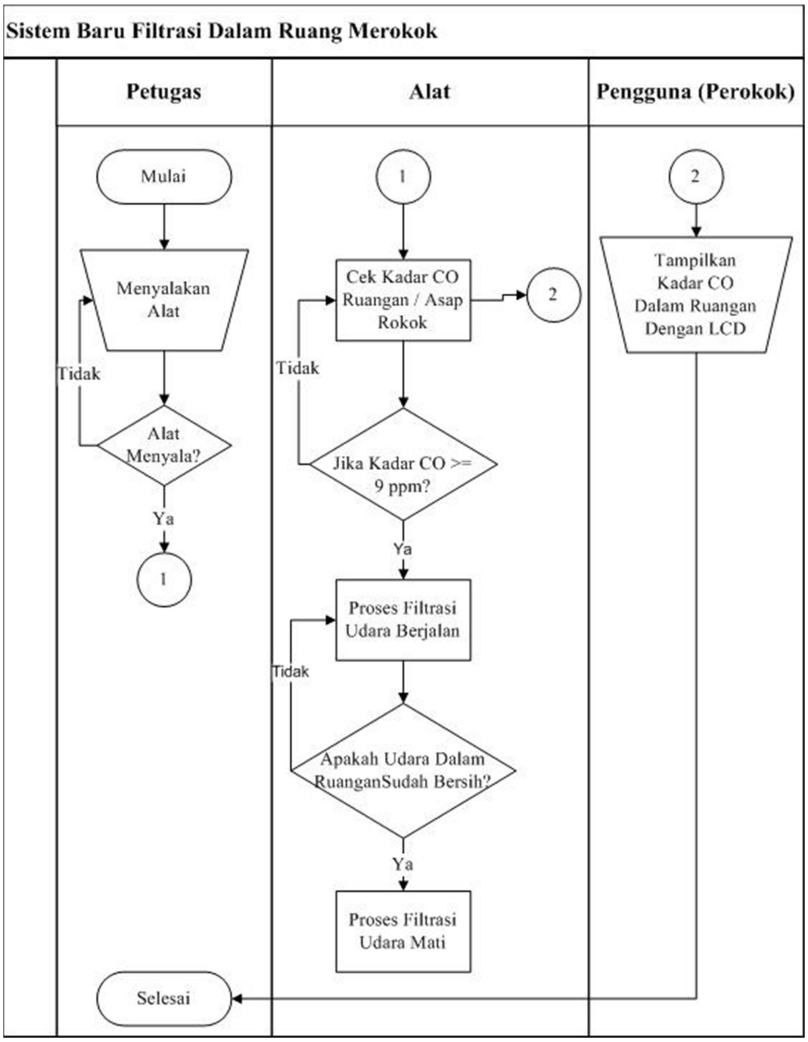

Figure 1.9 New System *Document Flowchart*

Information :

Starting from the officer turning on the tool, the tool starts checking the CO / cigarette smoke levels in the room and displays data on the CO levels in the room on the LCD. If the CO levels in the room are more than 12 ppm then the filtration process is running. After the filtration process, is the indoor air clean from cigarette smoke and CO levels, if "YES" turns off the filtration tool and displays CO level data on the LCD.

RESULTS AND DISCUSSION

Based on the results of research and findings at the Kendal District Court class 1B , the smoking room or *smoking area* in that place does not have a device that can filter cigarette smoke so that the smoking activity carried out causes cigarette smoke to spread outside the smoking room and also cause health problems for workers. in court or local residents . Officers only use fans to neutralize cigarette smoke in the smoking room so that cigarette smoke exposed to the fan will come out through the air ventilation gaps and will pollute the surrounding air. Therefore, the smoking room at Kendal District Court class 1B requires a device that can filter cigarette smoke and works automatically so that it can make the work of officers at Kendal District Court class 1B easier.

Based on the results of research and design on previous information systems, the following is an implementation made in prototype form. Program implementation is the application of a program from the C programming language to the Arduino Uno R3 design .

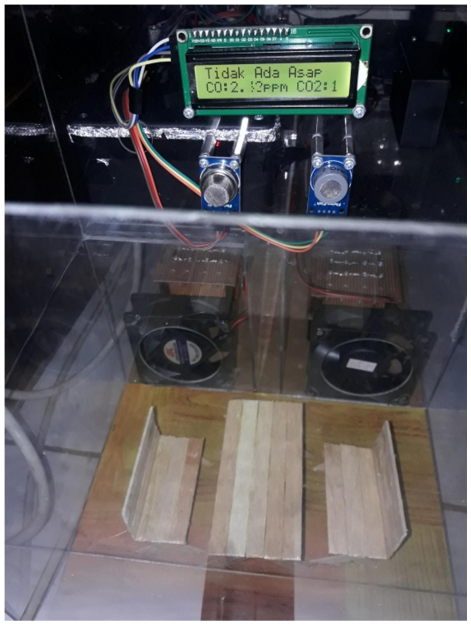

Figure 1.10 Room Testing When There is No Cigarette Smoke

The image above shows the indoor conditions when the ppm level is less than 9 ppm. And the LED light turns green which can be seen in figure 1.11.

Figure 1.11 The LED lights up green when there is no cigarette smoke

a. Room Testing When There is Cigarette Smoke

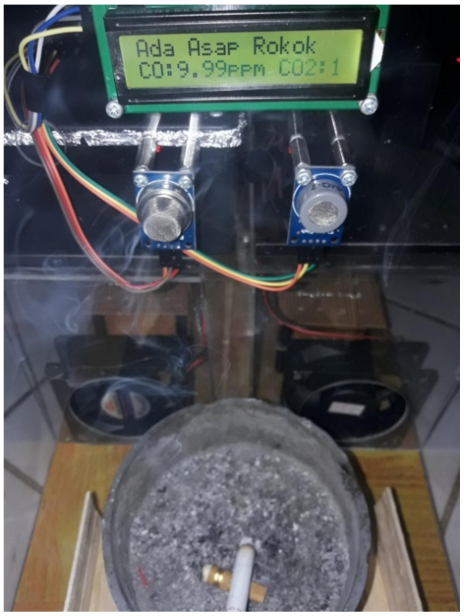

Figure 1.12 Room Testing When There is Cigarette Smoke

The image above shows the condition in the room when the ppm level is more than 9 ppm. It will automatically turn on the fan or *exhaust fan* and will carry out the filtration process by sparking high voltage electricity (corona) as an ionizer of cigarette smoke with electrical power technology which can be seen in figure 1.13 and the red LED can be seen in figure 1.14.

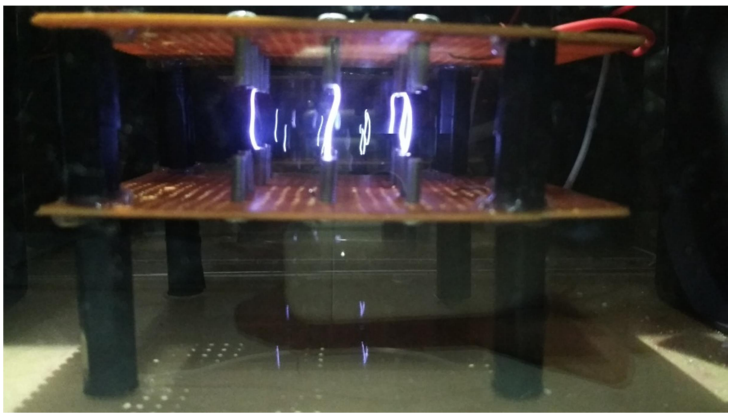

Figure 1.13 Corona Shape During the Filtration Process with Plasma Technology

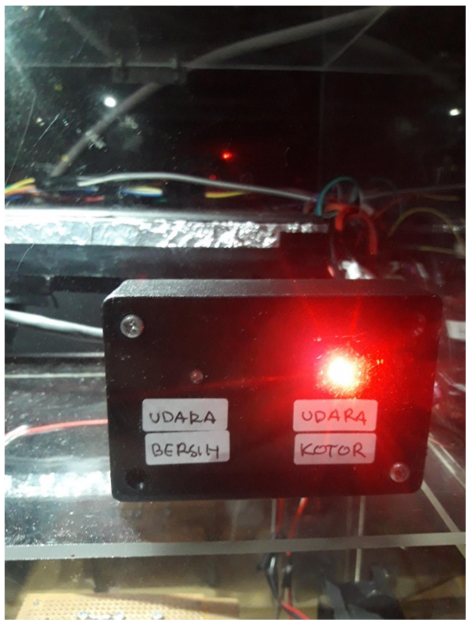

Figure 1.14 The LED lights up red when there is cigarette smoke in the room

CONCLUSION

The research that has been carried out is Air Monitoring and Filtration Using Plasma Technology. In accordance with the research objectives, this tool can detect cigarette smoke in a room that has exceeded the healthy room threshold and can filter cigarette smoke automatically and can provide information in the form of displays in the form of text, LEDs and buzzer sound.

SUGGESTION

From the conclusions above and the system that has been created, several suggestions can be put forward for consideration for further development, namely as follows:

1. From the system that has been designed there are still shortcomings in it. then it can be developed by adding a system that can provide information via smartphone or gadget.
2. Can add odor neutralizer from the cigarette smoke filtration process .
3. Add an oxygen sensor to determine the oxygen level in the room.

BIBLIOGRAPHY

Agung Budi Handoko, et al, 2013; " *Neutralizing Co in Smoking Areas Using Corona Discharge* ", Surabaya: Faculty of Engineering, Department of Electrical Engineering, Sepuluh November Institute of Technology.

Ahmad Muhajir, 2016; *" The Effect of Ignition Timing on Power and Torque in Motorcycles Using Premium Fuel, Pertalite and Pertamax Plus"* , Semarang: Faculty of Engineering, Semarang State University.

Asti Herlina, et al, 2016; *"Software Development Monitoring Information System at the Web-Based Development Stage"* , Bandung : Faculty of Engineering, BSI University Bandung.

Hari Santoso, 2016; *"Practical Arduino Guide for Beginners",* Malang: Elang Sakti,.

Meironi B, 2017; " *Creating a Simulation of Air Filter Equipment Smoke Becomes Clean Air"* , Padang: Faculty of Mechanical Engineering, Padang State Polytechnic.

Moch Subchan Mauludin et al, 2016; *"MQ-2 as an Anti-Cigarette Smoke Sensor Based on Arduino and C Language"* , Semarang: Faculty of Engineering, Wahid Hasyim University,.

Muhammad Nur, et al 2013; " *Application of Plasma Technology to Accelerate Mangrove Seeding as a Green Belt Rehabilitation Effort to Overcome Abrasion* ", Semarang: Faculty of Science and Mathematics, Diponegoro University.

DR. Muhammad Nur, DEA, 2011 ; " *Plasma Physics and its Applications"* , Semarang: UNDIP Press,.

Syahminan, 2018; " *Ammonia Gas Detection Sensor in Broiler Cages Using ATMEGA32 Using MQ-135* ", Malang: Faculty of Science & Technology, Kanjuruhan University, Malang.

Shahwill, Muhammad. 2013; *"Easy Guide to Arduino Microcontroller Simulation and Practice"* . Yogyakarta : Andi Offset,.

Vega Nataya Kinanti, 2016 ; " *Prototype of Cigarette Smoke Filtering in Smoking Areas Using Pulse Width Modulation (PWM) and Fuzzy Logic Tsukamoto Method* ", Kendari: Faculty of Engineering, Halu Oleo Kendari University,.

Victor Farhan Wijaya, 2016; *"Design and Construction of a Gas Monitoring System in the Environment Based on ArduinoKarya"* Lampung: Faculty of Engineering, University of Lampung,.