JURTEKSI (Jurnal Teknologi dan Sistem Informasi) ISSN 2407-1811 (Print)
Vol. XI No 1, Desember 2024, hlm. 45 – 52 ISSN 2550-0201 (Online)
DOI: http://dx.doi.org/10.33330/jurteksi.v11i1.3360
Available online at http://jurnal.stmikroyal.ac.id/index.php/jurteksi

IMPLEMENTATION OF AIR QUALITY DETECTION SYSTEM FOR HEALTHY ENVIRONMENTAL MONITORING

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Abstract: The increasing number of students at STMIK Royal Kisaran has raised the risk of air pollution caused by vehicle emissions, cigarette smoke, and waste burning, particularly around the campus canteen. The campus's location, which is close to a rubber factory and the Sumatra Crossroad, further exacerbates air quality and significantly impacts the health of individuals active at STMIK Royal. This study aims to develop a system that can measure air quality in real-time and detect pollutants in the campus environment. The system utilizes MQ-135 and MQ-2 sensors integrated with a microprocessor to process and transmit data to an IoT-based database. This research employs a qualitative descriptive method to describe the facts and trends based on the available data. The results indicate that air quality is good in the morning, worsens during the afternoon, and improves again in the evening, reflecting increased pollution during periods of heightened industrial and transportation activities. The implementation of this system is expected to contribute to the creation of a healthier environment and raise awareness about the importance of air quality.

Keywords: air quality; campus environment ; IoT; pollution.

Abstrak: Peningkatan jumlah mahasiswa di Kampus STMIK Royal Kisaran telah meningkatkan risiko polusi udara akibat asap kendaraan, rokok, dan pembakaran sampah, terutama di sekitar kantin kampus. Lokasi kampus yang dekat dengan pabrik karet dan jalan lintas Sumatera sehingga memperburuk kualitas udara dan sangat mempengaruhi kesehatan para individu yang beraktivitas di STMIK Royal. Penelitian ini bertujuan mengembangkan sistem yang dapat mengukur kualitas udara secara real-time dan mendeteksi polutan di lingkungan kampus. Sistem ini menggunakan sensor MQ-135 dan MQ-2 yang terintegrasi dengan mikroprosesor untuk mengolah dan mengirim data ke database berbasis IoT. Penelitian ini menggunakan metode deskriptif kualitatif untuk menggambarkan fakta dan kecenderungan dari data yang tersedia. Hasilnya menunjukkan bahwa kualitas udara baik di pagi hari, memburuk di siang hari, dan membaik lagi di sore hari, menunjukkan peningkatan polusi saat aktivitas pabrik dan transportasi meningkat. Implementasi sistem ini diharapkan dapat mendukung terciptanya lingkungan yang lebih sehat dan meningkatkan kesadaran akan pentingnya kualitas udara.

Kata kunci: IoT; lingkungan kampus; kualitas udara; polusi.

INTRODUCTION

Air is a type of natural gas consisting of nitrogen, oxygen, argon, and carbon dioxide, as well as small amounts of other gases such as air, neon, helium, methane, and ozone. Air is a layer of gas that covers the earth and plays an important role in supporting life on earth. Having certain physical and chemical properties, such as air pressure, density, humidity, and the ability to

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influence climate and nutrition, water is the most important substance after water in its very important contribution to life on the earth's surface[1]. Clean air is very important for global human well-being, if the environment is healthy then human health will also be good. Bad air has the potential to have negative impacts on several aspects of the environment, including humans, animals, and plants. Therefore, it is important for us to understand whether the air quality in the environment where we live is suitable or not.

Air has enormous benefits and has a big influence on everyday life because it has the potential to affect the health of humans, animals and other plants, and has a vital role in maintaining life on earth[2]. In addition, healthy air is also important for the life of animals and various plants on Earth.

The location of the STMIK Royal Kisaran campus is very close to a rubber factory and the Trans-Sumatra highway, which results in air pollution possibly increasing because vehicle exhaust fumes are carried by the wind and result in increased air pollution in the STMIK Royal Kisaran campus environment.

Looking at the source (https://www.iqair.com/id/indonesia/north-sumatra/kisaran) the air quality in Kisaran City, Asahan Regency shows a figure of 52 pm which means the air quality shows moderate status, while the healthy air value must be below 50 pm, this shows that air pollution is still very high, therefore it is very important to implement air quality detection tools in the campus environment, especially as explained above, the STMIK Royal Kisaran campus is very close to industrial locations and the Trans-Sumatra highway, the impact of air pollution is increasing very rapidly.

By the increasing number of students of STMIK Royal Kisaran Campus, there is an increase in the volume of incoming air which can increase the risk of pollution. air due to vehicle exhaust fumes, cigarette smoke and smoke from burning garbage around the environment, especially in the campus canteen. Therefore, it is important for us to take steps to improve good air quality around the campus environment, in order to create a healthy environment.

The increasing development and development of the industrial world around the STMIK Royal Kisaran campus will increase the impact of air pollution, this is evidenced by the increasing number of vehicles and industries that use fuel oil, the petroleum that we use in carrying out industrial activities will further worsen the quality of the air we breathe every day. This damage to air quality is caused by various sources, both biological and non-biological sources. Poor air quality is caused by industrial exhaust gases, combustion in vehicle engines such as exhaust fumes are the result of imperfect fuel combustion and contain hazardous substances such as lead (Pb), suspended particles (SPM), nitrogen oxides (NOx), and sulfur oxides (SO2)[3]. Factory smoke and household waste that is burned carelessly without further processing, this has a dangerous impact on human health if it is ignored continuously [4].

In life on earth, air is very important in the human respiratory system, if humans or living things breathe very dirty or unhealthy air, over time diseases such as shortness of breath, pneumonia and many others will arise, in several survey institutions have determined the quality of healthy air to the worst and cannot be inhaled by

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humans. Healthy air in the ideal range is 0 to 50 good, 51 to 100 moderate, 101 to 150 not too healthy or sensitive for certain groups, 151 to 200 unhealthy, 200 to 299 dangerous, above 300 very dangerous. Therefore, we must create a healthy environment so that the body is also healthy[5].

Currently, air pollutants can have a direct impact on human health, either suddenly, acutely, chronically, or chronically with unclear symptoms. Among them are skin rashes, dermatitis, and skin allergies to the emergence of other chronic diseases. The negative impact on health caused by air pollution has a direct impact on society. The impact of air pollution not only affects human health, but also the surrounding environment[6]. Air pollution is defined as an environmental pollution system that has a negative impact on human health, standard of living, or ecosystem function. [7].

Therefore, in an effort to help detect good air quality especially for STMIK Royal Kisaran students, an air quality detection system was created. Namely with a system that can detect air quality around our environment using a microcontroller that is made as simple as possible both from the circuit and how the tool works. This is done so that people who want to use this tool can easily understand this tool, it is hoped that this tool can overcome the problem of air pollution that occurs around us.

According to research[8]entitled "Design of Air Quality Detection Device with IoT (Internet of Things) Using Wemos ESP32 D1 R32" uses the Blynk application to monitor air quality via smartphone. This tool uses the WEMOS ESP32 D1 R32 sensor, MQ-135 sensor to detect CO2 gas, MQ-7 sensor to detect CO gas, and DHT22 sensor to measure temperature and humidity.

Then in the research[9] with the title "Design of Arduino-Based Air Quality Measuring Instrument Using MQ-135 Sensor. This study aims to design an Arduino-based air quality monitoring instrument using the MQ-135 Sensor. This tool is designed to provide real-time air quality information via an LCD board, with the aim that the public can monitor and take preventive measures against changes in air quality around them.

Next in the research[10] entitled "Design and Implementation of User Interface for Air Quality Monitoring System Based on Android Application" Sensor nodes for air quality monitoring are important devices in measuring important parameters that affect air conditions in a particular location.

The purpose of making this tool is to help students know the air quality around the campus environment. Healthy air is very important for human health, especially for students as the next generation. With this tool, students can monitor air pollution levels in real-time, so they can take preventive steps to maintain their health. In addition, this tool can also provide education about the importance of a clean and healthy environment, which ultimately supports the creation of a better quality of life for all parties on the STMIK Royal Kisaran campus.

METHOD

Research methods are the way a particular research will be conducted. The analysis method used in this study is qualitative descriptive analysis. Qualitative analysis method is a research approach used to describe facts and trends carefully based on available data. Meanwhile, descriptive method serves to present qualitative data in detail through de-

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scriptions of research objects, including images, words, or other elements that cannot be analyzed statistically. The data used in this analysis comes from the related research location.

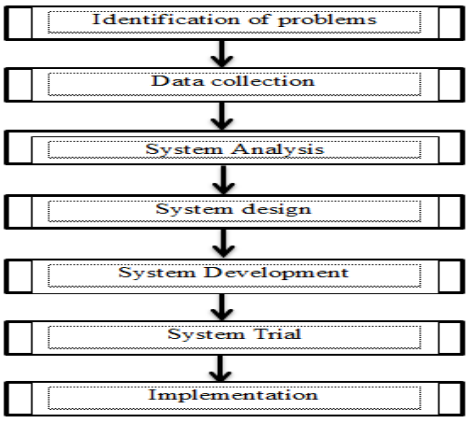

Image 1. Research Framework

At this problem identification stage, the process and results of problem solving or problem inventory are presented. The purpose of this problem identification process is to ensure that the designed system can meet the needs and is able to provide solutions to existing problems. The problem discussed in this study is how to create an air quality detection control system to create a healthy environment.

Data collection a way to find data as a tool that will later be used to analyze problems that arise during the study. To ensure high-quality data, instrument validation and data quality assessment are very important. This time the data collection methods used include library research and observation. During the study, I directly interviewed several students and managed to collect relevant and in-depth data, and obtain more detailed information and understand their perspectives comprehensively.

Conducting analysis of previously collected data. The purpose of this data analysis is to obtain information about the needs of the system to be created so that the system can function properly and partly in accordance with the needs of the air quality detection system to create a healthy environment at STMIK Royal Kisaran. After the results of the analysis process are obtained, the next step is to validate and verify the analysis data to students to ensure that the analysis results are accurate and in accordance with needs, and to show students how the air quality detection tool works.

In the system design stage, the uses UML, block diagrams, context diagrams, electronic flow diagrams, and electronic design specifications. The purpose of this system design process is to meet the needs of end users and provide clear illustrations and comprehensive design guidelines for programmers and other stakeholders.

At this stage, the introduces a new system to replace the old system comprehensively and improve the existing system. Analysis of results and follow-up procedures. Programming language.

This part, the analyzes the developed system to see if the system functions properly, whether the input is accurate, and whether the output is satisfactory. Analysis of the system test results is carried out to evaluate all tasks completed and to increase confidence in all test results related to the system being run. The test is carried out in several predetermined test stages. The review process involves starting a ready-made instrument and evaluating it through several tests to ensure that the instrument is in accordance with its intended purpose.

Implementation is the process of checking the performance of a system. How well the developed system meets the existing requirements, and how well the system meets the anticipated needs, and how the system is implemented. Im-

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plementation is carried out after analysis and research. We understand system implementation as a process that determines whether a system can function properly.

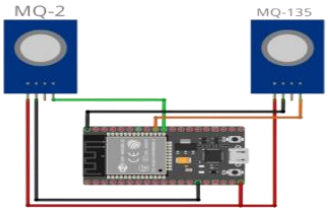

Image 2. ESP32 Configuration With MQ-2 And MQ-135 Sensors

In the configuration of the ESP32 system and the MQ-2 sensor and the MQ-135 sensor in the designed scheme, the MQ-2 and MQ-135 will be connected to the ESP32 via the specified pins. The MQ-2 and MQ-135 sensors will function to detect air and gas around the canteen environment, and the data obtained will be processed by the microcontroller.

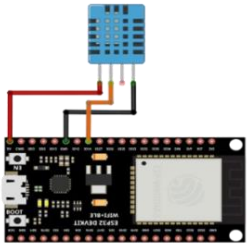

Image 3. ESP32 Configuration With DHT1 Sensor

In the system configuration between ESP32 and DHT11 sensor in the designed scheme, DHT11 will be connected to ESP32 via the specified pin. The DHT11 sensor will detect the temperature and humidity around the canteen environment, and the data obtained will be processed by the microcontroller.

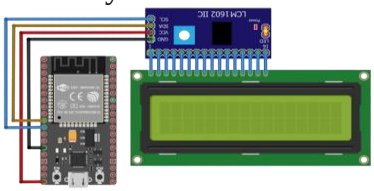

Image 4. ESP32 Configuration With LCD

From the whole circuit, it can be concluded that in the designed system configuration, the MQ-2, MQ-135, DHT11 and LCD sensors are connected to the ESP32 via the specified pins. The MQ-2 and MQ-135 sensors will send the programmed data code, while the DHT11 will detect the ambient temperature and the LCD will display the processed data results.

RESULTS AND DISCUSSION

After the implementation was carried out, the research results were obtained as presented in the description:

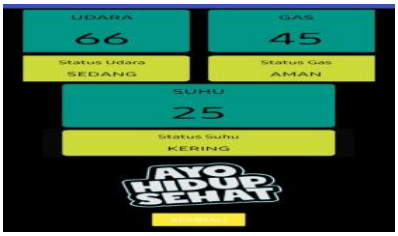

Image 1. Air Quality Detection System Application

This is a view of the air quality detection system application that will be used to monitor air quality in the campus environment, equipped with accurate sensors, an easy-to-use user interface, and the ability to generate detailed reports every day.

Image 2. Air Sensor Testing With Paper Waste Smoke

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The image of an air quality detector in a state of exposure to smoke from burning paper which causes the air sensor value to rise and change the status to bad. As in the application display, this proves that smoke from paper burning waste is also very bad for health.

Image 3. Air Sensor Testing With Cigarette Smoke

After testing using cigarette smoke, the sensor value that initially showed a safe status changed to bad with a value increasing to 905 PM (Particulate Matter). This indicates that cigarette smoke also contributes significantly to increasing air pollution. Thus, it is important to reduce exposure to cigarette smoke in order to maintain healthy air quality and prevent potential negative impacts on health.

Image 4. Temperature Sensor Testing

In the temperature sensor test, the data obtained is that the temperature changes according to the weather conditions around it. This shows that the temperature sensor works consistently.

Table 1. Air and Temperature Sensor Test Results

Air Sensor Testing With Burning Paper Smoke			
Time/Second	Air Sensor	Sensor Value	Status
1	Active	2723 pm	Bad
3	Active	2818 pm	Bad
5	Active	2962 pm	Bad
7	Active	3214 pm	Bad
10	Active	3227 pm	Bad
Air Sensor Testing With Cigarette Smoke			
Time/Second	Air Sensor	Sensor Value	Status
1	Active	541 pm	Safe
3	Active	905 pm	Bad
4	Active	917 pm	Bad
7	Active	934 pm	Bad
8	Active	967 pm	Bad
Temperature Sensor Testing			
Time/Minute	Temperature Sensor	Sensor Value	Status
2	Active	29 C	warm
3	Active	33 C	warm
5	Active	31 C	warm
8	Active	30 C	warm

Table 4. Direct testing of air quality detection devices

Air sensor testing in the morning			
Time/Minute	Air Sensor	Sensor Value	Status
1	Active	45 pm	Safe

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3	Active	55 pm	Moderate
5	Active	47 pm	Safe
7	Active	40 pm	Safe
10	Active	43 pm	Safe
Testing the air sensor during the day			
Time/Minute	Air Sensor	Sensor Value	Status
1	Active	80 pm	Moderate
2	Active	84 pm	Moderate
6	Active	103 pm	Bad
8	Active	90 pm	Moderate
11	Active	96 pm	Moderate
Air sensor testing in the afternoon			
Time/Minute	Air Sensor	Sensor Value	Status
1	Active	62 pm	Moderate
3	Active	76 pm	Moderate
4	Active	50 pm	Moderate
7	Active	58 pm	Moderate
10	Active	48 pm	Moderate
Morning temperature air sensor testing			
Time/Minute	Temperature Sensor	Sensor Value	Status
1	Active	23 C	Cold
4	Active	24 C	Cold
6	Active	23 C	Cold
8	Active	23 C	Cold
Temperature sensor testing during the day			
Time/Minute	Temperature Sensor	Sensor Value	Status
1	Active	37 C	Warm
3	Active	36 C	Warm
6	Active	38 C	Warm
8	Active	35 C	Warm
Temperature sensor testing in the afternoon			
Time/Minute	Temperature Sensor	Sensor Value	Status
1	Active	30 C	Warm
4	Active	31 C	Warm
8	Active	32 C	Warm
10	Active	31 C	Warm

CONCLUSION

This system successfully measures pollutants with high accuracy, provides real-time data useful for environmental analysis, and helps prevent negative impacts on human health. And air quality detectors make it easier for us to monitor the air quality in our environment so that we can know and make decisions easily

in handling it.

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