Simple LoRa Protocol as a Communication System for Monitoring Levels of Toxic Gas at Coal Mining in Village Kuripan Mountain Ogan Komering Ulu

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Abstract. Currently, the mineral mining industry and energy sources have been carried out almost all over the world, and currently the process of monitoring gas levels in coal mines is carried out mostly using manual methods such as having someone sent or assigned to check the condition of the mine in several parts. Based on observations, it is known that the monitoring system carried out is still very simple and quite time consuming and can endanger a person's life. Based on this, the problem in designing this system is whether the existing gas level monitoring system can minimize time effectively and efficiently, and how is the gas level monitoring system that can minimize time to be effective and efficient, the design of this tool focuses more on the effectiveness and time efficiency of the gas level monitoring system in coal mines.

Recent advances in technology have been used by humans with the aim of simplifying a job. Sensor technology is one of these advances. Therefore, the authors are interested in designing a gas level monitoring system in IOT-based coal mines. The aids that can detect gas levels in the coal mine are the MQ-2 and MQ-7 sensors. Furthermore, the sensor will display the gas content contained and detect gas levels for each sensor. So with the Internet of things technology, it can speed up the process of setting the length of the protocol that will be received, so that it can increase production results.

Keywords: Artificial Intelligence · Electronic Components · Sensor and Transducer · Internet of Thing · LoRa System

1 Introduction

Mining is an activity in the context of extracting and processing resources to extract minerals and energy sources that are stored under the ground that we walk on. Such as coal, oil, gold, lime, and so on [1, 2]. Currently, the mineral mining industry and energy sources have been carried out almost all over the world, and currently the process of monitoring gas levels in coal mines is carried out mostly using manual methods, such as someone being sent or assigned to check the condition of the mine in several

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parts. Miners have a duty to report mine conditions in real time, this method is very time-consuming and ineffective.

Lack of supporting system facilities for monitoring gas levels in coal mines. Based on observations, it is known that the monitoring system carried out is still very simple and quite time consuming and can endanger a person's life. Based on this, the problem in designing this system is whether the existing gas level monitoring system can minimize time effectively and efficiently? What is the gas level monitoring system that can minimize time to be effective and efficient? The design of this tool focuses more on the effectiveness and time efficiency of the gas level monitoring system in coal mines. Recent advances in technology have been used by humans with the aim of simplifying a job. Sensor technology is one of these advances. Therefore, the authors are interested in designing a gas level monitoring system in IOT-based coal mines. The aids that can detect gas levels in the coal mine are the MQ-2 and MQ-7 sensors. Furthermore, the sensor will display the gas content contained and detect gas levels for each sensor. After this sensor knows the result, it will be sent to LoRa communication and from Lora Communication it will be sent to an Android-based application to see the results. For the purpose, and improve the existing monitoring and communication system in the mining area, and to achieve the desired time-efficient effectiveness, a supportive system is needed. An IoT-based monitoring system where this system can make it easier for workers to send data on mining conditions in real time. From these problems, LoRa technology assistance or a wireless network for the Internet of things is needed. Internet of things is a concept or program where an object has the ability to transmit or transmit data over a network without using the help of computer and human devices. The development of IoT can be seen from the level of convergence of wireless technology, micro electro mechanical, internet, and Quick Responses Code. IoT is also often identified with Radio Frequency Identification as a method of communication. So with this LoRa technology, it can speed up the process of setting the length of data information transmission, so that you can immediately find out the presence of toxic gases in the area. The tool will work optimally if the distance between the transmitter and receiver is less than 900 m, at a distance of 900 meters–1.2 km Lora still receives data but not optimally because there is a delay caused by blocking objects, such as cars, trees, and others, The tool will work optimally if there are no obstacles and in a high and straight place [3–5].

2 Design System

This paper, for design consists of several steps, namely the manufacture of electronic parts and mechanical parts. Each step is carried out step by step, but each stage must be related to one another so that there is a match between one material and another so that it can get good results as expected.

The planning and design steps consist of electronic design and mechanical design. Electronic design is the design stage in the form of compiling the required circuits. While the mechanical design is the design of the tool frame so that it is shaped according to the desired tool design with predetermined sizes.

Block diagrams are part of the planning of a tool, because this block diagram can know how the circuit works, so that the block diagram will produce a system that can be functioned or can work according to the plan (Figs. 1, 2, and 3).

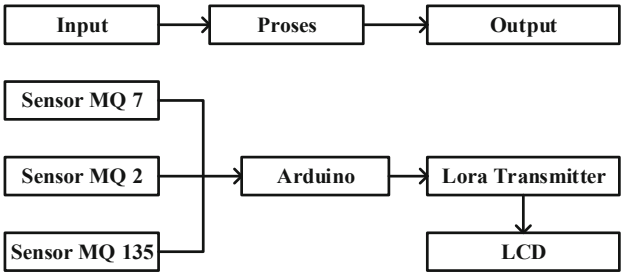

Fig. 1. Digram Block Simple LoRa Protocol as a Communication System for Monitoring Levels of Toxic Gas at Coal Mining In Village Kuripan Mountain Ogan Komering Ulu

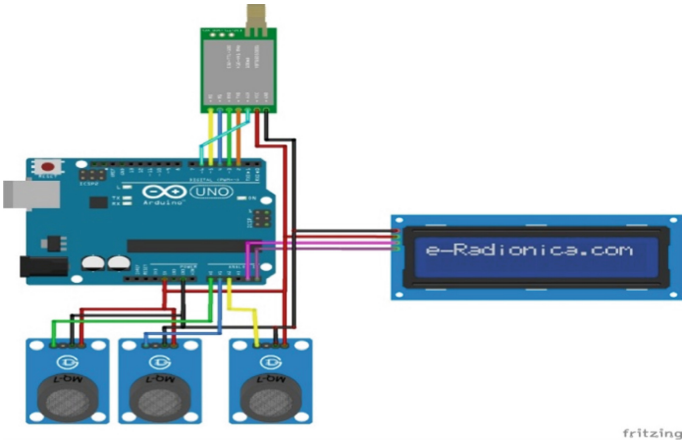

Fig. 2. Schematic of the circuit on trasmitter side

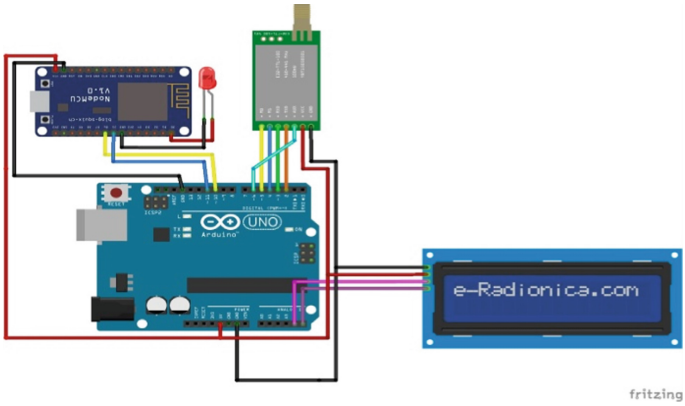

Fig. 3. Schematic of the circuit on trasmitter side

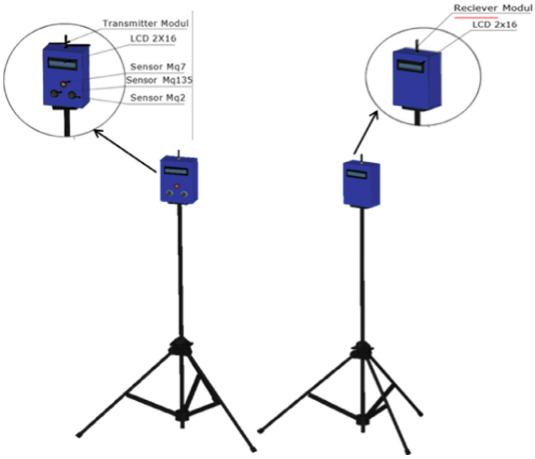

Fig. 4. Design of monitoring toxic gases on the transmitter and receiver sides of a coal mine. Internet of Things Based

Before taking data, the researcher will describe the results of the design of a tool for monitoring toxic gases on the transmitter and receiver side, then to find out the results of a tool whether the designed tool can work well and see the interaction on the software that has been programmed. Then the next step that must be done is to test and analyze and find out the results of the tool testing. The design of Lora Software as a monitoring system for toxic gas levels in coal mines Based on the Internet of Things used is 18650 battery, NodeMCU ESP8266, Arduino Uno, mq-2 sensor, mq-7 sensor, mq-135 sensor, 16×2 LCD, while the software used is MIT App Inventor. The following is an overview of the tools for monitoring toxic gases on the transmitter and receiver sides of a coal mine. Internet of Things Based (Fig. 4).

3 Current Result

Testing on the device this time Regarding Monitoring Toxic Gas Levels Using Arduino Uno as a Microcontroller with sensors mq-2, mq-7, and mq-135 as a toxic gas detector which is connected to the LoRa Transmitter, then it will be sent to the lora receiver and processed on the NodeMcu then the received data is sent to AdaFruit.io which is connected to the MIT App.

In the graph below (Fig. 5) there is experimental data on the mq-2 sensor on several samples where the y-axis is the PPM value detected by each gas sample and the X-axis is a description of the length of time the gas is detected by the sensor, from the graph it can be analyzed that the mq-2 sensor is sensitive to LPG gas and coal smoke because this sensor has been calibrated on LPG/Methane gas according to the mq-2 sensor datasheet.

In the graph below (Fig. 6), there are experimental data on the mq-7 sensor on several samples where the y-axis is the PPM value detected by each gas sample and the X-axis is a description of the length of time the gas is detected by the sensor, from the graph it can

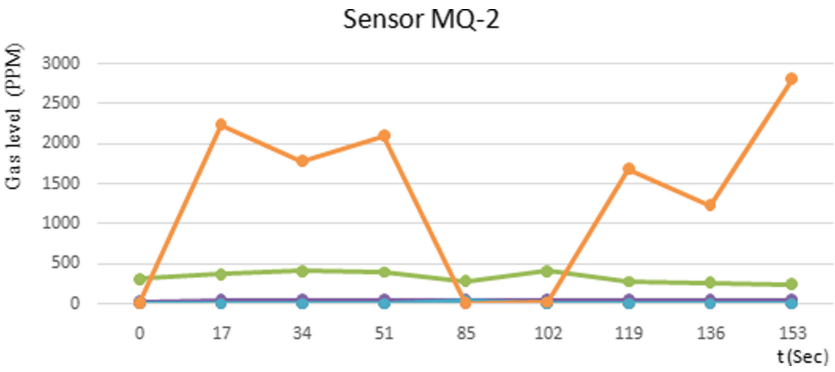

Fig. 5. Sensitivitas MQ-2 sensor

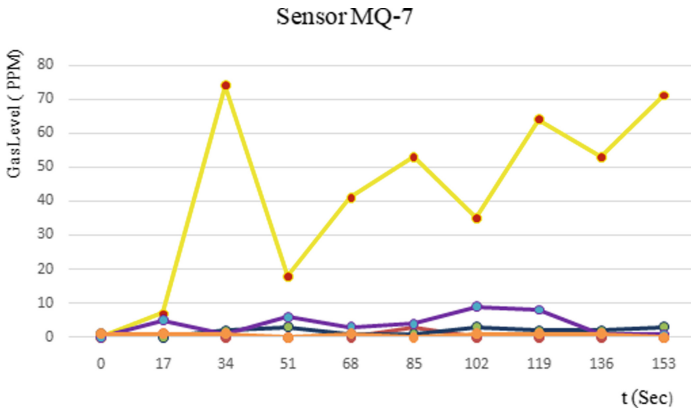

Fig. 6. Sensitivitas MQ-7 sensor

be analyzed that the mq-7 sensor is sensitive to plastic smoke and paper smoke because this sensor has been calibrated on CO gas according to the mq-7 sensor datasheet.

In the graph above (Fig. 7) there are 5 samples that have been tested for their concentration at a predetermined time, from the graph it can be analyzed that the mq-135 sensor is sensitive to coal smoke, plastic smoke, and paper smoke because the mq-135 sensor has been calibrated on gas. CO2 is in accordance with the mq-135 sensor datasheet, the gas measured during testing is relatively up and down due to natural factors such as wind and others.

If the PPM of the gas rises and has reached the Danger Level depending on the sensitivity of each sensor that has been calibrated previously based on the Sensor DataSheet and the PPM level of each gas, a "WARNING" image will appear on the MIT application as shown in Fig. 8.

When the device detects high gas levels, the gas ppm results will be read and the graph on the Feed Sensor in Ada Fruit will increase and the gas PPM data will be read on the MIT application and a notification appears on the Android screen "DETECTED HAZARDS" as shown in Fig. 9.

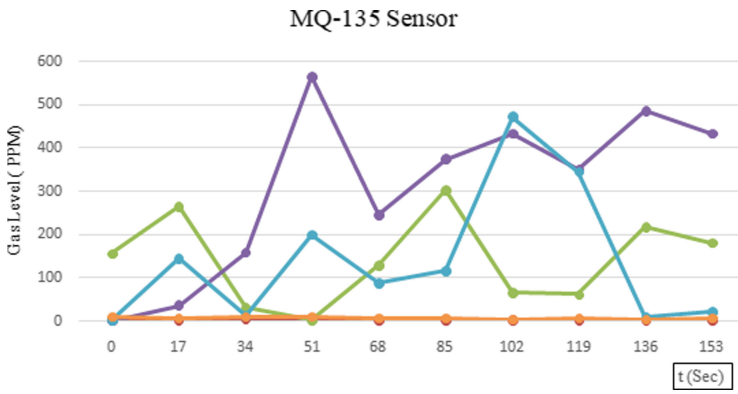

Fig. 7. Sensitivitas MQ-135 sensor

Fig. 8. Polluted air condition

Next, the results of the LoRa test will be displayed, which will explain the analysis of the range between the LoRa Transmitter and the LoRa Receiver, the test is carried out by sending mq2, mq7, mq-135 sensor data from the transmitter to the receiver in several locations on Jalan Demang Lebar Daun Palembang. For a distance of 0 m–200 m is carried out from the RSIA Bunda Noni point (red pin) - the yellow line pin point, a distance of 200–400 m is carried out on the red line pin, the 600 m distance testing is carried out on the Pink pin, the 800 m distance testing is carried out on the Blue pin, 1 km distance is done on the Purple pin, the distance of 1.2 km is done on the Green pin, form more please details can be seen Fig. 10.

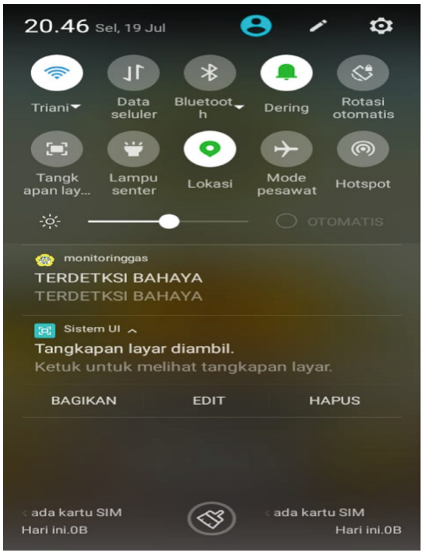

Fig. 9. Notification at LoRa Application

Fig. 10. Test Point LoRa Application

4 Conclusion

In the Toxic Gas Detection Test, the MQ-2 gas sensor is detected in the 200–5000 PPM range so that if it exceeds 2000 PPM it will display a WARNING image and DANGER notification on the application, then the MQ-7 gas sensor detected is in the 0–100 range. 10 (Safe Air) 10–200 PPM (Hazardous Air), MQ-135 Gas detected is in the range 0–350 (Safe Air) 350–700 (Dangerous Air).

In the application, users can monitor gas levels whether they are still in a safe or dangerous level by looking at the application display if the PPM increases and has reached the danger level depending on the sensitivity of each sensor and gas, a “WARNING”

image will appear on the application, and a notification will appear on the application. Android "DANGER DETECTED" screen.

On several samples such as coal smoke, plastic smoke, paper smoke, and LPG gas, this test is also carried out with a period of several minutes on each sample, if the detected gas value is consistent then the PPM on the sensor will increase on the LCD display, simultaneously when the tool is triggered with some of these samples, the position of the Smart Phone is connected to the Hotspot in the NodeMCU Program on this tool that uses the MIT Application, data sent to Adafruit enters every 17 s.

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