Monitoring distribution system of carbon monoxide and surface ozone based on GPS and microcontroller

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Abstract. Jakarta is the most populous city in Indonesia. This is directly proportional to the increasing number of motorized vehicles in Jakarta. The number of Jakarta motorized vehicles causes air pollution in Jakarta to become uncontrollable. Air pollution is the presence of one or more physical, chemical or biological substances in the atmosphere in an amount that can endanger the health of living things. Ozone and Carbon Monoxide, including dangerous elements that exist in air pollution. Ozone is a pollutant that causes significant respiratory disease. Carbon Monoxide is dangerous because it can form compounds with Hemoglobin to form HbCO, and this is toxic to the blood. We can find out the quality of the air somewhere, through the content of Ozone and Carbon Monoxide in the area. At present the number of Ozone and Carbon Monoxide gauges in Indonesia is still small, so that not all regions have been monitored for air quality conditions. The purpose of this design is to determine the level of air quality and to monitor ozone gas and carbon monoxide automatically based on Global Positioning System (GPS) and portable. This system was built using Arduino Mega 2560 (used as a controller), ozone sensor, Carbon Monoxide gas sensor and GPS (used as a timing and determinant of location). Programming is done using the Arduino IDE application. The measurement results are stored using a microSD Card, and displayed on the LCD. This system can inform the condition of air quality in an area, because this tool is portable (can be carried anywhere), in real time and data generated every second.

1. Introduction
The Meteorology Climatology and Geophysics Agency (BMKG) is a government agency tasked and responsible for meteorology, climatology and geophysics (MKG). BMKG is a representative of the Indonesian government in the World Meteorological Organization (WMO) to conduct monitoring of air quality which is part of the WMO program. In accordance with Law of the Republic of Indonesia No. 31/2009 concerning MKG, the implementation of BMKG tasks consists of observation, data management, services, research, engineering, development and international cooperation. Climatology observations include climate and air quality. Observation of air quality includes particulate matter, sulfur dioxide, nitrogen dioxide (NO), nitrogen dioxide (NO2), ozone (O3), carbon monoxide (CO), and KAH composition. Observation of air quality is needed in the process of monitoring air pollution because air is an important environmental component in life.
Air pollution in the unhealthy to dangerous category after ISPU can interfere with the health of living things or harm aesthetic values (Satra, Ramdan. 2016). Ozone and carbon monoxide, including dangerous elements that exist in air pollution. Ozone is a very reactive form of oxygen. A pale blue gas that is poisonous, with a pungent odor similar to chlorine and strong oxidizing properties, can form naturally or be caused by human activity. In the higher layers (stratospheric layers with higher ozone concentrations, 2 to 8 ppm), ozone is a good thing because it helps prevent harmful ultraviolet rays from reaching the earth's surface. But when the same ozone is on the surface of the ground, ozone becomes a serious respiratory hazard.

Carbon monoxide is a gas that is difficult to detect because it has no color, odor, taste, and also does not stimulate (Sarifuddin et al., 2016). Though this gas is very dangerous for health. At low levels can cause shortness of breath and pale. At higher levels can cause fainting and at levels greater than 1,000 ppm can cause death. In an effort to anticipate changes in air quality due to the influence of ozone and carbon monoxide, instruments need to be able to measure the concentration of the gas directly in the field and provide accurate values for further analysis. Research related to the "Monitoring Distribution System of Carbon Monoxide and Surface Ozone Based On GPS and Microcontroller" is expected to be able to support air quality observation activities and facilitate direct observation in the field due to its portable model.

2. Methodology

2.1. Diagram Block
This design uses Arduino Mega 2560 with 3 (three) inputs and 2 (two) outputs. The following picture is from the Diagram Block. Figure 1 explains various information. Arduino Mega 2560 as the control center. Ozone sensor, Carbon Monoxide sensor and GPS are input (input) into the Arduino Mega 2560. The microcontroller outputs 2 (two) outputs. Two outputs issued are MicroSD Card which functions as data storage and OLED Display which functions as a direct display of the results of this microcontroller processing.

![Diagram Block](image)
2.2. Schematic Design
This system circuit schematic contains the relationship picture of the sensor and several other supporting electronic components that make up the acquisition system. The overall circuit scheme is created using the Fritzing application.

![Figure 2. Schematic Design](image)

The circuit schematic in Figure 2 above shows several electronic components, namely the MQ-7 sensor, MQ-131 sensor, 128x64 OLED LCD display I2C 0.96, and the LiPo Syma X8 battery connected to the Arduino Mega 2560 microcontroller. RTC DS3231 for processing timing and GPS for the location. The microcontroller is also connected to the MicroSD card as a data storage. The sensor readout output is displayed in real time on the OLED display.

3. Result and Discussion
Air quality standards in Indonesia are regulated in the Decree of the State Minister for the Environment Number: KEP 45 / MENLH / 1997 Concerning Air Pollution Standards Index. In the decision, which are used as considerations include: that to provide convenience from the uniformity of ambient air quality information to the community at a certain location and time as well as a material in making efforts to control air pollution it is necessary to compile an Air Pollution Standard.

Instrument testing and data collection are done in public places. The author chose a terminal and an electric train station as a place of research. The selected time is a busy time from human activities. Data collection was carried out at each place for 3 hours.

![Figure 3. Results of CO concentration in Pondok Ranji Station](image)

Figure 3. shows the results of observations of CO concentrations at Pondok Ranji Station. Observations were made for 3 hours at 11.00 - 14.00 WIB. The average measurement results obtained are 47.76 ppm. Based on the Air Pollution Standard Index that has been regulated by a Ministerial Decree, the measurement results above are still relatively healthy because the measurement results are
still below 50 ppm. There are several times the measurement results show values above 50 ppm. it is still a normal category because at that time there were many human activities that spurred the use of motorized vehicles that affected the environment as measured by this instrument

![Concentration of Ozone in Pondok Ranji Station](image)

**Figure 4.** Results of Ozone concentration in Pondok Ranji Station

Figure 4. shows the results of observations of Ozone concentrations at Pondok Ranji Station. Observations were made for 3 hours at 11.00 - 14.00 WIB. The average measurement results obtained are 2.65 ppm. Based on the Air Pollution Standard Index that has been regulated by a Ministerial Decree, the measurement results above are still relatively healthy because the measurement results are still below 50 ppm

![Concentration of CO in Lebak Bulus Terminal](image)

**Figure 5.** Results of CO concentration in Lebak Bulus Terminal

Figure 5. shows the results of observations of CO concentrations at Lebak Bulus Terminal. Observations were made for 3 hours at 15.00 - 18.00 WIB. The average measurement results obtained are 48.13 ppm. Based on the Air Pollution Standard Index that has been regulated by a Ministerial Decree, the measurement results above are still relatively healthy because the measurement results are still below 50 ppm. There are several times the measurement results show values above 50 ppm. it is still a normal category because at that time there were many human activities that spurred the use of motorized vehicles that affected the environment as measured by this instrument.
Figure 6. Results of Ozone concentration in Lebak Bulus Terminal

Figure 6. shows the results of observations of Ozone concentrations at Lebak Bulus Terminal. Observations were made for 3 hours at 15.00 - 18.00 WIB. The average measurement results obtained are 2.67 ppm. Based on the Air Pollution Standard Index that has been regulated by a Ministerial Decree, the measurement results above are still relatively healthy because the measurement results are still below 50 ppm.

4. Conclusion

The results that have been reached and the conclusions that can be drawn from this study are as follows. Instrumentation system has been running well. OLED Display has successfully displayed measurement results, GPS coordinates and time. Based on Ozone and Carbon Monoxide values, the air quality at Pondok Indah Terminal is still in the HEALTH category. Based on Ozone and Carbon Monoxide values, the air quality at Pondok Indah Terminal is still in the HEALTH category.

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