



Visualization of Balikpapan City Air Quality Clustering and Forecasting Using The Backpropagation Object Clustering Method And Artificial Neural Network Forecasting

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ABSTRACT

Air quality plays an important role in creating good climatic conditions. Air quality also has a big influence on people's health, air quality that is full of pollution will certainly have a bad impact on health. Some parameters that support air quality monitoring are PM10, SO₂, NO₂, and CO. Air quality needs to be monitored regularly to determine whether parameters exceed quality standards or not, based on Minister of Environment and Forestry Regulation No. 14 of 2020 concerning Air Pollution Standard Index and Air Pollution Control. Government agencies have carried out air quality monitoring which is usually provided in reports and most of the results are not published, so that sometimes people do not know the condition of the air quality around their environment. One tool for evaluating air pollution levels that is quite effective with information that is comprehensive, easy to understand and can be used by the public is the Air Pollution Standards Index (ISPU). Therefore, a monitoring system through visualization of air quality is needed to determine the level of pollutants in the area. An artificial neural network is a Neural Network configured for certain applications, such as pattern recognition or data classification, and then refined through a learning process. The output of this research it was found this value is still in the class 1 range. Then the prediction results for the air NO₂ (Nitrogen Dioxide) parameters at the end of 2023 were obtained at 71.32. which means the air in Balikpapan city is still in the good category.

Keywords: ISPU, Monitoring, Air Quality, Pollutants, Neural Network.

1. INTRODUCTION

The increase in the number of industries, such as mining companies in East Kalimantan and population density has resulted in the waste being produced. The resulting waste is disposed of through an air funnel or directly into the combustion chamber. This can result in decreased air quality in the environment. The impact of poor air quality will also have a direct effect on the surrounding environment and the people who live around it. The number of people suffering from shortness of breath due to bad air around where they live is also very high. Balikpapan City has an environmental agency to monitor pollutant levels, especially in Balikpapan City. Air quality plays an important role in the process of processing oxygen in the air. Some parameters that support air quality monitoring are PM10, SO₂, NO₂, and CO. Air quality needs to be monitored, periodically to find out whether parameters exceed quality standards or not, based on Minister of Environment and Forestry Regulation No. 14 of 2020 concerning Air Pollution Standard Index and Air Pollution Control. Government agencies have carried out air quality monitoring which is usually provided in reports and most of the results are not published, so that sometimes people do not know the condition of the air quality around their environment.

Therefore, a monitoring system through visualization of air quality clustering is really needed to determine the level of pollution. An artificial neural network is a neural network configured for certain applications, such as

pattern recognition or data classification, and then refined through a learning process [1]. The learning process that occurs in biological systems involves adjusting the synaptic connections that exist between neurons. In the case of a Neural Network, adjusting the synaptic connections between neurons is carried out by adjusting the weight values that exist for each connectivity from both input, neuron and output [2].

Based on the description of the problem above, this research aims to determine air quality through a quality index monitoring system and be able to predict air quality in the future in that place, so that the benefits will be felt by local residents and industry, namely becoming more aware and caring more about the air in the area, the environment. The aim of this research is to determine the value and feasibility of air quality parameters in Balikpapan as well as air quality pollution control strategies. The urgency of this research looks at air quality in Balikpapan City which is influenced by the increase in industry and vehicle volume, so there is a need for innovation in monitoring air quality digitally and supporting Balikpapan City to become a Smart City.

2. METHODS

This research was carried out in Balikpapan City. This research was carried out from July to September 2023. The data used was air quality data from the Balikpapan City Environmental Service. Air quality data from 2015 to 2022. The following are the stages in the research method:

2.1 literature Study

The literature study aims to collect data before carrying out the research, including assessing the novelty of this research. At the literature study stage, it was found that this research would provide great benefits for academics and stakeholders related to the need for air quality data in Balikpapan City.

Kategori	Rentang	Penjelasan
Baik	0-50	Tingkat kualitas udara yang tidak memberikan efek bagi kesehatan manusia atau hewan dan tidak berpengaruh pada tumbuhan, bangunan atau nilai estetika.
Sedang	51-100	Tingkat kualitas udara yang tidak berpengaruh pada kesehatan manusia ataupun hewan tetapi berpengaruh pada tumbuhan yang sensitif, dan nilai estetika.
Tidak sehat	101-199	Tingkat kualitas udara yang bersifat merugikan pada manusia ataupun kelompok hewan yang sensitif atau bisa menimbulkan kerusakan pada tumbuhan ataupun nilai estetika.
Sangat tidak sehat	200-299	Tingkat kualitas udara yang dapat merugikan pada sejumlah segmen populasi yang terpapar.
Berbahaya	300-lebih	Tingkat kualitas udara berbahaya yang secara umum dapat merugikan kesehatan yang serius

FIGURE 1 Air Quality Indicator [5]

2.2 Data Collection and Grouping

Title Primary data and secondary data that have been obtained from surveys and sampling in the field are then collected and then grouped based on indicators and variables.

2.3 Raw Data Processing

The data that has been collected and grouped is then processed using a data extraction process. Whether an ANN model is good or not is determined by the relationships between neurons or what is usually called network architecture. In forming the architecture of an artificial neural network, patterns of connections between neurons are formed. These neurons will transform the information received through their outgoing connections to other neurons.

In neural networks this relationship is known as weight and bias. The artificial neural network architecture in prediction, namely

1. Input Layer, the unit tasked with receiving input from outside that describes a problem
2. Hidden Layer, a hidden unit whose output value cannot be observed directly.
3. Output Layer, a unit which is an ANN solution to a problem [4].

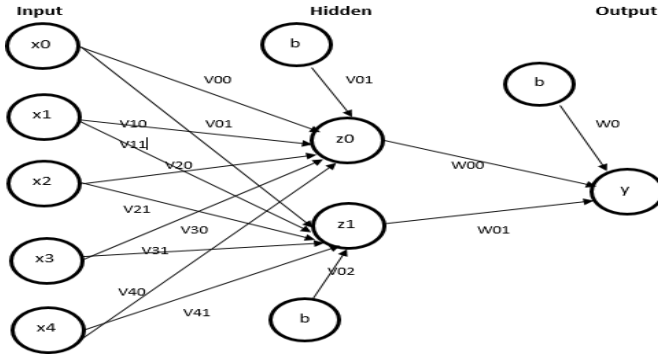


FIGURE 2 Artificial Neural Network Architecture [3]

Information:

$X_i, i \in \{0, 1, 2, 3, 4\}$ = act as neurons in the input layer (PM10, SO₂, NO₂, and CO).

$Z_j, j \in \{0, 1\}$ = act as hidden layer neurons.

$V_{ij}, i \in \{0, 1, 2, 3, 4\} j \in \{0, 1\}$ = weight that is between input and hidden .

b = Bias.

$W_{jk}, j \in \{0, 1\} k \in \{0, 1\}$ = weight between the hidden and output layers.

$Y_k (y)$ = acts as the output layer.

Randomly initialize the initial weights and then enter the predetermined weight and bias values. A checking process is carried out on the criteria values that have been determined at the beginning. If this is met, the resulting output will be a coal price prediction and the process will be stopped. The number of iterations is the criterion in question. If it does not meet the criteria intended, it will continue at the feedforward process stage. Then the process carries out a backpropagation error. Then the weight and bias update stage is carried out.

2.4 System Planning and Manufacturing

The process of creating a flowchart for the system to be created, as well as creating a data flow diagram for the system. The system design that has been carried out is then seen from the results of the flowchart that has been formed and then a system will be created using the website-based PHP programming language which will be adapted to the DFD flow.

3. RESULT AND DISCUSSION

A series of air quality monitoring systems are needed to determine the suitability of the air. An artificial neural network is a Neural Network configured for certain applications, such as pattern recognition or data classification, and then refined through a learning process. The learning process that occurs in biological systems involves adjusting the synaptic connections that exist between neurons. In the case of a Neural Network, adjusting the synaptic connections between neurons is carried out by adjusting the weight values that exist for each connectivity, both from input, neuron and output.

In this research, an information system has been created that uses a website-based application to monitor the results of regular water quality monitoring. The following is a display of the website-based application used

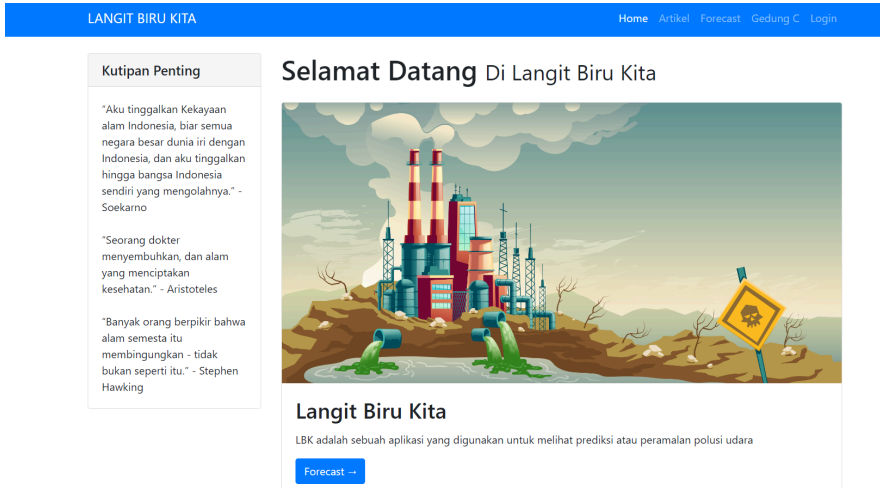


FIGURE 3 main page display

On the main page, users can log in first to use this website-based application. Then you can continue to input data into the application so that you can continue with forecasting.



FIGURE 4 main page user login

FIGURE 4 main page user login

The image above on the admin page is a place to add, change and delete indicator values

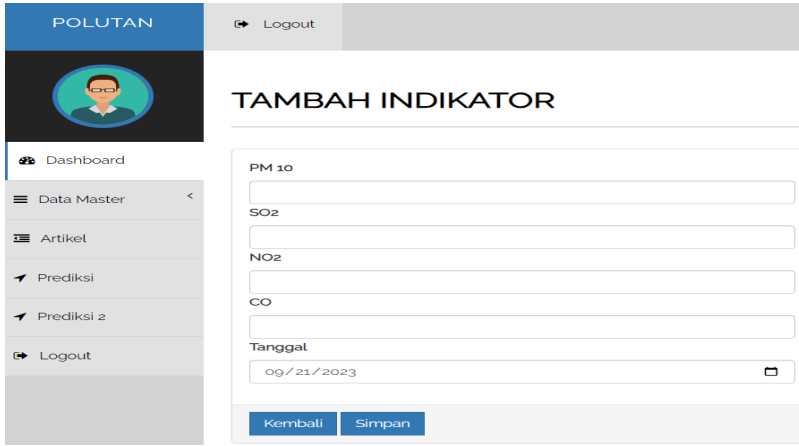


FIGURE 4 Display of air quality parameter data that has been input

The air quality data obtained from DLH Balikpapan City is air quality data from January 2023 . The parameters measured include PM10 (Particle Pollution), SO2 (Sulfur Dioxide), NO2 (Nitrogen Dioxide), and CO (Carbon Monoxide).

Air quality needs to be monitored regularly to find out whether parameters have exceeded quality standards or not. Air quality needs to be monitored, periodically to find out whether parameters exceed quality standards or not, based on Minister of Environment and Forestry Regulation No. 14 of 2020 concerning Air Pollution Standard Index and Air Pollution Control. Government agencies have carried out air quality monitoring which is usually formed in reports and most of the results are not published, so that sometimes people do not know the condition of the air quality around their environment.

This research aims to determine air quality through a quality index monitoring system and to be able to predict air quality in the future in that place, so that the benefits will be felt by residents, namely becoming more aware and caring more about their environment, especially air, which is a basic or primary need. in everyday life. The following are the results of air quality predictions in Balikpapan city.

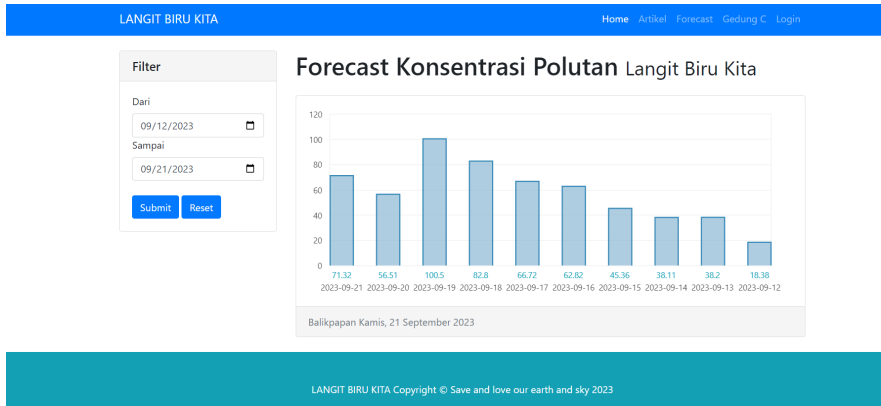


FIGURE 5 Display Predicted value

Show entries Search:

#	Tanggal	PM 10	SO2	NO2	CO
1	2023-09-14	40.44	76	12.5	1
2	2023-09-13	39.66	70	5	2
3	2023-09-12	46.78	64	5.5	3
4	2023-09-11	33.37	67	7.5	2
5	2023-09-10	36.67	71	0.4	2
6	2023-09-09	32.47	66	2	1
7	2023-09-08	37.69	65	3	3
8	2023-09-07	44.49	66	3.5	2
9	2023-09-06	30.3	66	0.6	1
10	2023-09-05	21.79	67	0.4	3

Showing 1 to 10 of 211 entries Previous 1 2 3 4 5

FIGURE 6 Distribution value

The first parameter that has been input and then predicted the value for the end of 2023 is the PM 10 parameter (Particle Pollution). It can be seen in Figure 5 showing a graph of the results for the PM 10 value. The next parameter is SO2 (Sulfur Dioxide) whose predicted value is for the end of 2023. In Figure 6 you can see the distribution of SO2 parameter values from January 2023 to SO2 value. The third parameter is NO2 (Nitrogen Dioxide) whose predicted value is for the end of 2023. In Figure 6 you can see the distribution of the NO2 parameter values from January 2023 to predicted for the end of 2023. The final parameter is CO (Carbon Monoxide) whose predicted value is for the end of 2022. In Figure 6 you can see the distribution of the CO parameter values from 2015 to predicted for the end of 2022.

4. CONCLUSION

Balikpapan City air quality predictions have been carried out through a system-based application where the value of each parameter is then adjusted based on Minister of Environment and Forestry Regulation No. 14 of 2020 concerning Air Pollution Standard Index and Air Pollution Control.

1. Based on the prediction results for the air CO parameters in Balikpapan City at the end of 2023, it was found this value is still in the class 1 range. Then the prediction results for the air NO₂ (Nitrogen Dioxide) parameters at the end of 2023 were obtained at 71.32. which means the air in Balikpapan city is still in the good category until the 21st when this article was written
2. The values of the air quality parameters are still considered adequate and meet the airworthiness of Balikpapan City. The PM₁₀ parameter value is predicted to be higher than the previous year due to the increase in the number of residents and companies producing gas and producing mining materials, thus affecting the appropriateness of air quality in Balikpapan City.

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