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DEVELOPMENT OF A DATABASE FOR AN INFORMATION SYSTEM FOR MONITORING ATMOSPHERIC AIR QUALITY

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An important factor in ensuring environmental safety in urban areas is the monitoring of air quality using information systems, which involves the continuous collection, processing, analysis, and storage of data. The complexity of such systems lies in the generation of large volumes of heterogeneous data, which necessitates its structured presentation and the application of effective analytical processing methods.

Open air quality monitoring platforms, such as OpenAQ and the Copernicus Atmosphere Monitoring Service, provide access to large datasets of measured and forecast data. These information resources are widely used in scientific research and in the design of modern environmental monitoring systems [1, 2].

The purpose of this work is to develop a database for an air quality monitoring information system.

As part of the study, a conceptual database model was developed to integrate the processes of collecting, storing, and processing information on ambient air quality (fig. 1).

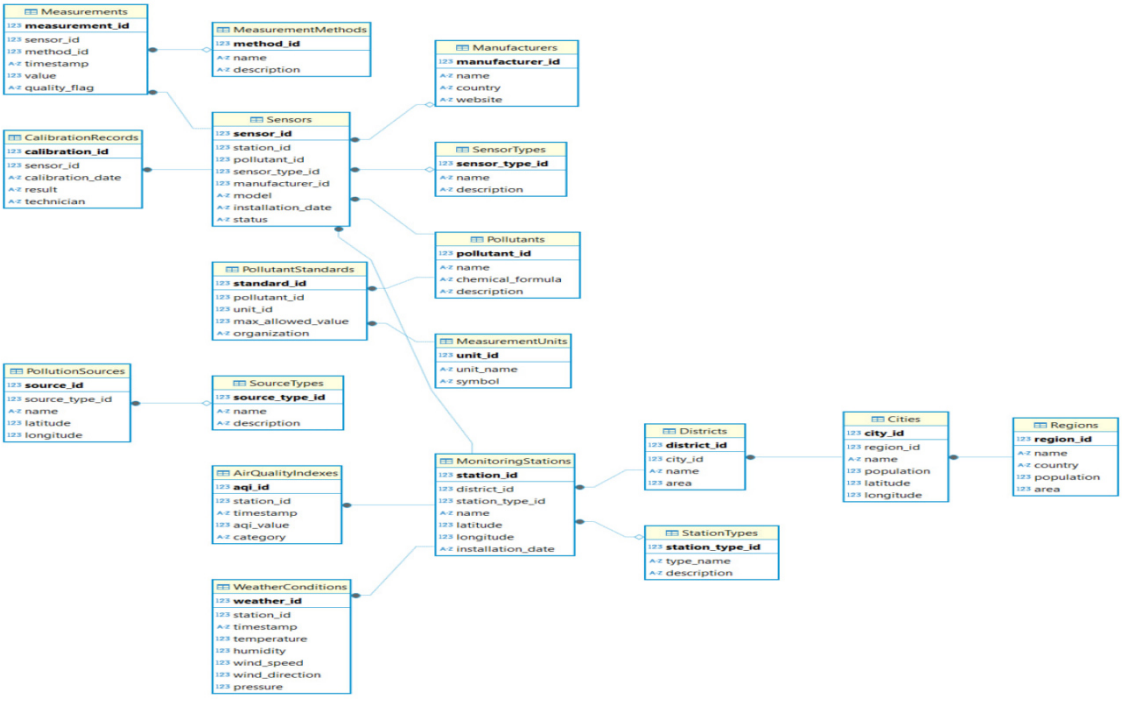

Figure 1 – Database of the Air Quality Monitoring Information System

The database covers the main entities of the subject domain, including: regions, cities, districts, monitoring stations, sensors, pollutants, measurement results, weather conditions, and air quality indices, as well as reference tables for station types, sensor manufacturers, units of measurement, regulatory values, and pollution sources.

The model implements a hierarchical structure of geographic objects, establishes links between stations and sensors, and ensures that measurement results are time-stamped. In total, the schema contains 18 relationships, which ensures data normalization and minimizes redundancy.

The database structure enables operations such as creating, reading, updating, and deleting records containing geographic data, information about monitoring stations, sensors, pollutants, measurements, weather conditions, air quality indices, and pollution sources.

The developed database model enables analytical data processing, including the assessment of pollutant concentration trends, the identification of instances where regulatory limits are exceeded, the analysis of the impact of weather conditions on air quality, and the calculation of composite indicators. The use of time attributes in measurement and meteorological condition tables enables time series analysis.

Based on the proposed structure, a set of analytical queries has been implemented, including the determination of statistical characteristics (mean, maximum, and minimum values of indicators), the assessment of pollution levels at various territorial levels (stations, cities, districts, regions), analysis of sensor activity and their calibration status, as well as the detection of exceedances of maximum permissible concentrations. In addition, queries are provided for analyzing the air quality index, identifying periods of environmental deterioration, assessing the impact of meteorological factors (temperature, wind speed) on pollution levels, as well as determining the most polluted areas and dominant pollutants.

The proposed structure can be implemented in relational database management systems such as SQLite, PostgreSQL, MySQL, and other similar DBMSs. It serves as the foundation for building information and analytical systems for environmental monitoring that utilize open data from government and international platforms [2, 3].

The results obtained can be used in future research to apply methods of intelligent analysis and multidimensional processing of environmental data.

References

1. OpenAQ. Open air quality data platform [Electronic resource]. Available at: https://openaq.org (accessed: 14.04.2026).

2. Copernicus Atmosphere Monitoring Service. Air quality monitoring andforecasting data [Electronic resource]. Available at: https://atmosphere.copernicus.eu (accessed: 14.04.2026).

3. Chen L., Zhang Y., Li Q. Global air quality datasets for environmental analytics // Environmental Data Science. – 2022. – Vol. 1. – Article e12.