**REPORT TITLE**

**Predicting air quality index using attention hybrid deep learning and quantum-inspired particle swarm optimization**

1. **Project Members**

* **Group: 23**
* **Members:**
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1. **Project Objective**  
   The project aims to accurately predict the Air Quality Index (AQI) in Seoul, South Korea, by developing a hybrid deep learning model. This model is intended to support urban planners and policymakers in effectively monitoring and managing air pollution.
2. **Methodology**  
   The proposed model combines several advanced techniques:

* **Transformer**: Extracts linear components from AQI time series data.
* **ACNN (Attention-based Convolutional Neural Network)**: Identifies important global and local features.
* **LSTM (Long Short-Term Memory)**: Captures complex nonlinear patterns and long-term dependencies.
* **QPSO (Quantum-inspired Particle Swarm Optimization)**: Optimizes the hyperparameters of the LSTM network.
* **XGBoost**: Aggregates and refines the predictions from the previous models to produce final AQI estimates.

1. **Dataset**

* **Source**: Seoul Air Data platform.
* **Period**: January 1, 2017 to December 31, 2019.
* **Data**: Hourly pollutant concentrations (PM2.5, PM10, NO₂, CO, SO₂, and O₃) from 25 monitoring stations across Seoul.
* **Preprocessing**: Includes timestamp standardization, outlier removal, missing value interpolation, normalization, and AQI calculation using national standards.

1. **Model Evaluation**  
   Model performance was assessed using four key metrics:

* Mean Absolute Error (MAE)
* Mean Squared Error (MSE)
* Root Mean Squared Error (RMSE)
* R-squared (R²)

Results show that the proposed model outperformed traditional statistical and deep learning models:

* MSE decreased by 31.13%
* MAE decreased by 19.03%
* R² improved by 2%

1. **Research Contributions**

* Developed a comprehensive hybrid model integrating deep learning and quantum-inspired optimization.
* Improved AQI prediction accuracy and stability.
* Provided a highly applicable tool for real-world environmental monitoring, especially in densely populated and industrialized cities like Seoul.

1. **Future Work**

* Apply the model to other urban areas with similar pollution challenges.
* Integrate additional data sources such as meteorological data and satellite imagery.
* Implement the model in real-time AQI monitoring systems for public health and environmental policy support.