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REVIEWER'S REPORT

Manuscript No.: IJAR-59787

Title: Air Quality Monitoring System Based on Deep Learning: Hybrid CNN-2 BiLSTM Model.

Recommendation:

Accept as it is .....

Accept after minor revision.....

Accept after major revision .....yes.....

Do not accept (*Reasons below*) .....

Rating	Excel.	Good	Fair	Poor
Originality			Y	
Techn. Quality			Y	
Clarity			Y	
Significance			y	

Reviewer's ID: JPR-Dr.Shaweta sachdeva

Detailed Reviewer's Report

1. The manuscript addresses an important research problem; however, the novelty of the proposed CNN-BiLSTM architecture is insufficiently established, as similar hybrid deep learning approaches have already been extensively investigated for air quality prediction.
2. The authors should clearly highlight the specific research gap and explain how the proposed model differs from existing CNN-LSTM, CNN-BiLSTM, and other hybrid forecasting architectures.
3. The literature review requires further critical analysis and comparison with recent studies. A comprehensive comparative table highlighting existing methodologies, datasets, performance metrics, and research limitations would strengthen the manuscript.
4. The dataset description lacks sufficient information regarding the distribution of monitoring stations, geographical coverage, missing values, and the number of observations retained after preprocessing.
5. The selection of 14 input features requires stronger justification. The authors should explain the feature selection criteria and investigate how individual environmental variables contribute to AQI prediction.
6. The manuscript reports an exceptionally high R^2 value of 0.9942 on the first dataset. Such performance requires additional validation to rule out potential data leakage, target-related feature contamination, or overfitting.
7. The authors should clarify whether the AQI and AQI_Bucket variables were included among the model's input features, as their inclusion could potentially introduce target leakage and artificially improve prediction accuracy.
8. The experimental evaluation is limited to linear regression, SVM, and a simple LSTM. Comparisons with more advanced approaches, such as GRU, CNN-LSTM, attention-based BiLSTM, and Transformer-based models, are recommended.
9. The proposed model lacks an ablation study to demonstrate the individual contributions of CNN layers and the BiLSTM component to the overall prediction performance.
10. The authors should provide detailed information about hyperparameter optimization, including the learning rate, convolutional kernel sizes, number of training runs, and procedures used to select the optimal model configuration.
11. The results presented in Table 3 require more careful interpretation. On Dataset 1, the simple LSTM achieves a lower MAE (2.5810) than the proposed CNN-BiLSTM (2.6339), which contradicts the general statement that the proposed model outperforms all baseline models across the reported metrics.

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12. The manuscript does not include sufficient statistical validation to establish whether the observed performance improvements are significant. Repeated experiments, confidence intervals, or appropriate statistical significance tests would strengthen the findings.
13. The use of two datasets is useful; however, additional experiments across different geographical regions, seasonal conditions, and pollution levels are necessary to establish the model's generalizability.
14. The authors should evaluate the proposed model under different forecasting horizons, such as 3-hour, 6-hour, 12-hour, and 24-hour predictions, rather than restricting the evaluation to one-hour-ahead forecasting.
15. The manuscript lacks a detailed computational complexity analysis. Information regarding training time, inference time, memory requirements, and hardware configuration is necessary to assess practical deployment feasibility.
16. Figures 3 and 5 should be improved to provide clearer visualization of training and validation performance. The authors should also discuss possible overfitting and the stability of model convergence.
17. The discussion section should provide a deeper explanation of why the simple LSTM and SVM models experience substantial performance degradation on the second dataset, rather than attributing the differences primarily to dataset characteristics.
18. The manuscript would benefit from incorporating explainable AI techniques, such as SHAP or LIME, to identify the environmental parameters that most strongly influence AQI predictions.
19. The practical applicability of the proposed air quality monitoring system is insufficiently demonstrated. The authors should discuss real-time implementation, sensor integration, computational requirements, and operational challenges.
20. The conclusion primarily summarizes the experimental findings without sufficiently emphasizing the scientific contribution, practical implications, and limitations of the proposed methodology.
Suggested overall reviewer comment:
The manuscript addresses a relevant problem in air quality forecasting using a hybrid CNN-BiLSTM model. Although the reported prediction results are promising, several significant issues need to be addressed before the work can be considered for publication. The novelty of the proposed architecture is not sufficiently demonstrated, and the experimental evaluation lacks comprehensive benchmarking, ablation studies, statistical significance analysis, and adequate validation of model generalizability. Furthermore, the exceptionally high prediction accuracy requires careful examination of potential data leakage and overfitting. The authors should also improve the methodological explanation, justify feature selection, strengthen the discussion of experimental results, and provide a clearer account of the scientific contribution. Considering these limitations, major revision is recommended before the manuscript can be reconsidered for publication.