OXFORD BROKES UNIVERSITY

Solar Irradiance Prediction Using Attention-SolatMeNet

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Abstract

Addressing the urgent need to reduce fossil fuel use, our project focuses on improving solar energy prediction with the Attention-SolarMeNet model. This innovative approach combines advanced feature extraction and temporal analysis to enhance accuracy.Key results from two datasets are impressive: Dataset 1 had an MAE of 0.065, MSE of 0.009, RMSE of 0.098, R^2 of 0.852; Dataset 2 showed an MAE of 0.039, MSE of 0.006, RMSE of 0.081, R^2 of 0.829. This advancement in solar prediction technology is crucial for optimizing energy management, supporting renewable energy integration, and ensuring grid stability, offering significant value to the solar industry and the environment.

Dataset & Data Process

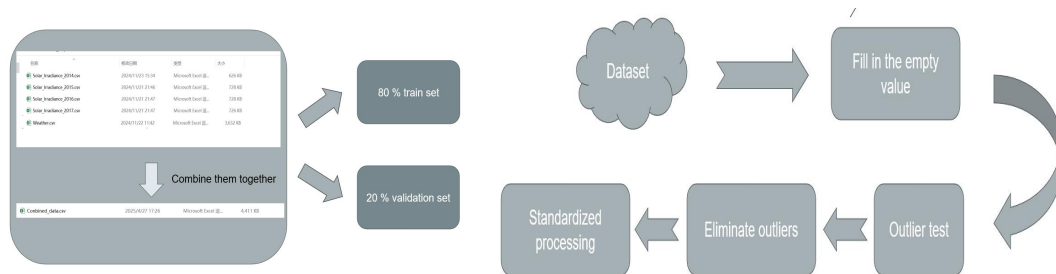Dataset 1 contains 20020 rows of solar data from 2015 to 2017, while dataset 2 records 6218 rows of environment factors.
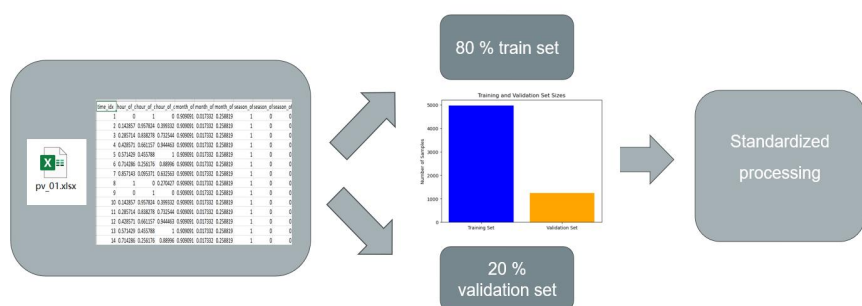

Figure 1: Dataset 1 processing

Figure 2: Dataset 2 processing
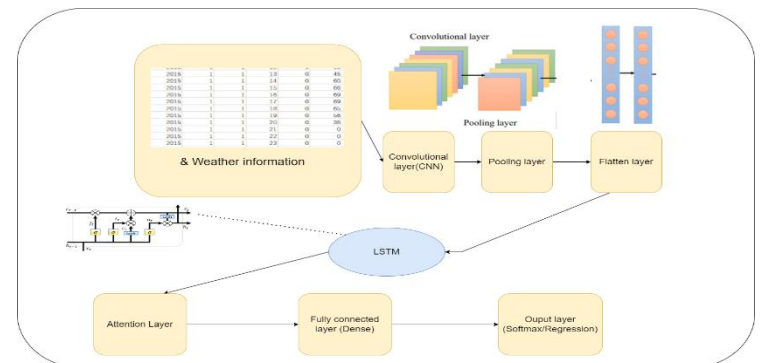
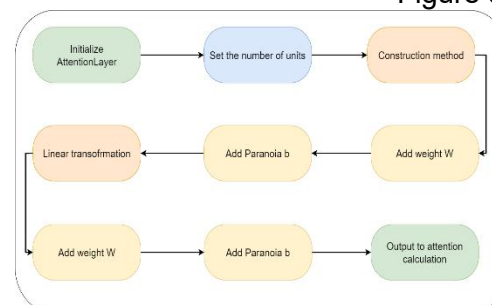## Proposed Model Attention-SolarMeNet

Figure 3: Model Overview

Figure 4: Attention Architecture

Figure 3 shows the architecture of Attention-SolarMeNet, which combines convolution layer, attention layer shown in Figure 4 and LSTM layer. The Attention –SolarMeNet is used capture features and time series for solar energy forecasting.

Model Explainability (SHAP)

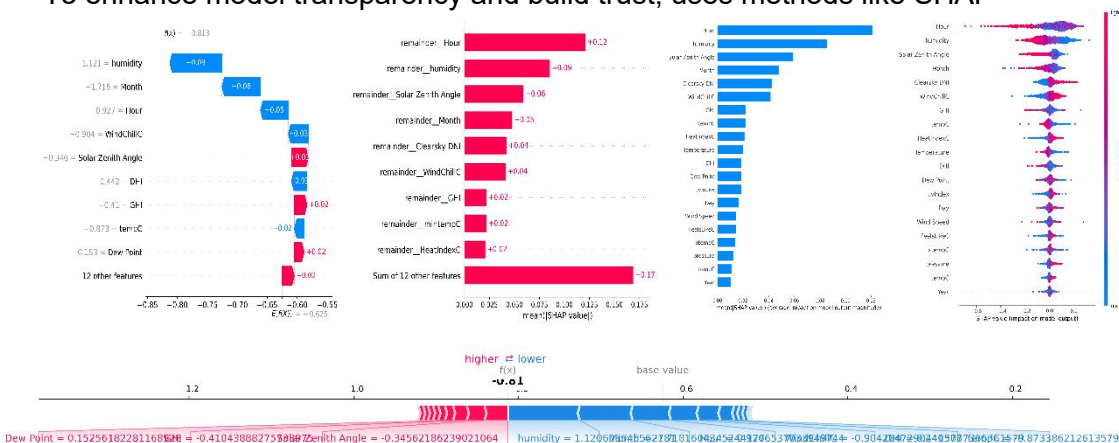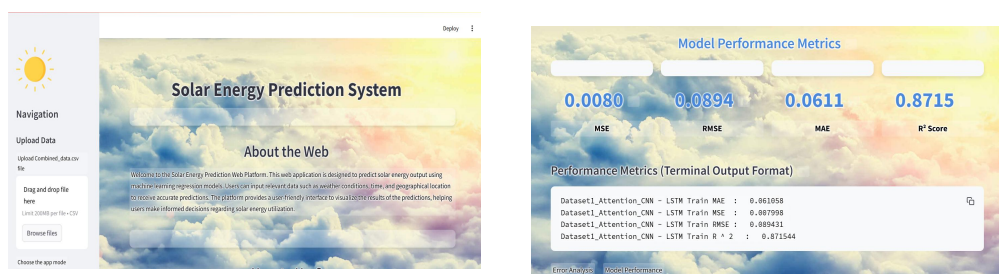To enhance model transparency and build trust, uses methods like SHAP
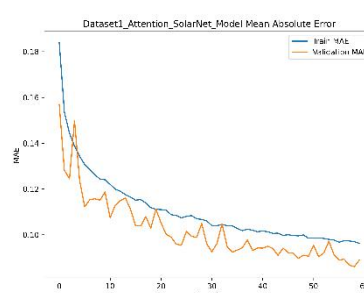

Figure 5: SHAP Plots
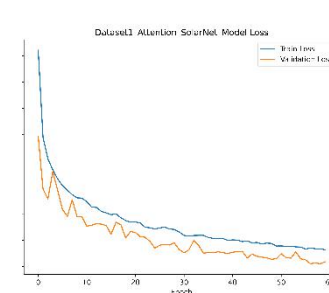
Result Analysis

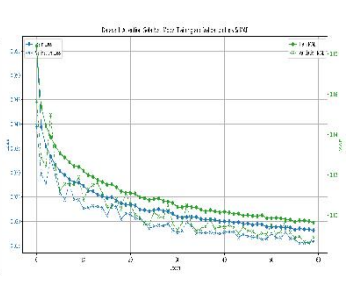Figure 6: MAE curve

Figure 7: Loss curve

Figure 6: Predicted value-actual value

Figure 6 and Figure 7 shows the MAE and Loss curve of dataset 1 and Figure 8 shows the prediction curve about predicted value and actual value

Web Deployment

This project develops a web-based solar energy forecasting platform, which can support upload csv file to predict the solar data, and show the evaluation indicators about the model.

Conclusion

Model development
- The Attention-SolatMeNet model was successfully developed for the prediction of solar irradiance.
- The model adopts deep learning techniques, especially the attention mechanism, to capture complex patterns in the data.

Performance Evaluation
- Tests were conducted on two different datasets, demonstrating excellent performance.
- The experimental results show lower MAE, MSE and RMSE.A relatively high R2 was obtained, proving the predictive ability of the model.

Reference

[1] S. M. J. Jalali, S. Ahmadian, A. Kavousi-Fard, A. Khosravi and S. Nahavandi, "Automated Deep CNN-LSTM Architecture Design for Solar Irradiance Forecasting," in *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, vol. 52, no. 1, pp. 54-65, Jan. 2022, doi: 10.1109/TSMC.2021.3093519.

[2] S.-C. Lim, J.-H. Huh, S.-H. Hong, C.-Y. Park, and J.-C. Kim, "Solar Power Forecasting Using CNN-LSTM Hybrid Model," Energies, vol. 15, no. 21, Art. no. 21, Jan. 2022, doi: 10.3390/en15218233.