Predictive Maintenance Model Comparison

Comparative analysis of different machine learning models for anomaly detection

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Performance Summary

This report compares several machine learning models used for predictive maintenance on compressor monitoring data. The goal is to detect anomalies and potential failures before they cause equipment downtime.

ACCURACY
Percentage of correct predictions (both normal and anomaly)

PRECISION
Proportion of positive identifications (anomalies) that were actually correct

RECALL
Proportion of actual positives (anomalies) that were identified correctly

F1 SCORE
Harmonic mean of precision and recall

AUC-ROC
Area Under the Receiver Operating Characteristic curve

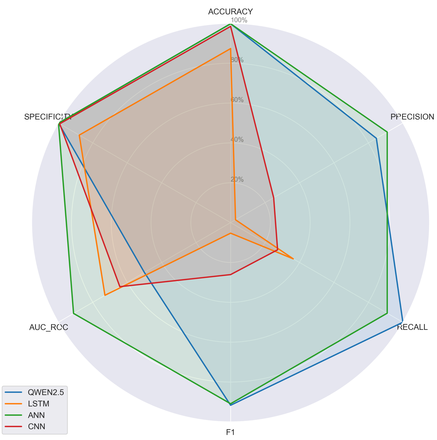
SPECIFICITY
Proportion of actual negatives correctly identified

Metrics Comparison

Model	ACCURACY	PRECISION	RECALL	F1	AUC_ROC	SPECIFICITY
QWEN2.5	**99.82%**	84.62%	**100.00%**	**91.67%**	50.04%	**99.82%**
LSTM	87.35%	2.86%	36.36%	5.30%	72.94%	87.85%
ANN	**99.82%**	**90.91%**	**90.91%**	**90.91%**	**91.15%**	**99.91%**
CNN	98.50%	25.00%	27.27%	26.09%	64.29%	99.20%

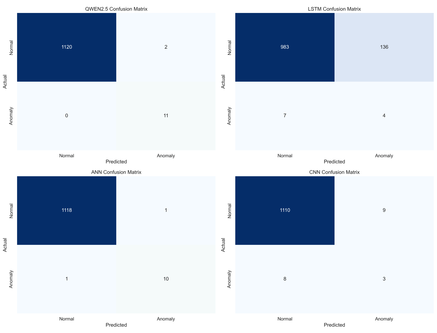
Visual Comparison

Radar Chart - Overall Model Performance



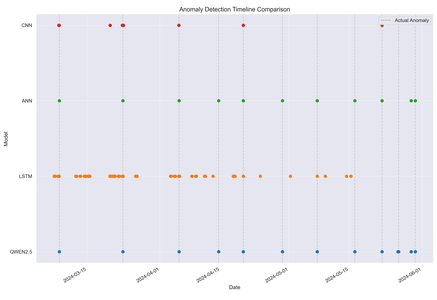
This radar chart shows all metrics for each model on a scale from 0% to 100%. A larger area indicates better overall performance.

Confusion Matrix Comparison



Confusion matrices show true positives, false positives, true negatives, and false negatives for each model.

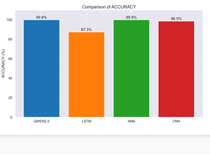
Anomaly Detection Timeline



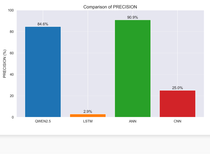
This timeline compares when each model detected anomalies. Vertical dashed lines represent actual anomalies.

Detailed Metric Comparisons

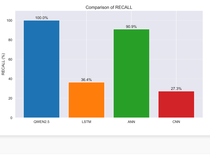
ACCURACY Comparison



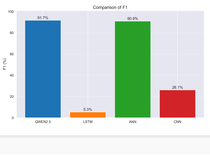
PRECISION Comparison



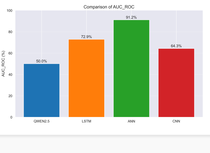
RECALL Comparison



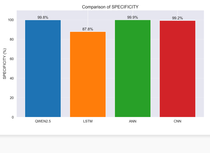
F1 Comparison



AUC_ROC Comparison



SPECIFICITY Comparison



Understanding the Metrics

- **ACCURACY**: The percentage of all predictions (both normal and anomaly) that were correct. While a high accuracy is generally good, it can be misleading in imbalanced datasets where anomalies are rare.
- **PRECISION**: When the model predicts an anomaly, how often is it correct? High precision means few false alarms.
- **RECALL**: What percentage of actual anomalies did the model detect? High recall means few missed anomalies.
- **F1 SCORE**: The harmonic mean of precision and recall, providing a single metric that balances both concerns.
- **AUC-ROC**: Area Under the Receiver Operating Characteristic curve, measuring the model's ability to discriminate between normal and anomaly classes across different threshold settings.
- **SPECIFICITY**: The proportion of actual normal samples correctly identified as normal.

For predictive maintenance, a balance between precision and recall is often critical. High precision reduces unnecessary maintenance checks, while high recall ensures fewer missed failures.