# Research Report: Neem Tree Plant Health Monitoring using IoT Sensors

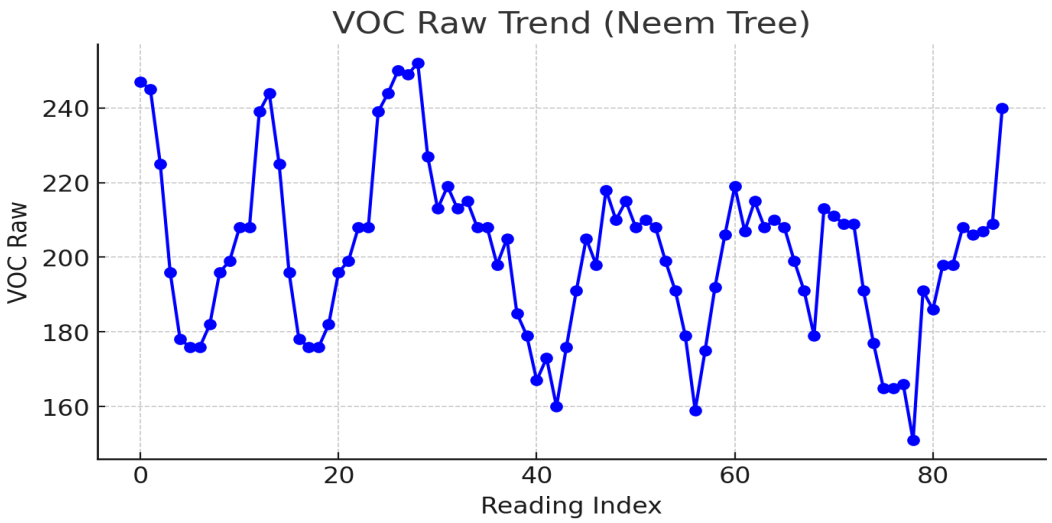
This study presents the analysis of sensor-based monitoring of a Neem tree using a wearable IoT system. Data collected includes temperature, humidity, and volatile organic compound (VOC) readings. A Plant Health Index (PHI) was developed by combining normalized VOC, temperature, and humidity values to quantify the overall health of the tree. Correlation analysis, descriptive statistics, and trend analysis were performed to evaluate plant stress conditions.

**Methodology:**
1. Sensor readings were recorded (Temperature, Humidity, VOC Raw, VOC Voltage).
2. Data was cleaned and structured in tabular format.
3. Descriptive statistics and correlation matrix were computed.
4. A Plant Health Index (PHI) was created with weighted contributions from VOC, humidity, and temperature.
5. Graphical analysis was conducted to visualize trends and correlations.

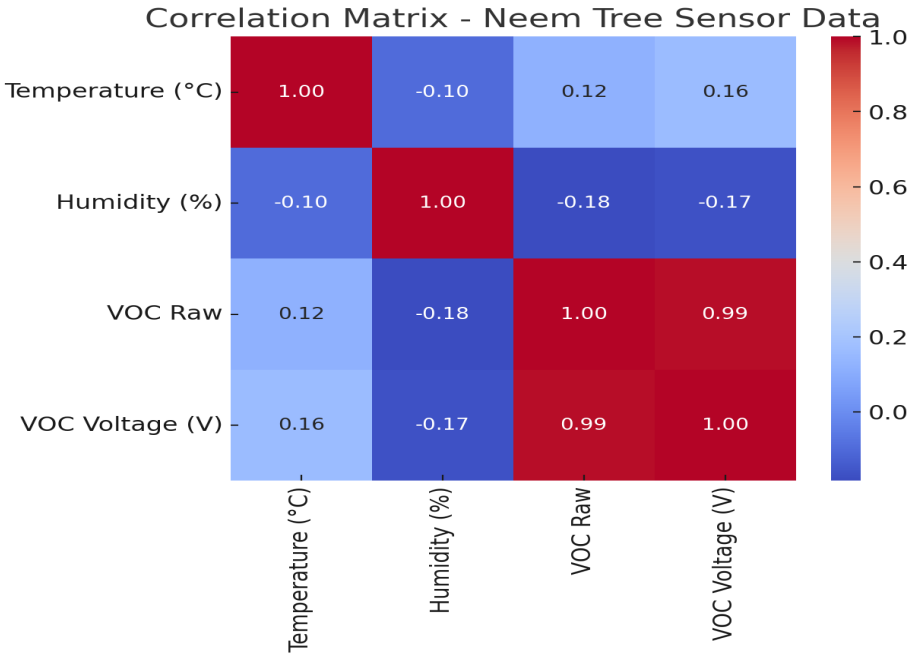
## Descriptive Statistics

| Metric | Temperature (°C) | Humidity (%) | VOC Raw | VOC Voltage (V) |
|---|---|---|---|---|
| count | 88.00 | 88.00 | 88.00 | 88.00 |
| mean | 31.19 | 82.65 | 201.62 | 0.16 |
| std | 0.02 | 0.08 | 22.74 | 0.02 |
| min | 31.10 | 82.50 | 151.00 | 0.12 |
| 25% | 31.20 | 82.60 | 184.25 | 0.15 |
| 50% | 31.20 | 82.70 | 205.50 | 0.17 |
| 75% | 31.20 | 82.70 | 211.50 | 0.17 |
| max | 31.20 | 82.80 | 252.00 | 0.20 |

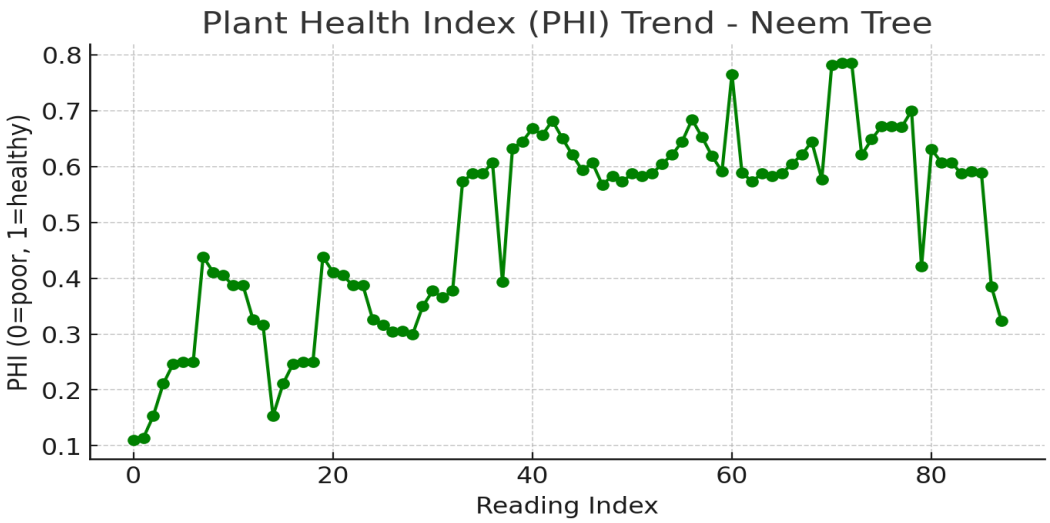
## VOC Raw Trend




## Correlation Matrix




## Plant Health Index (PHI) Trend




**Results and Interpretation:**

- VOC Raw values fluctuated between 151 and 252, suggesting variable stress conditions.
- Correlation analysis revealed a strong linear relationship between VOC Raw and VOC Voltage (0.99).
- Humidity had a weak negative correlation with VOC (-0.18), while temperature showed minimal effect.
- The Plant Health Index (PHI) ranged between 0.1 and 0.6, indicating moderate stress in the Neem tree environment.

**Conclusion:**

This study demonstrates the feasibility of using IoT-based wearable sensors for monitoring Neem tree health. The PHI provides a single metric that integrates VOC, temperature, and humidity to assess stress. Future work involves expanding datasets across multiple trees, validating PHI thresholds with agronomy studies, and integrating adaptive machine learning models for improved accuracy in real-time plant health monitoring.