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# AI/ML Solutions in Solar Energy Predictive Analytics

# Why Integrate Our AI-Powered Solar Analytics Application?

- Boost in Energy Generation (5–10%)
- Forecasting Accuracy Prevents DSM Penalties
- Accelerated Fault Detection and Reduced Downtime
- Soiling and Cleaning Optimization (Save Water, Manpower, Energy)
- Remote Access and Conversational AI Support
- SCADA-Free Monitoring Saves Millions
- Built-in Energy Forecasting – No Third-Party Dependency

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# Key Differentiators of Our Solar Analytics Application

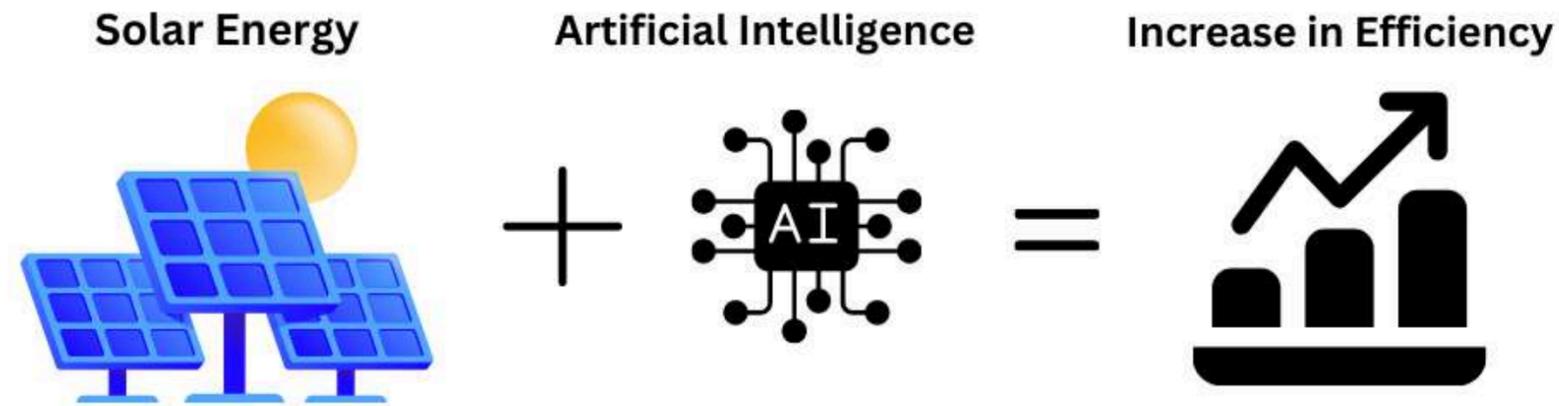
1. Unified Platform: Monitoring + Forecasting + Analytics
2. SMB-Level String Monitoring Beyond SCADA
3. Plant-Specific High-Accuracy Forecasting
4. Conversational AI Assistant
5. Smart Soiling Monitoring & Optimization
6. Centralized Remote Monitoring
7. Plug-and-Play IoT Deployment
8. Customizable Actionable Dashboards
9. Scalable Architecture

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# Key Capabilities of our Application



- Real-time String & Soil Monitoring
- Energy Forecasting
- Conversation AI Assistant
- Performance Optimization
- Predictive Maintenance and Analytics
- Actionable dashboards



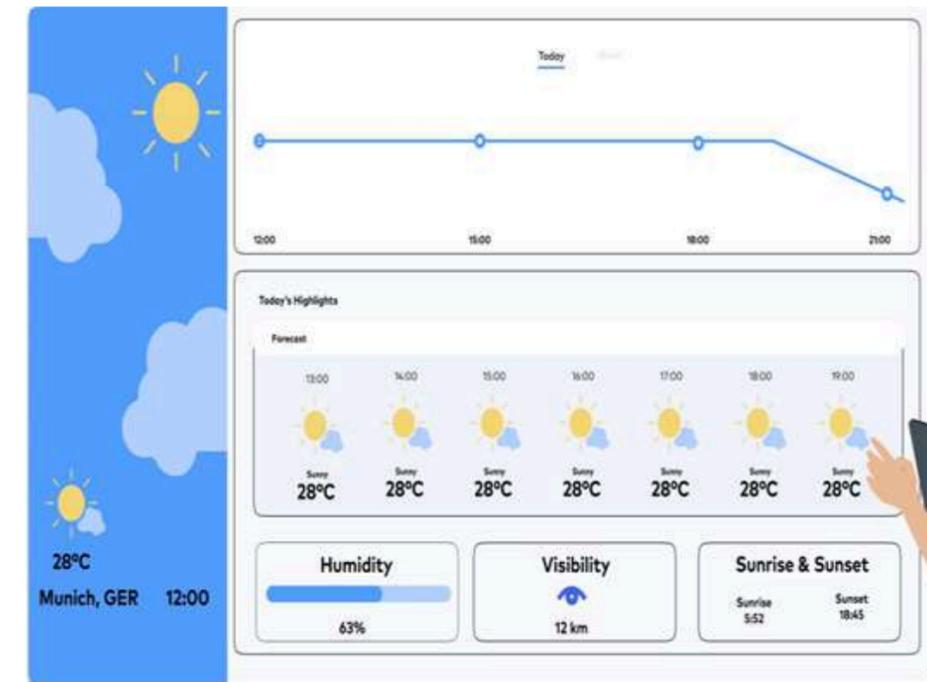
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# Solar Energy Forecasting

## Challenges:

- Forecasting across diverse geographic conditions
- Scaling models for multiple time frequencies
- Regulatory pressure to meet committed energy delivery



## Our application solutions:

- Multi-Frequency Forecasting
- Plant-Specific Forecasting Models
- Weather-Integrated Forecasts

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# Enhancing Solar Plant Efficiency Through String Monitoring



## Our IoT + AI based application:

- 4G/Wi-Fi-enabled SMB Interface
- Auto detects anomalies and deviations
- Automated vs. SCADA Comparison – Pinpoint data mismatches

## Benefits

- Immediate Deployment
- Quick Fault Resolution
- Better Yield Recovery
- Reduced Site Visit Frequency for String Diagnostics



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# AI-Based Soiling Monitoring & Cleaning Optimization



## Why it Matters for Solar plants?

- The plant's proximity to dust-intensive environments
- Heavy reliance on frequent manual cleaning
- Potential Energy Yield Loss

## Solution:

- Real-Time Dust Accumulation Alerts
- Cleaning ROI Estimation
- Energy Loss Trendline
- Panel (Zone) - Level Impact Analysis
- Smart Cleaning Schedules

# Inverter Monitoring & Analytics



**Solar Inverter**

- Modbus TCP/IP & RS-485 Communication (Tested with commercial inverters)
- SMBs Monitoring DC Input
- (String-level power to inverter)
- Inverter Parameter Tracking
- (Voltage, Current, Power, Frequency, Temperature)
- Efficiency & V-I Curve Analytics
- (Real-time trends, derating, thermal stress)
- AI-Based Fault Detection
- (Ground faults, over-temp, imbalance, shutdowns)
- Faster Root Cause Isolation (Panel/String/Inverter-level diagnosis)

# Conversational AI Assistant for Plant Insights & Faster Troubleshooting



## Smart Assistant for Faster Decision-Making

- Instant Access to Plant Insights
- Proactive AI Recommendations
- Role-Based Access Control
- Seamless Integration
- Remote AI assistant
- Business impact
- Faster troubleshooting
- Lower Training Costs
- 24/7 AI support

## Visual Concept:

User query → AI analysis → Actionable suggestion

# Performance Optimization



## Smart AI-Driven Recommendations

- DC/AC power, irradiation, and temperature
- Auto-suggests actions (e.g., shading or soiling inspection, inverter tuning, cooling)
- Assigns priority levels (Low / Medium / High) for each recommendation

## Multi Plant Performance Analysis

- Visual comparison of energy output and efficiency across plants
- Identify low-performing sites at a glance
- Instant Alerts

# Predictive Maintenance and Analytics



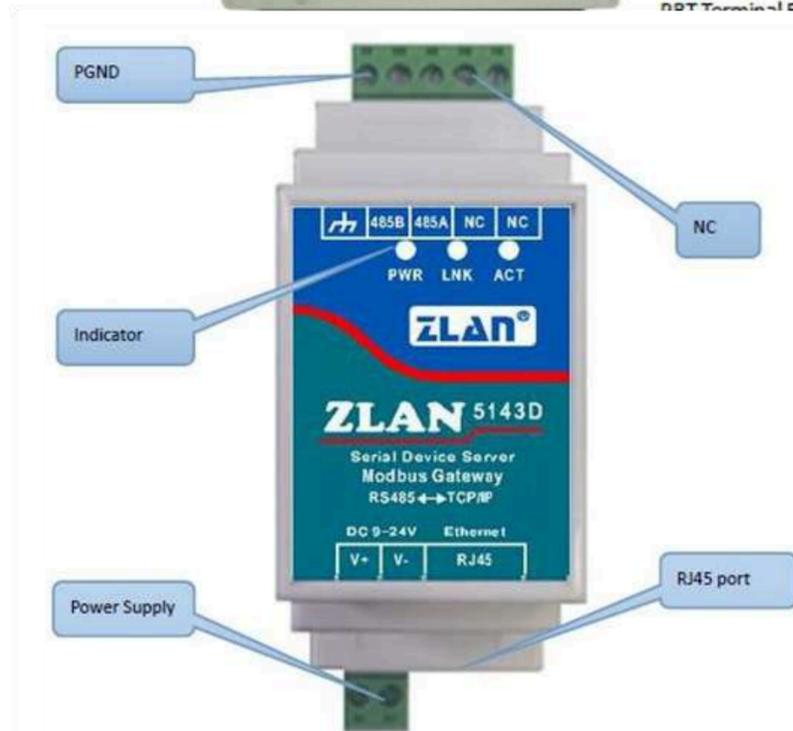
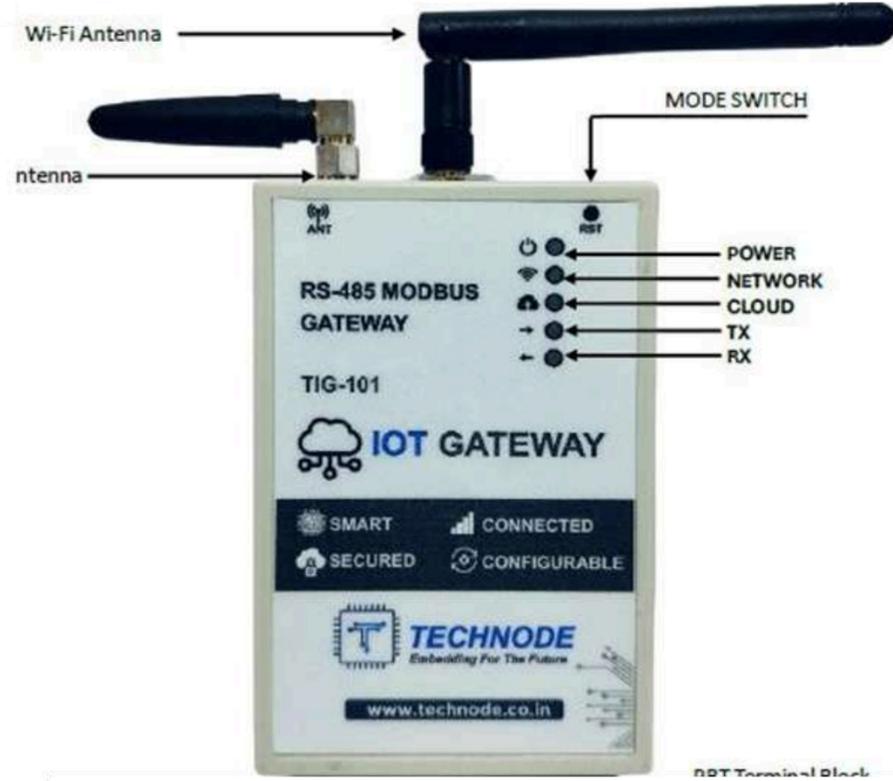
## How our AI powered App Solves Pain Points:

- Multi-Asset Health Monitoring ( Inverters | Panels | Combiner Boxes | Batteries )
- Inverter Efficiency trends
- Panel Image Analysis
- Failure Prediction & Energy Loss Estimation

## Output:

- Extended asset lifespan
- Faster Troubleshooting (AI-Driven Root Cause Insights)
- Alerts & Actionable Recommendations





# Conclusion: Transforming Solar O&M with AI

## 1. Proactive Asset Health Monitoring

- Real-time insights to prevent failures across inverters and strings

## 2. Data-Driven Decision at Early Level

- AI-powered analytics for higher yield and cost-efficient maintenance

## 3. Scalable Across Any Plant Size

- From domestic rooftops to utility-scale farms (1kW–100MW+)

## 4. Seamless Integration

- Works with SCADA/IoT systems via Modbus, RS485, and API

## 5. Future-Ready & Modular Platform

- Built for remote monitoring, Energy storage integration, evolving regulations, and market trends.



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