Zhengzhou Hengling New Energy - Solution

Smart Municipal Street Light Control System Solution

Zhengzhou Hengling New Energy Technology Co., Ltd.

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1. REQUIREMENT ANALYSIS & INVESTIGATION

1.1 Project Background

Traditional municipal street lighting systems face significant challenges: - High energy consumption accounting for 30-40% of municipal electricity bills - Manual inspection requiring 2-3 days per 100km of roads - Fault detection latency averaging 48-72 hours - Limited dimming capabilities leading to over-illumination - Lack of centralized monitoring and data analytics

1.2 Client Requirements

- **Energy Efficiency Target**: 50-70% energy reduction compared to HID systems
- **Reliability**: 99.9% system uptime with remote fault detection
- **Scalability**: Support 10,000+ lighting nodes per control center
- **Integration**: Compatible with existing SCADA and IoT platforms
- **ROI**: Payback period within 3-4 years
- **Maintenance**: Reduce OPEX by 60% through predictive maintenance

1.3 Site Survey Parameters

- Road classification: arterial roads, secondary roads, residential streets
- Pole height range: 8m-12m standard configuration
- Spacing distance: 25m-35m between fixtures
- Power supply: 220V AC grid + solar hybrid options
- Environmental rating: IP66/IK10 for harsh weather conditions

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2. SOLUTION DESIGN

2.1 System Architecture

Three-Tier IoT Architecture: - **Perception Layer**: Smart LED controllers, sensors, metering modules - **Network Layer**: LoRaWAN/NB-IoT/4G cellular communication - **Application Layer**: Cloud-based CMS platform with AI analytics

2.2 Core Technologies

- **Adaptive Dimming Algorithm**: AI-based brightness adjustment based on traffic flow
- **Predictive Maintenance**: Machine learning for failure prediction 2-3 weeks in advance
- **Energy Harvesting**: Solar PV + battery storage hybrid system
- **Edge Computing**: Local decision-making reducing cloud latency
- **GPS Asset Tracking**: Precise geolocation for every lighting node

2.3 Hardware Specifications

Component	Specification
LED Luminaire	50W-200W, 160lm/W efficacy, 50,000hrs lifespan
Smart Controller	NEMA 7-pin / Zhaga 4-pin compatible
Communication	LoRaWAN Class A, 2km range, 10-year battery
Sensors	Photocell, PIR motion, temperature, current/voltage
Gateway	500 nodes capacity, Ethernet/4G backhaul

2.4 Software Platform Features

- Real-time dashboard with GIS mapping
- Customizable dimming schedules and profiles
- Automated fault alerts via SMS/email
- Energy consumption analytics and reporting
- API integration with third-party systems
- Multi-tenant administration with role-based access

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3. PRODUCT CUSTOMIZATION

3.1 Luminaire Customization

- Optical design tailored to road width and classification
- Color temperature options: 3000K-5700K per municipal standards
- Housing materials: die-cast aluminum with anti-corrosion coating
- Mounting options: side-entry, post-top, adjustable bracket
- Branding: custom laser engraving of municipal logos

3.2 Control System Customization

- Communication protocol selection based on local infrastructure
- Integration with existing traffic management systems
- Custom alert thresholds and escalation workflows
- Multi-language interface for international deployments
- White-label platform branding options

3.3 Energy Configuration

- Grid-tied, off-grid, or hybrid power options
- Battery capacity sizing based on autonomy requirements (3-7 days)
- Solar panel tilt angle optimized for local latitude
- BMS configuration for extreme temperature ranges

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4. PROJECT IMPLEMENTATION

4.1 Project Timeline

Phase	Duration	Activities
Planning & Design	2 weeks	Site survey, CAD design, BOM finalization
Procurement	3-4 weeks	Manufacturing, QC testing, logistics
Installation	4-8 weeks	Pole preparation, fixture mounting, wiring
Commissioning	1-2 weeks	Network setup, system calibration, training
Total	10-16 weeks	End-to-end project delivery

4.2 Installation Methodology

- **Pre-installation**: Site marking, cable routing planning, safety briefing
- **Fixture Installation**: Standardized mounting templates, torque specifications
- **Network Deployment**: Gateway placement optimization, signal strength testing
- **Quality Checks**: Photometric testing, electrical safety verification
- **Documentation**: As-built drawings, installation records, test reports

4.3 Safety Standards Compliance

- IEC 60598-1 luminaire safety
- IEC 61347-2-13 LED driver safety
- EN 50155 railway applications (if applicable)
- ISO 45001 occupational health & safety
- Local electrical codes and regulations

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5. SYSTEM COMMISSIONING & TESTING

5.1 Functional Testing

- Individual luminaire on/off and dimming verification
- Communication latency testing (<500ms response)
- Sensor calibration and threshold verification
- Failover and redundancy mechanism validation

- Energy metering accuracy verification (±2% tolerance)

5.2 Performance Testing

- 72-hour continuous operation stress test
- Network coverage and reliability testing
- Energy consumption baseline measurement
- System response time under peak load
- Cybersecurity penetration testing

5.3 Acceptance Criteria

- 100% node connectivity success rate
- Energy savings verification vs. baseline
- System uptime >99.9% during trial period
- All functional requirements verified
- Complete documentation handover

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6. PROJECT DELIVERY

6.1 Deliverables Package

- **Hardware**: All luminaires, controllers, gateways, and accessories
- **Software**: Cloud platform license, admin/user accounts
- **Documentation**:
    - Operation and maintenance manual
    - System architecture diagrams
    - Network configuration details
    - Spare parts list and recommended inventory
    - Training materials and videos

6.2 Training Program

- **Technical Training**: System administration, troubleshooting, firmware updates
- **Operator Training**: Dashboard navigation, report generation, basic maintenance
- **Maintenance Staff**: Component replacement, calibration procedures
- **Training Format**: On-site classroom + hands-on practical sessions
- **Certification**: Competency assessment and certification upon completion

6.3 Warranty Coverage

- **Hardware**: 5-year comprehensive warranty
- **Software**: Lifetime updates and technical support
- **Response Time**: 24/7 technical support, 4-hour critical issue response
- **On-site Support**: 48-hour on-site engineer dispatch for critical issues

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7. OPERATION & MAINTENANCE

7.1 Preventive Maintenance Schedule

Frequency	Activities
Monthly	System health check, energy consumption review
Quarterly	Visual inspection, cleaning, connector tightening
Semi-annually	Photometric testing, sensor recalibration
Annually	Full system audit, firmware updates, battery testing

7.2 Predictive Maintenance Features

- AI-driven failure prediction algorithms
- Automated work order generation
- Spare parts inventory management
- Maintenance cost tracking and optimization
- Performance benchmarking against KPIs

7.3 Lifecycle Management

- **Year 1-5**: Warranty coverage, regular maintenance
- **Year 6-10**: Component replacement planning, efficiency optimization
- **Year 10-15**: System upgrade assessment, technology refresh
- **End-of-Life**: Environmentally responsible recycling and disposal

7.4 Performance Monitoring KPIs

- Energy savings percentage (target: 60%+)
- System uptime percentage (target: 99.9%+)
- Mean Time To Repair (MTTR) (target: <4 hours)
- Maintenance cost per fixture (target: <$5/year)
- Carbon emissions reduction metrics
