Smart Valve Controller



1.Description

The Smart Valve Controller is an AI-enabled retrofit platform that transforms conventional hydraulic valves into fully autonomous and intelligent control units.

Designed for municipal and industrial water networks, it delivers precise pressure regulation, optimized flow management, predictive analytics, and advanced safety functions—without requiring replacement of existing infrastructure.

Its rugged IP68 enclosure, ultra-low power design, integrated solenoid-valve actuation, and secure multi-protocol communication make it the most advanced and reliable solution for modern water network digitalization Key Features.

2.Applications

- Urban and regional water distribution networks
- Pressure reduction and District Metered Area (DMA) zones
- Storage tanks and elevated reservoir level control
- Pumping station protection and efficiency improvement
- Industrial water distribution and critical infrastructure networks
- Emergency shutoff in seismic, flood, or intrusion events

3.Technical Specifications

Parameter	Specification
Processor	Quad-core ARM
Memory/Storage	microSD expandable
Power Supply	9–48 VDC, surge/polarity protection
Power Consumption	< 6 W (average)
Operating Temperature	−20°C to +70°C
Enclosure	IP68 rugged housing
Inputs/Sensors	Pressure (0.5% FS), Flow, Valve position optional acoustic/seismic/intrusion
Actuators	Electro-hydraulic or motorized valve actuation, fail-safe emergency shutoff
Communication	Wi-Fi, Ethernet, LTE, NB-IoT, LoRaWAN, RS-485
Protocols	MQTT, OPC-UA, Modbus RTU/TCP, HTTPS, IEC 101/104, DNP3
Security	Secure boot, encrypted communication, role-based access control, IEC62443 compliant

4.Key Features

- Six advanced control modes: Pressure, Flow, Level, Pump Protection, Reverse Flow, Emergency Shutoff
- Three-layer pressure management with adaptive self-learning control
- Smart alarm system capable of detecting faults under all conditions and instantly reporting them to prevent incidents
- Ultra-low power consumption (<6 W) with intelligent energy management and backup battery for continuous operation during blackouts
- Integrated solenoid-valve block for reliable actuation of pressure-reducing valves
- AI-driven leak detection, abnormal pattern recognition, and predictive maintenance
- Virtual flow sensing – accurate measurement without costly external flowmeters
- Expandable sensor ecosystem: pressure, flow, valve position, optional acoustic, seismic, vibration, flood, or intrusion
- Fail-safe design with automatic fallback setpoints and emergency shutoff capability
- Rugged IP68 industrial enclosure with wide operating temperature (−20°C to +70°C)
- Secure and versatile communication: MQTT, OPC-UA, Modbus, HTTPS, IEC 101/104, DNP3
- Multiple interfaces: Wi-Fi, Ethernet, RS-485, LTE, NB-IoT, LoRaWAN
- Cloud-ready analytics with real-time and historical visualization
- Web dashboard for remote monitoring, configuration, and firmware updates

5.System Architecture

Hardware Layer

- **Processor:** Core ARM, secure boot, encrypted storage
- **Power:** 9–48 VDC, surge and polarity protection, <6 W average
- Backup battery option for uninterrupted operation
- **Sensors:** Pressure transducers (0.5% FS), virtual/analog/pulse flow sensing, valve position feedback, expansion for seismic/acoustic/flood/intrusion
- **Actuation:** Electro-hydraulic or motorized valves with solenoid control, fail-safe shutoff
- **Enclosure:** IP68 rugged housing, −20°C to +70°C

Software Layer

- Embedded multithreaded architecture
- Real-time closed-loop control with adaptive algorithms
- Configurable safety logic: pause if abnormal >30s
- Virtual flow sensing and data consistency checks
- Local event logging and buffering during comms loss

Communication Layer

- **Interfaces:** Wi-Fi, Ethernet, RS-485, LTE, NB-IoT, LoRaWAN
- **Protocols:** MQTT, OPC-UA, Modbus RTU/TCP, HTTPS, IEC 101/104, DNP3
- **Cybersecurity:** Encrypted communication, role-based access, server authentication, compliance with IEC 62443 standards
- **C loud integration:** secure link to central analytics & AI prediction

6.Control & Operation

- Multi-mode automatic and manual operation
- Real-time adaptive pressure and flow regulation
- Programmable setpoints with support for fixed, time-based schedules and flow-base
- Intelligent emergency response, including rapid shutoff in case of anomaly detection
- Remote override capability via secure web and mobile dashboard
- Full integration with SCADA, PLC, and IoT ecosystems

7.Data Storage, Monitoring & Analytics

- Local data logging with high-capacity, industrial-grade memory
- Cloud-based storage for historical and real-time data
- Advanced monitoring dashboards for pressure, flow, position, energy consumption, and system status
- Predictive analytics for maintenance scheduling and fault prevention
- Secure data access with role-based permissions
- Automated reporting and event notification via email, SMS, or cloud APIs

8.Alarm & Safety System

- Configurable thresholds for pressure, flow, and valve position
- Smart alarm handling with instant detection, reporting, and event logging
- Timed response logic (abnormal >30s ➡ control paused)
- Expansion for seismic, vibration, flood, intrusion sensors
- Automatic reports and downloadable logs
- Real-time notifications to operator dashboard and central control system

9.Benefits

- **Leakage Reduction:** Dynamic pressure control minimizes NRW and pipe bursts
- **Energy Efficiency:** Optimized pumping, ultra-low power design
- **Reliability:** Alarm-driven protection prevents system damage
- **Scalability:** Modular design for both municipal and industrial deployment
- **User Empowerment:** Remote dashboard with predictive analytics and reconfiguration
- **Cybersecurity:** Industry-standard secure operation and access control