Introduction of AIoT Management Platform in water treatment plant

Dr. Shan-Shan Chou (周珊珊), Secretary General/WAOT
Dr. Bo-Chuan Cho (卓伯全), CTO/GSD
Introduction of Water Affairs Organization (Taiwan)

- Close co-work partner with industry, government department, university, and institute to promote water industry
- Exchange platform of international and domestic water business
- Promotion of new technologies & equipments about water affairs
- Leverage bridge with supply and demand of water affairs

Application areas:
- Tap water & drinking water
- Sewage & wastewater
- Raw water
- Reused water

Core parts:
- Management
- Technology
- Equipment
- Engineering
- Operation

Information & technology exchange platform
We sincerely invite you to join the community
Water Resources
AIoT Management Platform

Purpose

Complete full-cycle management of water treatment system

Objectives

❖ Equipment life extension
❖ Operational optimization
❖ Energy and cost saving
❖ E Inspection

Programs

❖ Intelligent process remote control
❖ Equipment empowerment to improve efficiency
❖ Preventive maintenance & active warning
❖ Precisely dosing to reduce cost
❖ Trend analysis & full observation
❖ Safe water quality & stable water supply

Strategies

❖ Equipment Empowerment
❖ AIoT Process Control
Water treatment processes
- Coagulation/flocculation
- Sedimentation
- Sand filtration
- Adsorption
- Disinfection
- Membrane treatment

Equipment Management System
- Integrated water treatment equipment
- Integrated pump station
- Aerator Management System
- Pump Management System

Equipment Empowerment
- RS485 sensor
- EP6 IoT gateway

AloT Process Control

Intelligent process monitoring & control modules
- Raw water quality monitoring and active early warning notification module
- Clear water quality monitoring and active warning notification module
- Filter backwash performance monitoring and control module

I.APP
- Intelligent monitoring and control modules for accurate dosing
- Edge Data Collecting
- Edge Computing
Intelligent process monitoring & control modules

- Equipment management system
  - Pump management system
  - Blower management system
  - Aerator management system

- SRP system

- Integrated water treatment equipment
- Integrated pump station

- Equipment empowerment
  - Improves efficiency

- Preventive maintenance & active warning

- Safe water quality & stable water supply

Intelligent process remote control

- Trend analysis & full observation

- Accurate dosing to reduce cost

- Equipment empowerment improves efficiency

- Intelligent monitoring and control module for accurate dosing
- Filter backwash performance monitoring and control module
- Raw water quality monitoring and active early warning notification module
- Clear water quality monitoring and active warning notification module

Intelligent process monitoring & control modules
Equipment health inspection APP
- Vibration
- Current/voltage/frequency
- Bearing & winding temp
- Water leakage detection

Intelligent inspection APP
- Field & equipment inspection
- Personnel positioning & security module
- Image recognition

AI simulation models
- Optimization of coagulant dose
- Optimization of disinfectant dose
- Prediction for backwash of filtration tank
- Prediction of water quality
- Evaluation of overall system performance

Training & Certification

Equipment Health Management Platform

Equipment Life Extension

Intelligent Inspection Management Platform

E Inspection

Water Quality & Treatment Management Platform

Operational Optimization

Resource & Energy Management Platform

Energy & Cost Saving
**Equipment Layer**

- Series of water treatment equipment

**Transmission Layer**

- IoT Monitoring & Control Management System

**Perception Layer**

- Equipment Monitoring
- Water Quality Monitoring

**Monitoring & Control Layer**

- Central integrated management system

---

**Decision-making Layer**

- Water Resources AIoT Management Platform

---

**Control Center SCADA**

**Central integrated management system**

**GSD Situation Room (TW)**

- Intelligent monitoring and control / edge computing / AI control
- Visual monitoring control record display
- Abnormal diagnosis / exclusion record
- Equipment failure alarm / sign-off / maintenance record
- Real-time/historical data query and trend chart
- Big data archive

---

**Flow Monitoring**

- Remote monitoring & control
- Equipment management
- Maintenance forecast
- Performance evaluation
- Energy optimization
- Cost optimization

---

**EP6 IoT Gateway**

**Adam 3600 Gateway**

- Real-time data acquisition / storage / transmission / monitoring
- Automatic scheduling / SMS control equipment
- Get information/device status via SMS
- SMS alert notification

---

**Water Quality Sensors**

- Water Quality Sensors
- pH
- Residual chlorine
- Turbidity
- NH₃
- Water & Sludge Level

---

**Flow Monitoring**

- Flow Monitoring

---

**Submersible pump series**

- Submersible pump series
- On land pump series
- Roots blower series
- Air bearings turbo blower
- Aerator series
- Mixer series
- Integrated water treatment equipment
Stand-alone Equipment Management
- Real-time control of equipment status
- Before equipment failure, alarm to notify maintenance
- For professional technical service team to provide settings, maintenance, technical improvement, equipment optimization suggestions

Multi-equipment Centralized Management
- Quickly build and manage multiple smart equipment.
- It saves time and efforts as there is no need for special software.
- Connecting with the PLC system, the existing control system is upgraded, with function of alarm and remote monitoring functions in case of abnormal events.

Integrated Equipment Management
- Achieving remote monitoring of processing equipment, abnormal alarms, to minimize inspection personnel or even unattendance.
- Built-in 4G module facilitates management of sewage treatment equipment in remote areas.
- Administrators can login to the web page to add new sites by themselves, with no specialist is required to modify program and proofreading.
• Real-time operation information capture
• Real-time measurement, analysis and diagnosis
• Diagnostic report management

• Face recognition
• Safety protection equipment identification
• Hanging object identification
• Recognition of other unsafe actions

• Mobile QR code login
• Flexible checklist settings
• Real-time progress feedback

• Faint judgment
• Inactivity alert
• Fall judgment
• Fall alert
• Distress alert

• GPS satellite positioning
• iBeacon triangulation
• AI KNN nearest neighbor positioning

Accurate detection failure factors hidden to arrange preventive maintenance in advance.

Patrol inspection no longer just pass, but patrol according to items scanned.

Precise positioning, toxic gas detection and safety risk control throughout full process to ensure personnel safety.

Identification of identity/object/unsafe actions for quick detection of risk warnings.
Intelligent Inspection Management Platform
Operational Optimization

Intelligent process monitoring and control modules

- Precisely dosing system
- Performance of filtration backwash
- Raw water quality

Precisely dosing system

AI simulation model

- Precisely dosing
- Water quality safety

- Optimization of coagulant dose
- Optimization of disinfectant dose

- Prediction for backwash of filtration tank
- Clean water quality

- Evaluation of overall system performance
- Prediction of water quality

- Intelligent process monitoring and control modules
Precise dosing intelligent control module

Image recognition and grayscale processing:

Coagulant dosage control

Optimization of coagulant dose

MLSS-1
MLSS-2
E
採樣泵
Sampling Pump
採樣自沉澱池進流水
Sampling From Sedimentation Influent
排放至沉澱池進流渠
Discharge to Inlet of Sedimentation
Filter backwash intelligent monitoring and control module
Disinfectant dosing intelligent control module

- Inflow water
- Turbidity of raw water
- Raw water quality
- Turbidity trend analysis
- Active warning notification
- Turbidity of raw water
- Disinfectant dosage control
- Optimization of disinfectant dose
- Residual chlorine in effluent
- Active warning notification
- Effluent water
- Turbidity of effluent water
- Clean water quality
- Residual chlorine trend analysis
- Raw water quality
- Residual chlorine in effluent
Comprehensive performance evaluation and water quality prediction AI model

- Inflow water
- Turbidity of raw water
- Coagulant dosage
- Filter water level/pressure
- Disinfectant dosage control

Evaluation of overall system performance

- Safe water supply
- Water quality qualification rate
- Residual chlorine in effluent
- Effluent Turbidity

Prediction of water quality
Energy & Cost Saving

- Power consuming status of main equipment
- Accumulated information for energy consumption
- Statistical analysis for energy consumption data
- Demand control and power planning

- Abnormal power consumption
- Equipment operating point adjustment
- Performance evaluation for equipment's energy saving optimization

- Material Invoicing Statistics
- Pharmaceutical Invoicing Statistics
- Equipment maintenance loss statistics

- Man-hour analysis
- Patrol time analysis
- Operation-hour analysis
- Maintenance hour analysis
- Abnormal accident handling hour analysis

- Electric energy monitoring data for main energy-consuming power equipment
- Operation optimization program power equipment power monitoring data
- Management data for material, chemical, consumables and PSI (purchase, sales and inventory)
- Registration information for operation record and working hours

- Energy overview
- Energy performance index
- Energy KPI Management Plan
- Energy demand forecast
- Real-time power consumption information
- Power consumption statistics for the first 6 months
- Electricity statistics
- Energy consumption trend analysis
- Historical data query

- Material consumption cost analysis
- Chemical consumption cost analysis
- Cost analysis of equipment maintenance loss
- Operation and maintenance labor cost analysis
  - Patrol site manpower
  - Inspection manpower
  - Operation manpower
  - Maintenance manpower
  - Abnormal accident handling manpower
For example, through the "Energy Consumption Overview", you can monitor the accumulative power consumption of each district, and know which unit, equipment or area the power consumption comes from, and find out the unreasonable energy consumption after comparing the differences between the districts; For high power consumption equipment (such as blowers), the power consumption profile can be monitored.

Through the "Energy KPI Management", the total power consumption can be allocated to each unit, so as to formulate energy-saving KPIs, and review the rationality of power consumption with the energy-consumption responsibility system. Consolidation and analysis of energy-related data, so as to know processing efficiency from changes in energy consumption.
Thanks for Your Listening!