Paddy Field Irrigation Monitoring and Control Using Internet of Things

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Most irrigation schemes are of river type. No reservoir or dam to store water. Water are stored mainly on the main canal. Main canal supply water to tertiary canals through the water gate on every 200 meters apart.
Paddy Planting Area - Selangor

In most of the paddy planting area, the irrigation scheme are off-river type with no reservoir or dam to store water.
Irrigation water is delivered directly from the main canal to tertiary canals.
- Regulated by water gate (about 200 m apart along the main canal).
- Standard irrigation block has coverage area of about 150-200 ha.
- Irrigation blocks receives water in their paddy plots direct from two tertiary canals.
Tertiary Canals

Tertiary Canal Water Gates

- Current water gates operated manually by a gate keeper.
- Gate keepers will open or close water gates allow water to flow from main canal into tertiary canals.
Challenges in Irrigating Paddy Field

- Current irrigation system operated manually.
- Gate keepers take hours to reach water gates to open or close them to supply water from main canal to tertiary canals (due to large area of coverage)
- Gate keepers role become extremely critical during dry season.

Good irrigation control

Poor irrigation control
Automation the Penstock at Tertiary Canals Using IoT

- Automate the system to control irrigation/water level.
- Each of tertiary canal water gates is installed with automated system to control water level.
- Automated system is powered using solar power.
Photo above show the typical water gate located beside the Main Canal. The river water is channelled to the tertiary canal through the penstock.
IoT System Architecture

- **IO Module**
- **UPA**
- **Gateway**
- **Data Transport Broker**
- **Data Ingestion & Processing**
- **Persistence & Concurrency**
- **TCP/IP**
- **MQTT, HTTPS, CoAP, REST, XMPP, DDS, etc.**
- **WIFI + LP Wi-Fi**
- **Bluetooth + BLE**
- **2G/3G/4G/LTE (GPRS)**
- **Ethernet**
- **WiHART**
- **Satellite**
- **Sensors**
- **Gateway**: Identity Protection + Secure Boot
- **UPAL**: Protocol Abstraction Layer
- **Device Attestation**
- **Security & Edge Management Systems**
- **Query**
- **Storage**
- **Compute**
- **Services Orchestration**
- **Analytics**
- **Metadata Catalog**
- **Cloud Management System** (Monitoring, Auto Scaling, Logging, Eventing)
1. Base on Water Level

- Level sensor will monitor water level in tertiary canal.
- Maximum and Minimum level is set in IoT gateway.
- If water level is low, IoT gateway will signal the actuator to open water gate to allow water to flow in from main canal.
- Once water level in tertiary canal reach the max level, the IoT gateway will signal actuator to close the gate to stop water from flowing into the tertiary canal.

![Diagram showing water level control](image)
Method of control

2. Remotely control via Internet

- Water gate is installed with control system which is linked to the internet.
- Gate can be controlled using a computer installed in control room (could be located in office) or using a internet phone/tabs.
Advantages of Our System

1. Efficient distribution of water.

2. Each gate can operate simultaneously and independent from each other.

3. Reduce “human involvement” in opening and shutting of water gates.

4. Reduce “time delay” as gate keepers needs to cover a wide area.

5. Max and Min water level can be adjusted remotely (eg. During dry season water level at main canal drops, tertiary water gates can be programmed to shut at a lower water level)

6. Water level of each tertiary canal can be recorded and plotted in a trending chart for records for improvement studies (to better manage and plan of water utilization)

7. System will report any water level which exceeded the set target.
**Trending Report** (eg. Canal Water Level, Rainfall, Temperature, etc)

- Data such as water level, rainfall, temperature can be captured and recorded for research purpose.
System Implementation

The IOT Gateway interface with I/O Module. Communicate through the 3G Modem to the Cloud server at dedicated data centre.
Use the industrial Digital I/O and Analog Input Modules as the field interface modules. With the Ethernet connection to IOT gateway. The IOT gateway as the MODBUS Master retrieve data from the I/O module.

System Architecture

- Penstock Fully Open Status
- Penstock Fully Close Status
- Power Failure
- Solar System Battery Low
- Cage Door Open
- 4-20mA Signals:
  - Water Level
  - Barometer Pressure
- RTD Signals:
  - Ambient Temperature
  - Equip. Rack temperature
The propose system (Canal Water Controller) will consist of local controller, which collect data from the sensors and forward to the cloud server which the data collected is processes and analyse.
The smart device can access the Data Centre to view the status of the site situation anywhere, any time in the world.
The IoT Solution for Agriculture will be implemented along the Main Canal and the Tertiary Canal.
Site Photo
Thank You!

Good Management Yields Bountiful Harvest