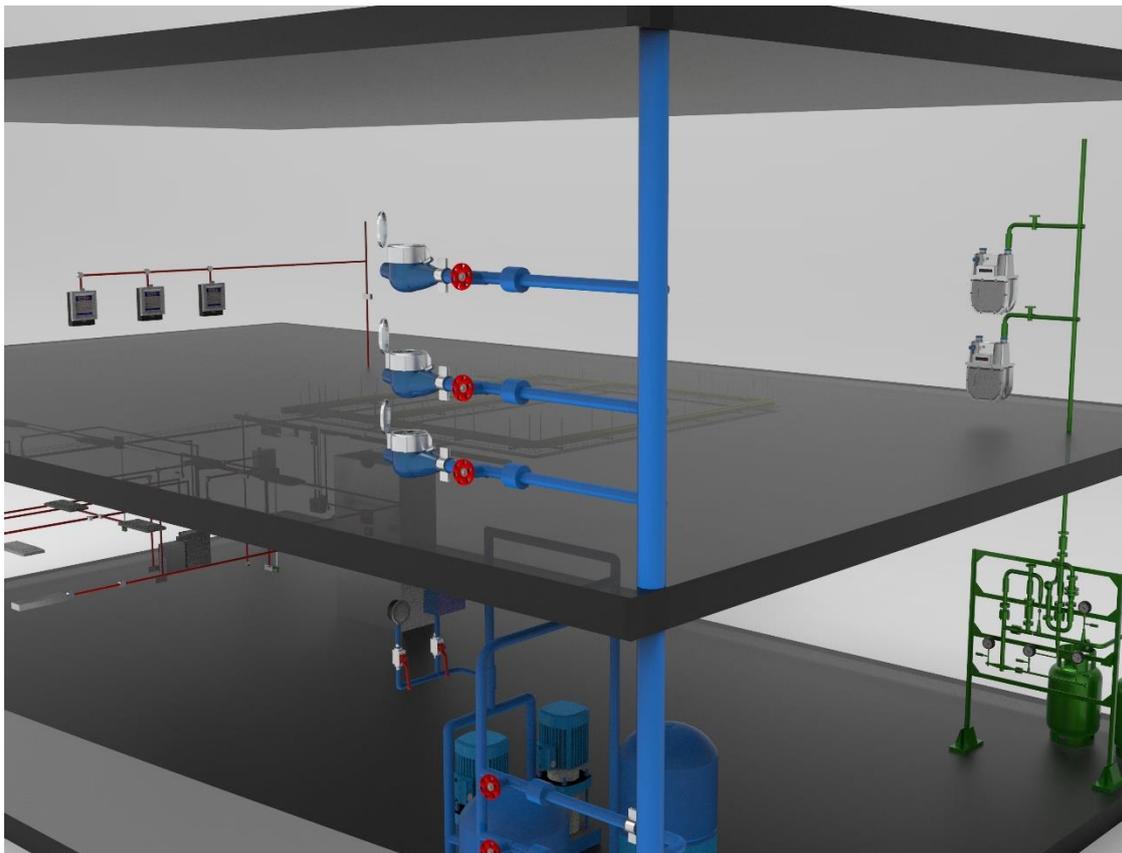ELITEUN AI-AMI digital & analog Hybrid Meter Reading System

HMRS

System Introduction

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ELITEUN INTELLIGENCE TECHNOLOGY LTD

Contents

1 System Overview

1.1 Background

The development of economy prompted an increasing demand for energy and higher requirements for energy metering management. Advanced operation facilities and automated measurement systems are essential for strengthening competitiveness of a region and for promoting economic development. The increasing challenges have made adopting advanced measurement systems that are applicable to various environments an imperative. Restructuring the energy market strategically to achieve sustainable energy development becomes a major focus of enterprises.

Current measurement systems tend to contain a series of issues such as:

➢ Analog and digital devices are managed in separated systems.

➢ The incapability to interact with field devices via remote management leads to poor interoperability and timeliness.

➢ Actual consumption of water, electricity and gas cannot be analyzed in real-time as references to estimate the consumption of next cycle, thus the challenge to save cost remains.

➢ Traditional manual meter-reading and measurement methods are hard to apply in distributed device systems.

1.2 Positioning

Effective management methods are needed to control energy consumption properly, to monitor and adjust energy supply, and to improve energy dispatch efficiency. HMRS (Hybrid Meter Reading System) is dedicated to helping water, electricity and gas companies to realize automatic meter reading, anomaly analysis, and remote terminal control. This solution provides better user experience, improves energy supply process, and helps to save energy. It also enhances enterprise operation efficiency and lowers operation costs.

Instead of replacing existing equipment with new ones, HMRS serves as a more flexible solution for enterprises. This system not only connects the plug and play Smart Meter Reading Modules to analog meters, maintaining the value of old devices and protecting the investment of historical equipment, but also connects to digital meters, so both old and new meters can be centrally managed on the same platform, facilitating business operation and reducing operation and maintenance costs.

HMRS is the link between the original analog devices and the current digital devices in the era of Internet of Everything, avoiding resource waste caused by eliminating historical investment in the process of business digital transformation. The system fits in different environment by choosing different communication, including wired technologies of RS485 or wireless technologies of GPRS, Lora or NB-IoT.

HMRS is also highly scalable as it can access a variety of sensors in the data perception layer and third-party application system in application layer as required, so it is truly *usable*, *easy to use* and *commonly used* at a business level.

HMRS consists of data acquisition devices and data management application. Data are acquired at perception layer through embedded technology. Data management application system is deployed at the application layer to manage the entire process. With both hardware and software development strength, ELITEUN's self-developed software and hardware are highly coordinated, ensuring HMRS package delivery with high standards.

1.3 Highlights

ELITEUN HMRS is featured with the following functions:

➢ AI algorithm recognizes photos of the dial-plate of analog meters as numbers.

➢ Digital & analog meters are managed on ONE platform.

➢ It enables instantaneous interaction between cloud monitoring system and controlling devices around the meter.

➢ Intelligent data acquisition and management facilitate consumption estimation and on-site device control.

➢ The system supports distributed and large-scale deployment, provides real-time reports on consumption data and field device status.

➢ The system is highly scalable and supports various sensors.

➢ Industrial-grade security protocols are applied to ensure data security.

1.4 Benefits

ELITEUN HMRS system brings the following benefits to customers:

➢ A hybrid management platform empowers enterprises to accelerate their digital transformation.

➢ Instant response provides real-time data insights for business strategies.

➢ High security and scalability maximize the value of the metering system.

2 Network Architecture

2.1 Networking Overview

ELITEUN HMRS applies an integrated, open network architecture composed of three layers: application, data transmission, and data perception.

Components:

➢ Application layer: manages terminals and all functions. HMRS system contains application system, database, and third-party system (accessible).

∎ HMRS application system and database – Cloud Server

– manages HMRS relay system, creates commands to control field devices, assigns and delivers commands to HMRS relay system for processing.

– The cloud carries out operation management such as statistics analysis, generates reports, and timely reading of terminal devices. It helps energy companies to manage the volume consumed by users.

∎ Third-party application system (accessible): connects to HMRS to form a closed loop management including payment, line loss and other business process.

➢ Data transmission layer: refers to the carrier network between application layer and data perception layer.

➢ Data perception layer: contains HMRS relay system, data acquisition units, Smart Meter Reading Modules, and other sensors deployed.

∎ HMRS relay system-Relay Server

– manages the data acquisition unit cluster and terminals, executes commands, distributes and delivers tasks to data acquisition units or to other terminals.

– can function as a gateway to transmit data between data perception layer and application system.

∎ Data acquisition unit: collects data from Smart Meter Reading Modules, and uploads data to HMRS relay system through protocol conversion.

- Smart Meter Reading Module: a built-in camera to snap photos of the meter dial plate in real time, the module uploads photos to data acquisition unit. It can get charged through Power-bus simultaneously.

- Smart meter: with built-in GPRS, NB-IoT or Lora module, it can directly communicate with HMRS relay server wirelessly without going through data acquisition unit.
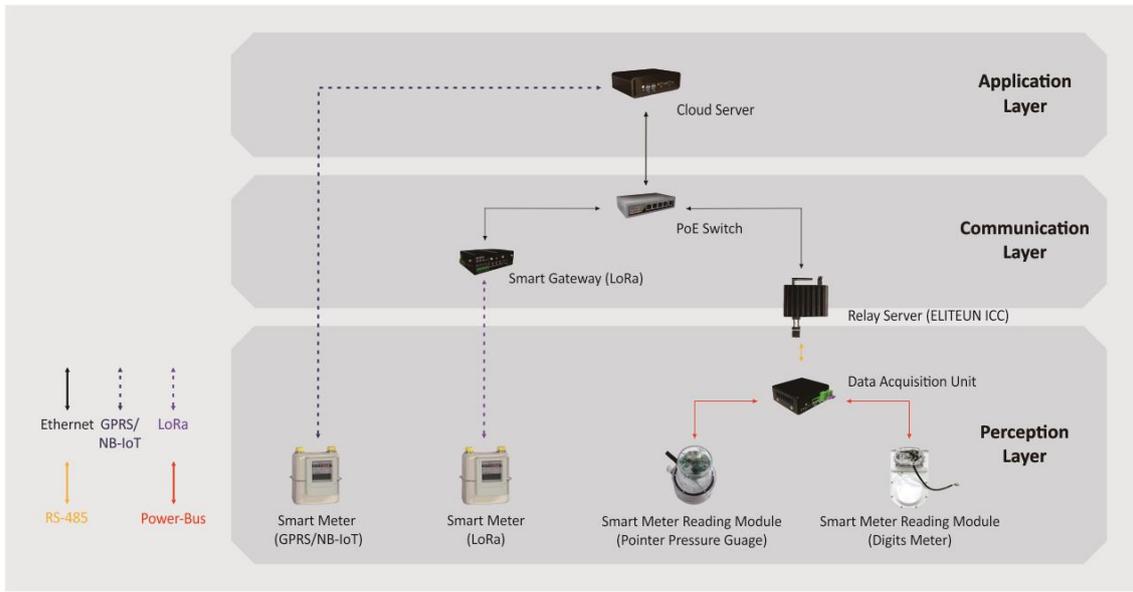
2.2 Networking at Different Layers

2.2.1 Network at application layer

In HMRS, database and third-party application systems (accessible) in application layer are both deployed in Cloud Server. Devices and systems communicate with each other by HTTP/HTTPS based on Ethernet. Application systems are connected to HMRS relay system through wired network or wireless GPRS/3G/4G network.

2.2.2 Network at data transmission layer & data perception layer

➢ HMRS application system communicates with relay system through carrier network. A Data Transfer Unit (DTU) server can be deployed between Relay Server and Cloud Server, connecting HMRS Relay Server through LAN, while connecting HMRS Cloud Server through 4G.

➢ Data acquisition unit uplinks HMRS relay Server through RS-485. It connects and supplies power to Smart Meter Reading Module via Power-bus. This wired mode ensures the

reliability of communication in an area where cabling is convenient. The valid communication distance between Smart Meter Reading Module and data acquisition unit can reach as far as 150 meters.

➢ Smart meters with embedded GPRS/ Lora/ NB-IoT communication modules can be wirelessly connected to relay servers via their own communication protocols. It is suitable for areas where devices are widely distributed and cabling costs are high.

3 Basic Functions of the HMRS System

3.1 Data Acquisition

Data Acquisition refers to the process of acquiring information from terminals, which is the core function of HMRS. It feeds original data to upper-layer application system to realize more functions such as energy consumption volume analysis and device management. HMRS can obtain device data including the usage, running status, and parameter settings.

3.2 Consumption volume anomaly analysis

HMRS application conducts consumption volume anomaly analysis based on acquired data. The application system can detect and categorize unexpected data once they are pre-defined. If unexpected data is detected, an alert and a notification is sent to the corresponding personnel requesting further actions.

4 Functions of Components

4.1 HMRS System

Based on the Bee Force™ IoT cloud platform, HMRS acquires and processes data and controls on-site devices intelligently, leveraging data insight to drive business transformation. The system consists of intelligent recognition, data acquisition, data analysis, profile management, device management and system management.

➢ Intelligent recognition: snapped dial reading photos are pre-processed, such as rotated or cropped. The information in photos will be recognized, extracted and transformed by computer vision algorithms. In addition, the transferred text appeared on the interface can be manually adjusted. (this function is only authorized to super administrators)

➢ Data Acquisition: acquire consumption volume data and parameter information of each device.

- Data Analysis: organize and analyze acquired data and present them in various charts and reports

- Profile Management: administrators can log in to HMRS on different terminal devices to create, modify, delete, query and export the files of suppliers, users and terminals.

- Device Management: data acquisition units and terminals are centrally managed, including online status, topology, parameter configuration, software information query, remote device upgrade, remote maintenance and device installation, replacement, and removal.

- System Management: administrators can assign different authorizations to different users, and maintain information of users, passwords, system idle timeout interval, system tasks, licenses, data overflow dump, and of error codes.

4.2 Industrial Control Computer (ICC）

ELITEUN ICC with strong computation can provide ultra-fast data processing and access. It is used to deploy HMRS application system or HMRS relay system.

- Dual ethernet ports perfectly fit for flexible configuration.

- High performance processing achieves fast and smooth data experience.

- Small size design takes up less space, making it light and easy to install.

- Synchronous / asynchronous dual-display and supports VGA and HDMI.

4.3 Data Acquisition Unit

Data acquisition unit is applied in analog & digital hybrid meter reading scenarios. Its downlink connects to Smart Meter Reading Module by Power-bus. It uplinks to Relay Server by RS-485. Overall, it undertakes tasks of data acquisition, protocol conversion, and power supply to Smart Meter Reading Module.

4.4 Smart Meter Reading Module

ELITEUN Smart Meter Reading Module is a self-developed high-end device which takes pictures of the meter by its embedded camera then recognizes the digits in the reading. With Power-bus, this module helps to remotely and intelligently read, monitor and manage meters in real-time.

- It identifies non-smart meter scale intelligently.

- It supports hybrid connection of both smart and non-smart meter.

- It supports wired or wireless transmission from terminal to cloud.

- ➢ It supports remote intelligent control.

- ➢ It supports mass deploy and management at a scale up to million devices.

- ➢ It connects to various sensors to support real-time on-site monitoring.

- ➢ It is simple to implement, flexible to deploy and easy to maintain.

- ➢ It is an open system for easy connection to third-party system

4.5 Other Sensors

HMRS can also access to various sensors to monitor and manage the surrounding environment of meters, such as infrared, temperature and humidity sensors, to help users realize more comprehensive remote field control. Communication of sensors can be realized via wired RS485, or wireless methods such as GPRS, Lora, NB-IoT, etc.

5 Performance and Specifications

5.1 HMRS Application User Interface

5.1.1 Overview

It displays meter status by region.

5.1.2 Overview by region

It displays meter status and consumption statistics for designated area.

5.1.3 Centralized meter reading

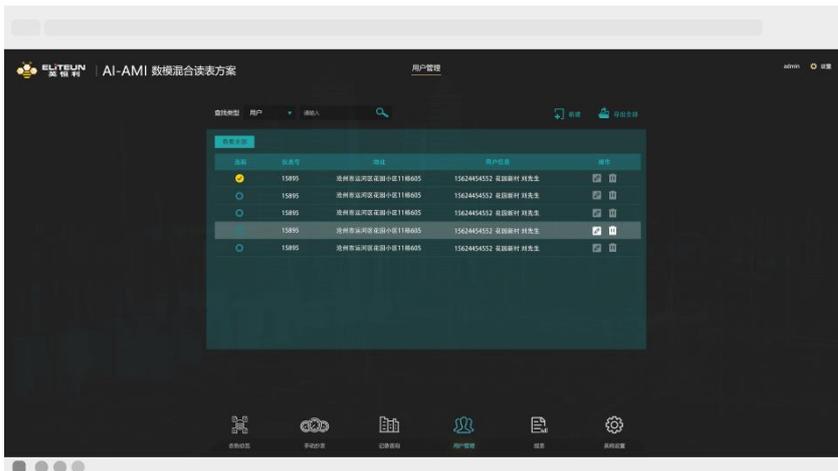Centralized meter reading by region, it displays the status of real-time meter reading.

5.1.4 Single meter reading

Parameters are configured for single meter reading for remote maintenance and verification.

5.1.5 User management

User information is centrally maintained and data can be exported anytime.
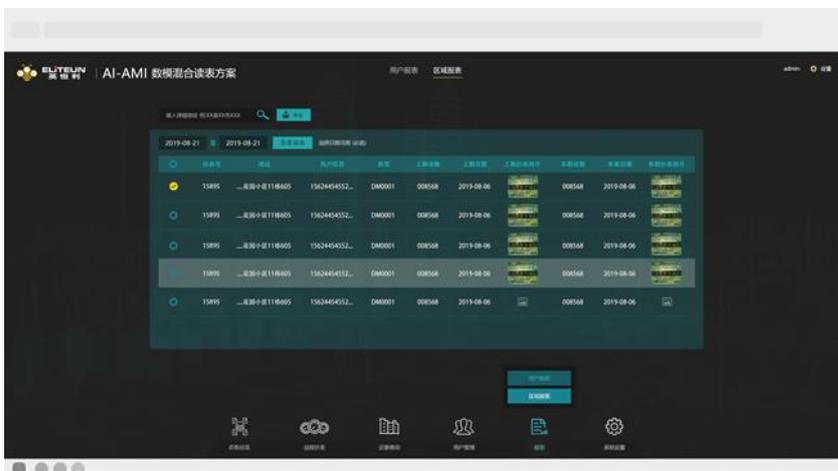

5.1.6 Create user

Meter information is directly added while creating a new user.
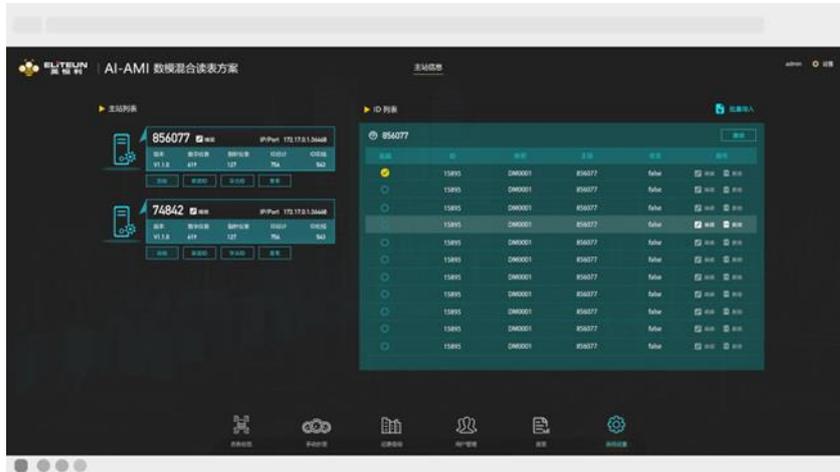
5.1.7 Report by user

5.1.8 Report by region

5.1.9 Settings

Data acquisition units and all the meters connected to it are centrally managed

5.1.10 Help

It provides FAQ and general settings.

5.2 Specification of Industrial Control Computer (ICC)

Category		Specification
Processor	CPU	Intel Celeron Processor J1900, 4 core
	Frequency	2.0GHz Turbo 2.42GHz
	L2 Cache	2MB
	BIOS	American

Memory	Type	1 single channel SODIMM slot，DDR3L 1066/1333/1600MHz
	Max Capacity	8GB
	Socket	1*204-pim SO-DIMM
Display	Chipset	Intel IBay Trail, max power consumption: 10W
	Graphic Engine	DirectX11.1.OCL 1.2，OGL 3.2
	VGA	Maximum supported resolution: 2650×1600@60Hz
	HDMI	Maximum supported resolution: 1920×1200@60Hz
	Dual-display	VGA+HDMI, Synchronous / asynchronous dual-display
Ethernet	LAN1	10/100/1000/ Mbps Realtek 8111F, wake-on-LAN
Audio	Main system	Audio control chip: Realtek ALC662, dual track, stereophonic, line out
I/O	Serial	scalable
	USB	1×USB3.0 4×USB2.0
Other		Watch dog timer
Extension	Mini-PCIE	1 × Standard Mini-PCIE
Storage	HDD	SATA2.5"HDD （Highest data conversion rate: SATA2.0）
	SSD	1 × Standard mSATA socket
Software	OS	Windows7 Windows8 Windows10
	Linux	ubuntu/LINUX/CENTOS
Power supply	Power type	DC-IN5.5*2.5
	Input voltage	12V
	Power adapter	DC 12V 3A/36W (AC TO DC,100~240V)

5.3 Specification of Data Acquisition Unit

External input interface	RS485
	RS232
External output interface	POWERBUS 总线输出
Power supply	DC 12~48V
Operating temperature	-20℃~+85℃; 10%~95%RH
Power	4W

5.4 Specification of Smart Meter Reading Module

Category		Specification
CPU	MCU	Espressif Systems ESP32 Xtensa 32-bit LX6
	Frequency	2-60MHz
	Wireless	2.4GHz Wi-Fi and Bluetooth
	Process	40nm
Camera OV2640	UXGA	1600 x 1200
	Output Format 8-bit	YUV 422/420 / YCbCr422 RGB565/555
	Pixel	200W
	Focal length	3.2 meters
	Aperture	2.8
	Field of view	60°
Others	Power type	Power-bus
	Input voltage	24V
	Current	10mA
	Operating temperature	-25℃~70℃
	Certification	IEC II 3G Ex ic IIC T6 Gc