

Network Services for Stores

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ABSTRACT

It has recently become an urgent priority for retail industry, including supermarkets and convenience stores, to save energy and solve labor shortages due to the declining birthrate and aging population. To address the challenges, Fuji Electric has developed a network connection system to collect operational information and alarm histories from each store equipment, such as showcases, and to deliver data to the equipment via the cloud. A function that analyzes the operating conditions of equipment and detects signs of abnormality is equipped to allow for preventive maintenance of each piece of equipment. In addition, monitoring trends by store and equipment allows users to reflect them to operation control conditions and maintenance plans, contributing to energy saving and improved efficiency of operational tasks.

1. Introduction

Various industrial sectors are being asked to contribute to achieving the sustainable development goals (SDGs). The retail industry, typified by supermarkets and convenience stores, is currently faced with the urgent task of promoting energy saving to help combat global warming and to solve labor shortages caused by the declining birthrate and aging population in Japan. Fuji Electric has been offering its “Ecomax” Series, a line-up of equipment cooperative control systems that contribute to energy saving in stores, since 2011. In this paper, we will describe the development of a network system for stores with greatly expanded features and performance, as well as information on the availability of services.

2. Circumstances Surrounding Convenience Stores

Convenience stores are creating new sales points by expanding small-volume ready-made meals and frozen foods as well as by expanding the selection of freshly prepared products at sales counters in order to meet new needs, such as the rise in demand for take-out foods and sales without face-to-face interaction due to the impact of COVID-19 restrictions. It is against this backdrop that convenience stores are deploying new types of equipment. At the same time, in order to reduce CO₂ emissions and power consumption, equipment manufacturers are taking initiatives to promote the use of renewable energy sources and achieve energy-saving in store equipment. In addition, labor

shortages due to the declining birthrate and aging population in Japan have forced some stores to stop operating 24 hours a day. Even stores that are increasingly employing senior citizens and foreign nationals are looking for ways to save labor in store operations through the use of digital technologies, in order to alleviate the steep learning curve of store equipment.

3. Characteristics of Network Services for Stores

Fuji Electric has been offering convenience stores with a wide variety of equipment, such as refrigeration equipment (showcases and cooling units), counter fixtures (warming and cooking equipment installed next to cash registers) and automatic change dispensers, as well as facility management systems designed to improve energy and maintenance efficiency for equipment. When we first launched our facility management system in 2011, we designed it to save energy and improve maintenance efficiency for individual stores. Today, however, we are faced with the need to solve challenges common to entire convenience store chains, such as reducing CO₂ emissions and saving labor in store operations. In this respect, there is a need to optimize the entire convenience store chain by increasing the number of stores managed by systems.

Next, we will describe the characteristics of our newly developed network services for stores.

3.1 Systems for store controllers

(1) Overview

Figure 1 shows the system configuration for store controllers. Store controllers are connected to showcases, cooling units and watt-hour meters in stores, and also communicate with external servers via the Internet.⁽¹⁾ Conventional systems communicate with the outside world by synchronizing data to the cloud

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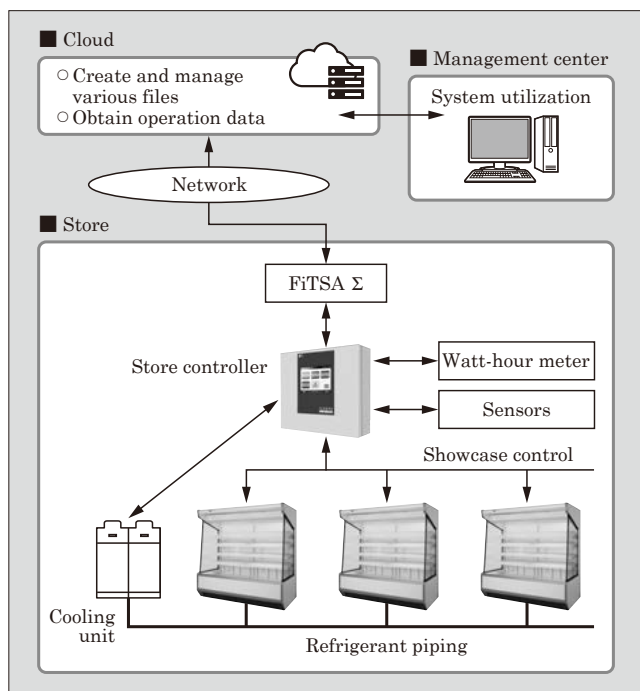


Fig.1 System configuration for store controllers

via virtual private networks (VPNs) and file transfer protocol (FTP) connections. The problem is that introducing this system to thousands or tens of thousands of stores would require an increase in server routers for VPNs and an expansion of server resources due to the increase in data collection time. In contrast, our new system uses message queuing telemetry transport security (MQTTS) as the communication protocol, since it is both large-scale and highly secure. Because MQTTS communication sends data asynchronously, it can send data to servers even in unstable network environments, facilitating expansion to tens of thousands of networks. It also uses Fuji Electric's "FiTSA Σ " IoT/M2M controller instead of a VPN server router to achieve MQTTS communications. The FiTSA Σ is a SIM-integrated product that supports MQTTS communications. The store controller has FTP server and web server functions and can be used to easily transfer and modify various types of files to and from an external cloud.

(2) Operational support for refrigeration equipment

Refrigeration equipment in stores must store products at optimal temperatures at all times and operate continuously 24 hours a day, 365 days a year. Furthermore, because refrigeration equipment consumes a large amount of power, optimizing its operation can significantly contribute to energy saving in stores. Conventional systems have functions to visualize operation data (such as being HACCP compliant), alarm history and power data.

In addition to the functions of conventional systems, our newly developed system also has the ability to analyze the operating status of equipment and detect signs of abnormalities, enabling predictive maintenance of each piece of equipment through the analysis

of operating data. It can also track trends by store and by equipment and reflect them in maintenance plans.

These functions can detect failures in advance and shorten repair lead times, and by using power consumption records to compare data not only for each device but also for each store and region, it can distribute setting conditions for operation control that are highly effective in saving energy, thereby achieving energy saving for the whole convenience store chain.

3.2 Counter fixtures

Since a counter fixture is used to prepare and dispense food products in stores, routine maintenance is essential, such as replenishment of ingredients used in sales and periodic cleaning of the fixture.

Figure 2 shows the system configuration of a counter fixture. The newly developed system collects information on the operating status of the counter fixture and alarms. It detects and records the detachment and attachment of parts that need to be cleaned, so that the status of maintenance can always be known. It can inform clerks of areas that need to be cleaned and when to do so, and encourage them to ensure that maintenance is performed.

In addition, a counter fixture is expected to offer products with renewed flavors and aromas in accordance with changes in seasons and tastes in order to attract new customers and retain existing ones. To accomplish this, food preparation methods for the counter fixture need to be adjusted to match the timing of menu changes in the stores. The newly developed system pre-registers the control data of the counter fixture according to the new menu recipes in the cloud. The control data is distributed to the counter fixture via the network, but is not immediately executed. The control data is updated when maintenance work is performed so that new menus can be offered. This ensures that menus can be updated without requiring

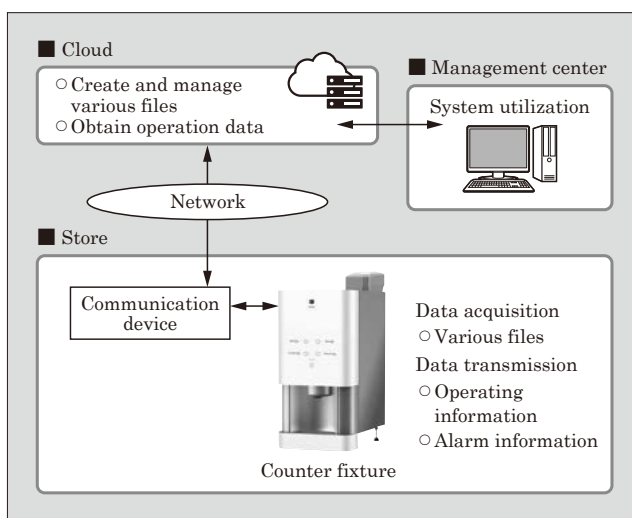


Fig.2 System configuration of counter fixture

cumbersome procedures. This feature also makes it easy to implement sales promotion measures such as area-specific or time-limited product offerings.

3.3 Automatic change dispensers

Automatic change dispensers are devices that interface with point-of-sale (POS) registers to automatically accept and dispense cash at checkouts, and have been increasingly deployed in convenience stores to reduce the labor required for checkout tasks.⁽²⁾ They are increasingly requiring features that facilitate operations and contribute to labor saving.

Figure 3 shows the system configuration of a change dispenser. The newly developed system records into the interfaced POS system the history of cash transactions, such as the number of deposits and withdrawals of coins and bills into and out of the automatic change dispenser, as well as the history of operations such as deposits, withdrawals and key operations. These records can also be viewed from management centers connected via the network. These

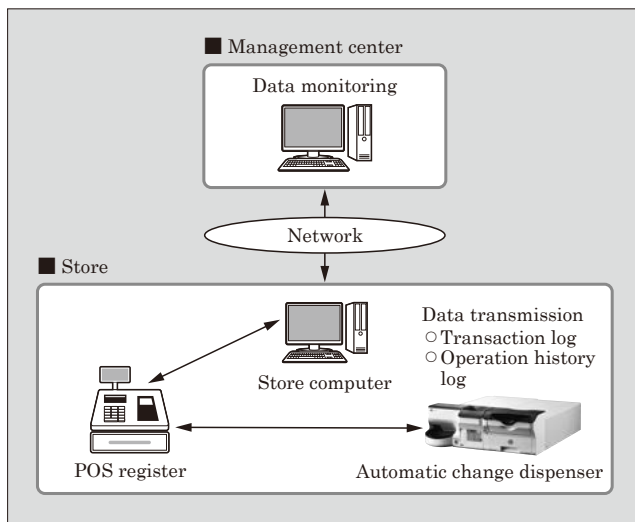


Fig.3 System configuration of a change dispenser

functions help reduce the load on stores by allowing management centers to grasp the status of equipment in the store, making it possible for them to perform various tasks, such as restoring equipment in the event of an operational error by an untrained clerk and promptly responding to equipment malfunctions.

4. Vision for the Future

Currently, energy and labor saving can be achieved by optimizing the operation of refrigeration equipment and air conditioners, since these types of equipment consume large amounts of electricity. In order to further reduce CO₂ emissions, we are planning to develop a new store controller with a built-in energy management system, and envision a system that can expand the use of renewable energy sources for electricity supplied to the stores from the outside. We believe that popularizing such a system in supermarkets and convenience stores throughout Japan will contribute to reducing CO₂ emissions.

5. Postscript

In this paper, we described the latest network services for stores, which contribute to further energy and labor saving in store operations.

In the future, we intend to contribute to the retail industry, typified by supermarkets and convenience stores, by working toward further energy saving and the use of renewable energy sources through connection of in-store and out-of-store systems.

References

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