Expansion of Vending Machine Operation Services

TANAKA, Seiichi*   **YANAGAWA, Hiroyuki***   **MIZUNO, Kenta***

ABSTRACT

In the vending machine business, there are calls for efforts to contribute to the SDGs, such as by improving the working environment and reducing food loss and waste. Having been rolling out its Vending Machine Operation Services to improve the efficiency of vending machine operation, Fuji Electric has now developed new functions. These functions are dynamic pricing, which changes product selling prices according to set rules; a smartphone remote controller, which simplifies vending machine remote operation; and New QR Code Payment, which enables the introduction of QR code payments at a low cost. These functions are expected to reduce operating hours by 20%, create an easy operating environment, and increase sales of vending machines.

1. Introduction

Fuji Electric has long been offering the "Vending Machine Operation Service" for businesses that operate vending machines to help improve their operational efficiency. In response to the recent rise in calls for contributions to the Sustainable Development Goals (SDGs), operator companies are stepping up efforts to take on challenges such as improving working environments and reducing food loss and waste. Since 2020, we have been gradually offering new and expanded services that address these issues and increase sales. This paper describes our expanded Vending Machine Operation Service.

2. Challenges in Operation of Vending Machines

The vending machine market is saturated in Japan. In addition, the expansion of retail channels, such as supermarkets and convenience stores, has intensified sales competition, which poses challenges for vending machine operators in terms of how to increase sales per vending machine.

Furthermore, with the decline in the working-age population due to the declining birthrate and aging population, and with the need to review and improve working environment in response to work-style reform, operators are looking for ways to improve efficiency in sales and inventory management operations. For example, workers who make their rounds of vending machines, having to go around multiple locations in a day, cannot increase the number of rounds any further because their jobs are very time-consuming, such as product replenishment and product replacement along

with price changes. New measures are also required to address the issue of having to dispose of items that have not sell before the best-before date.

3. Foundation for the Vending Machine Operation Service

To date, Fuji Electric has built a system that quickly transmit information to operators and other staff on sales, items sold out, failures, and operation of the vending machines. The information is aggregated on a cloud server in real time via a multi communication unit (MCU) integrated in vending machines. Figure 1 shows the system configuration of vending machine operation services. These existing services provide inventory management, which associates information about replenishment of products in vending machines with that about sales at vending machines, enabling remote management of product inventory and best-before dates, as well as route management, which provides suggestions for the best route to take based on the inventory information and route information.

The vending machines are connected to cloud servers via the Internet, and information is encrypted and sent back and forth. Cloud servers also ensure security by restricting access through operator user authentication and vending machine device authentication.

4. New Management Service Options

Fuji Electric has developed the following the Vending Machine Operation Services as listed in Table 1: dynamic pricing, which changes product sales prices remotely according to set rules; a smartphone remote controller that simplifies the operation of vending machine remote controls, which would otherwise require

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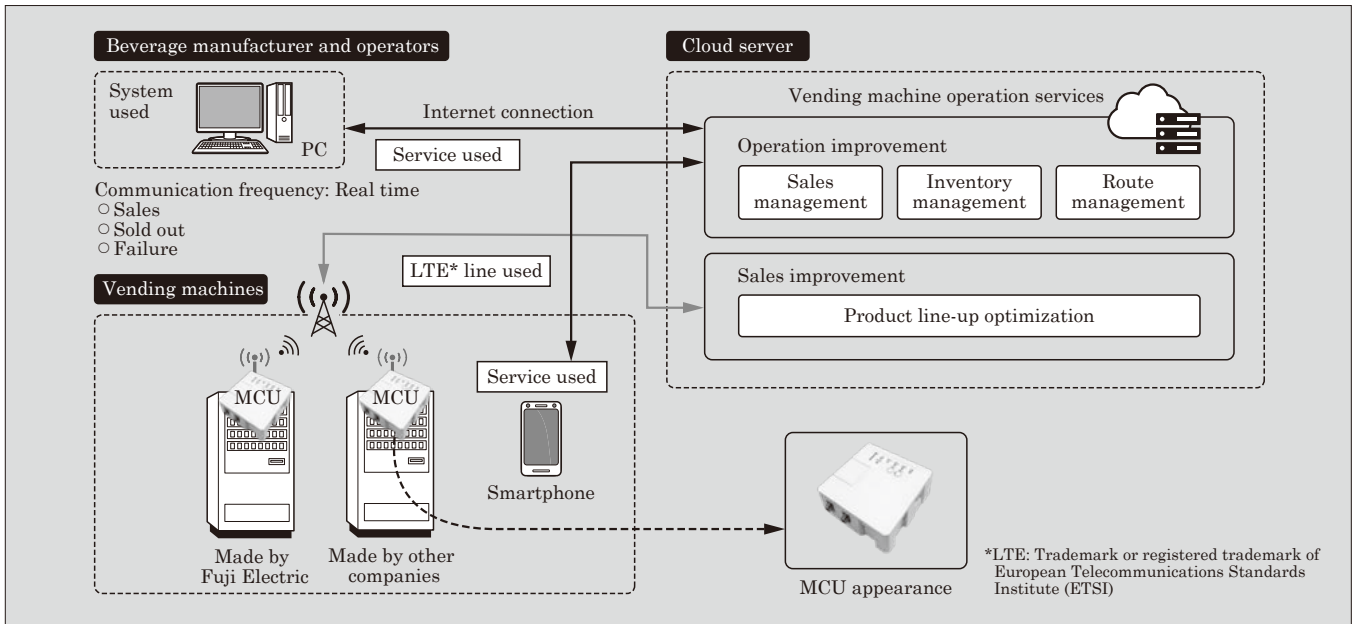* Food & Beverage Distribution Business Group, Fuji Electric Co., Ltd.

Fig.1 System configuration of the Vending Machine Operation Services[1]

Table 1 Examples of the Vending Machine Operation Services

Effect of introduction	Service
Operation efficiency improvement	Sales management
	Inventory management (sold out products, best-before dates of products, etc.)
	Route management (rounds and replenishment plan)
	Dynamic pricing
	Smartphone remote controller
Sales improvement	Product line-up optimization
	New QR Code Payment

☐ : Services described in this paper

proficiency to operate; and New QR Code*1 Payment, which enables the introduction of QR code payment at a low cost.

Table 1 shows the new service options developed to improve the efficiency of vending machine operation, along with the conventional options. Details of the features of these new services and their effects are described as follows:

4.1 Dynamic pricing service

Product discounts have long been used to sell off products in order to promote new products or replace products. Recently, unmanned sales without face-to-face interaction have attracted attention due to the COVID-19 pandemic, and food vending machines are also becoming more widespread. There is also a need to reduce food loss caused by a failure to sell products before the best-before dates.

Price changes for discounted sales currently require the use of the remote controller come with the

*1: QR code: Trademark or registered trademark of DENSO WAVE INCORPORATED

vending machine to change the pricing for each item. Furthermore, vending machines that do not have an automatic price display function to display changed prices need manually changing the price labels in the product display. These tasks require operators to go to the locations of vending machines and are a major burden for vending machine operations.

To improve the efficiency of such operations, we have developed a new dynamic pricing service capable of changing the prices of items in vending machines remotely and automatically. Figure 2 provides an overview of this service.

With this service, operators can access the cloud server provided by Fuji Electric from their company devices and change the settings of the respective vending machines to which rounds are made. The changed
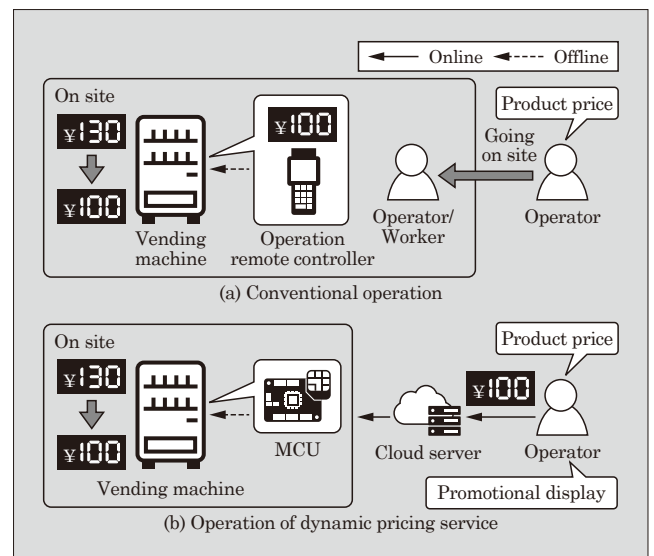

Fig.2 Dynamic pricing service overview

settings are sent from the cloud server to the vending machines via the vending machine MCU to reflect the new settings. This eliminates the need for operators to make rounds for pricing changes. In addition, the service allows operators to make changes based on the set rules according to their use cases. For example, available functions include a function to change the specified date/time/period for limited sales (timed sales) for events and prior to seasonal product changes, as well as a function to change the equipment and inventory condition specifications, which takes into account equipment conditions such as installation location, as well as inventory conditions such as sales and expiration dates.

In conjunction with this, we have also developed a new price display button that can maximize the effect of the dynamic pricing service. Figure 3 shows a conceptual image of the new price display button. The new features enabled by this new price display button are described as follows:

(1) "Recommended!" indication

Operators can show the text "Recommended!" on buttons assigned to items they especially want to sell. With conventional vending machines, operators used their own POP signs to make such promotional indications. This product accomplishes this using the indicators inside the buttons. In addition, the indication can be made to flash in order to highlight products.

(2) "Discount" indication

The text "Discount" can be shown on buttons assigned to items to be sold at discounted prices. With conventional vending machines, only the discounted sales prices are displayed when discounts have been applied, and the preparation of separate POP signs was required to tell purchasers that the products were discounted. As with the "Recommended!" indication, the "Discount" indication can be made to flash to highlight products, allowing easy solicitation to purchasers.

(3) Temperature indication

The temperature range (hot or cold) of the products can be shown on assigned buttons. While this was conventionally shown by using POP signs inside the product display, this button is equipped with temperature indicator lamps (orange, blue and purple) and temperature indicators (hot, cold, and room temperature), which can be linked to indicate the temperature

Fig.3   Conceptual view of new price display button

of a product. In addition, on conventional vending machines, room-temperature products needed to be indicated using POP signs, but with these buttons, room-temperature products can be indicated using the purple setting of the temperature indicator lamp and the room temperature setting of the temperature indicator.

(4) Use of four digits for display prices

With our sights set on non-beverage products such as food and goods, which are expected to expand in the future, this service supports four-digit price indication. Conventionally, the price indications only had three digits and, to handle any product worth 1,000 yen or more, the use of price labels was necessary, even if the buttons had a price display function.

Use of this service eliminates the need for operators to make rounds of vending machine locations to change the settings, reducing the work time of making rounds by 20% compared with conventional operations.

In addition, by conducting flexible promotions tailored to sales conditions and the surrounding environment, operators can increase sales without missing out on sales opportunities, and reduce the risk of having to dispose of products that were left unsold. Furthermore, four-digit price indication can be used to increase sales opportunities for a variety of products, including food and other goods besides beverages.

4.2 Smartphone remote controller

With conventional vending machines, operational settings were changed using the remote controller come with each vending machine, but this operation is not straightforward, which is assumed to have made new customers hesitant to introduce vending machines.

Conventional remote controllers for vending machines use a system in which users enter designated code numbers specified for individual purposes. Table 2 shows examples of inputs of the operation remote controller, and Fig. 4 shows an example of operation of the conventional operation remote controller. Operators are required to memorize these code numbers or read the instruction manual. Multiple buttons on the remote controller must be used to enter the desired code number, and multiple button operations are also required on the menu screen corresponding to the code number. In this way, with a conventional remote controller, it takes time to change and check the settings, which results in long work hours for operators.

We have developed a remote control system that can use a smartphone as the remote controller.

Table 2 Examples of operation remote controller input

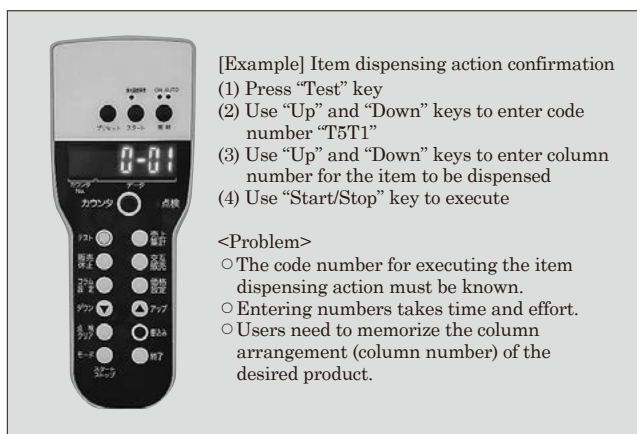| Operation	Input
Sales management	Sales aggregation key: TC
Lighting conditions	Mode key: 2-09
Item dispensing action	Test key: T5T1
Sales price change	Pricing key: Price input

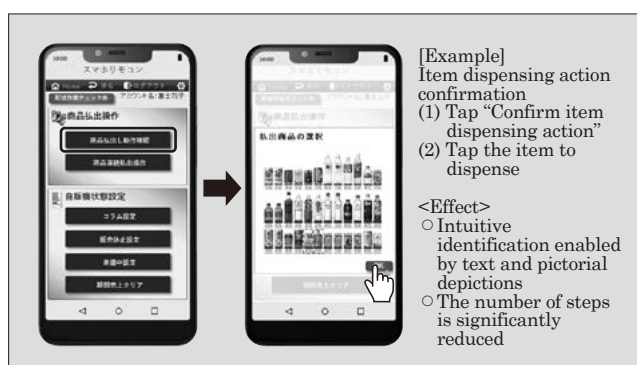Fig.4 Example of operation of conventional operation remote controller

[Example] Item dispensing action confirmation
(1) Press "Test" key
(2) Use "Up" and "Down" keys to enter code number "T5T1"
(3) Use "Up" and "Down" keys to enter column number for the item to be dispensed
(4) Use "Start/Stop" key to execute

<Problem>
○ The code number for executing the item dispensing action must be known.
○ Entering numbers takes time and effort.
○ Users need to memorize the column arrangement (column number) of the desired product.

Fig.5 Smartphone remote controller

[Example] Item dispensing action confirmation
(1) Tap "Confirm item dispensing action"
(2) Tap the item to dispense

<Effect>
○ Intuitive identification enabled by text and pictorial depictions
○ The number of steps is significantly reduced

This system connects the MCU to a smartphone via Bluetooth*2 and allows the user to set up a vending machine and check information using an application installed in the smartphone in advance. Unlike the code number input operation of conventional remote controllers, the new controller clearly indicates the operation procedure with pictures and letters, which are guided through screen displays for intuitive operation. In addition, with the smartphone remote controller, the settings stored on a cloud server can be changed in advance, greatly reducing on-site work time and preventing configuration mistakes.

4.3 Easy-to-introduce New QR code payment

Electronic money using near-field communication (NFC) has been the dominant form of cashless payment at vending machines, but with the rapid increase in the number of purchasers using QR code payment in Japan, the introduction and operation of payment devices that support QR code payment for vending machines has also been expanding. In order to make these QR code payments, either the QR code displayed on the mobile device must be read by the payment device (consumer-presented mode: CPM) or the QR code

*2: Bluetooth: Trademark or registered trademark of Bluetooth SIG, Inc.

must be displayed on the payment device and read by the mobile device (merchant-presented mode: MPM), as shown in Fig. 6. CPM requires a scanner or a camera, and MPM requires a liquid crystal display or another display device, making payment devices expensive. Many customers have given up introducing cashless payments because of this initial cost.

To solve this problem, we have constructed a new QR code payment system (New QR Code Payment) that can be introduced inexpensively by simply posting a single printout of a QR code. Figure 7 shows the conventional QR code payment flow (MPM system) and Fig. 8, the New QR Code Payment flow (MPM system). The New QR Code Payment system uses the MCU installed in a vending machine. The printed QR code is read by a mobile device and connected via Bluetooth, and the same QR code information for payment used for conventional QR code payments is sent to the MCU. The MCU of the vending machine sells an item by receiving the result of a payment made by
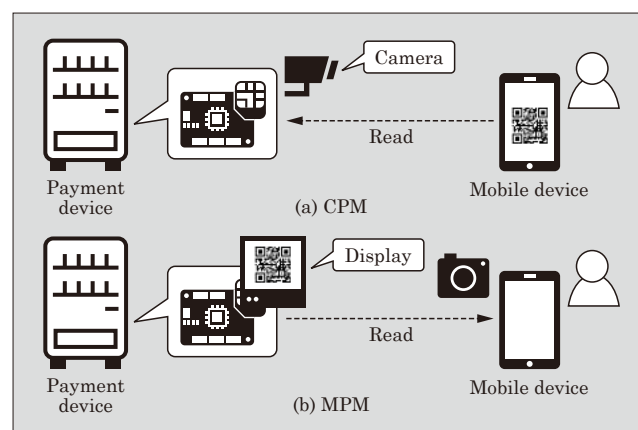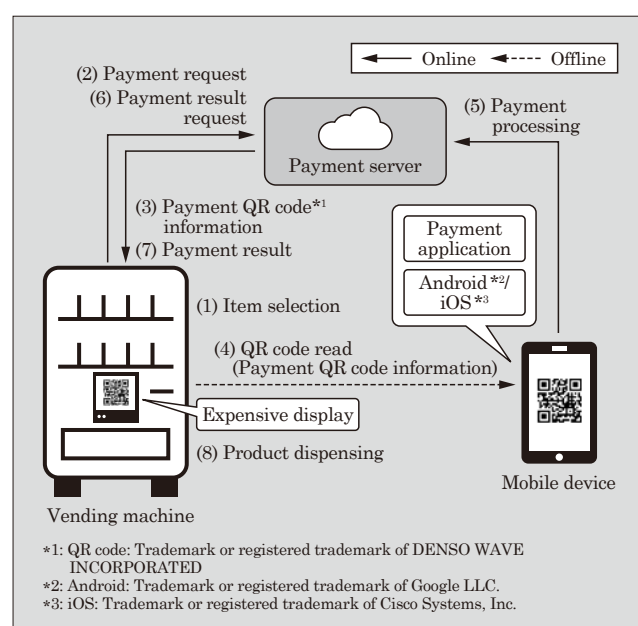

Fig.6 QR code payment system

*1: QR code: Trademark or registered trademark of DENSO WAVE INCORPORATED
*2: Android: Trademark or registered trademark of Google LLC.
*3: iOS: Trademark or registered trademark of Cisco Systems, Inc.

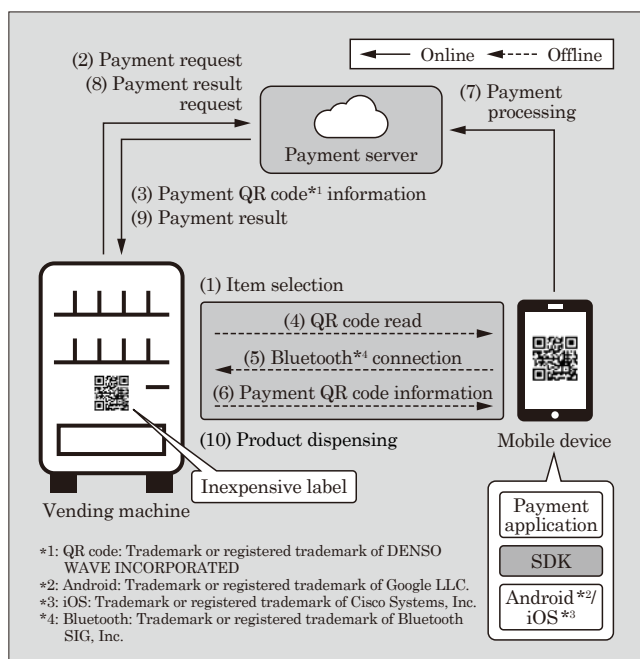Fig.7 Conventional QR code payment flow (MPM system)

Fig.8 New QR code payment flow (MPM system)

operating a mobile device from the payment server. From the purchaser's viewpoint, the payment flow is compatible with the QR code reading system (MPM) that uses the camera of a mobile device. Under this system, the MCU of a vending machine protects and secures payment information from spoofing, data forgery, and other incidents through three-party legitimacy verification of the transaction with the mobile device and the payment server. Building this system will need to develop a mobile device payment application. To this end, Fuji Electric has prepared a software development kit (SDK) to facilitate this process, which is provided upon customer request.

The New QR Code Payment, which is less costly to build than the conventional system, can be introduced even by customers who had given up installing cashless payment devices because of the initial cost. Support for QR code payment allows linking with discounts and loyalty programs by payment service providers, and its user-friendliness can be expected to increase the number of purchasers and boost vending machine sales.

5. Postscript

This paper has presented developments in the Vending Machine Operation Services. Developed as new services to solve customer problems, we believe that these services can improve the efficiency of vending machine operations and increase sales.

In the future, we will aim to contribute to the business of vending machine operator companies through further value enhancement of vending machines by continuously creating services that cater to market needs, such as by developing electronic key systems that improve operators' key management, as well as vending machine security and electronic receipt services, for which demand is increasing for vending machines due to the digitization of expense reimbursement processes.

References
(1) Katayama, S. et al. Vending Machine Operation Service Using IoT and AI to Increase Operational Efficiency. FUJI ELECTRIC REVIEW. 2021, vol.67, no.3, p.149-154.

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