

Automated Convenience Stores: Solve Japan's Labor Shortage with Technology

There are a total of 55,743 convenience stores across Japan, and they welcome 17,426,650,000 customers every year*1. Each store has an average of around 310,000 customers per year, with approximately 860 people visiting per day. People in Japan are now used to seeing foreign-born clerks behind the registers and handling the large numbers of customers. With Japan's shrinking population, the country has started to experience a labor shortage, making it necessary for convenience stores to employ foreign workers. However, more people are needed. In the future, the convenience store industry will need to carefully consider ways of running their operations without people, as there is no guarantee that foreign workers will always be available.

In order to solve this problem, Tokyo City University professor Yoshinobu Okano is developing technologies that will allow for IoT-based*2 automated convenience stores. This is his idea.

Integrated circuit (IC) tags are added to every product in a convenience store, and sensors are placed on shelves and at entrances to the store. The sensors register the information stored in those tags when a customer picks up products, and when they leave the store. The total purchase amount is paid through smartphone-based E-payments or other electronic wallet systems carried by the customer.

What is important in this approach is the distance between the radio transmitters (the sensors) and the products, and the strength of the radio waves being transmitted. The strength of a radio wave is proportional to the square of the distance from the transmitter, making it difficult to get the power just right. If the sensors on the product shelves are transmitting waves that are too strong, the sensors will read the information on product IC tags the customer didn't select, and that will lead to complaints. The sensors have to read only the tag information for products that are near the sensors, so radio wave output power has to be kept low. This means that there needs to be more sensors placed on the product shelves, which increases manufacturing costs for the shelves.

In addition, if the radio waves emitted by the sensors located at the entrance to the store are too weak, they won't obtain product information as customers leave the store, which will end up in the store losing income. To avoid this issue, entrance sensors must emit powerful radio waves, and must be prevented from reading tag information on products still on the shelves.

Okano has designed a shelf for products with manufacturing costs that are low enough for convenience store operators to accept. Also, people often don't like entering stores when they can't see what is inside. So, Okano has also created a fixture that blocks radio waves while leaving the inside of the store visible to passersby, by using a transparent plastic sheet affixed with a radio-absorbent board. He has already applied to patent his ideas, but if they can be commercialized, they will surely be usable in a range of industries, not only in convenience stores.

*1 According to calculations made in 2018 by the Japan Franchise Association.

*2 Internet of Things: the interconnection of a wide variety of devices over the internet.



Left: An automated register in the future.

Right: A transparent piece of radio-wave absorbent material.



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専門は通信・ネットワーク工学。人体と電磁波の相互作用や、電波を利用した近距離無線通信で情報をやり取りする RF-ID を研究している。後者は無人コンビニの技術に応用されている。著書に『無線とネットワークの基礎』(共著、数理工学社、2015) など。

岡野研究室の HP はこちら→

