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Smart Stores- The future of retail stores

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Introduction

Consumers have made their purchase decisions at the store shelf by providing the traditional brick-and-mortar retailers huge power to learn more about customer behaviors and preferences. With the advent rise of online shopping with smart technologies, new competitors in market threaten these long standing predominance of retailers. The traditional offline retail stores are now experiencing unprecedented impact in this scenario. These traditional retail giants are also trying to follow the trend of expanding service boundaries, allying with internet giants, developing independent Apps, establishing their separate network, including membership system for customers, investing heavily in building infrastucture, etc.

Are there other paths that can bring the traditional retail industry back to life? Compared to online shopping, the immersive real-time experienc provides an unparalleled advantage to offline shopping, which further enhances the customer experience, providing ultimate convenience and allowing consumers to put down their mobile phones and computers aside and re-enter stores, supermarkets, shopping malls.

So how can you build the smart retail stores of the future?

Offline shopping scenarios for customers

Offline shopping interactions

The basic process of offline shopping is to go into the store, pick the items, and settle the departures. Sometimes, this process of selecting goods seems complicated. We can't deny that this trend creates significant customer behaviors, or more clearly, the way people buy and spend on things. Let's have a look on the following instances how offline shopping is a cumbersome process.

A family shopping is an essential activity for both parents and children. When the child picks up a bottle of juice and puts it in the shopping cart, but the parents don't agree to buy it, they take it out and put it on the shelf. If you have more than one child, the interaction would be more complicated. Sometimes kids secretly put a box of their favorite cookies in their shopping cart, but the parents don't notice at that time. After picking out the items, it is being known at the cash counter and to be paid unnecessarily.

Most millennials typically shop with friends and won't make a purchase if their friends disapprove. Most of them are social shopper breed and It's really fun to go shopping with friends. Sometimes shoppers enjoy shopping as a social experience and see it as a chance to bond with friends. When a group of friends go shopping together, and for some reason few of them need to go halfway from shopping. In that case, it is very difficult to split the products and settle the price, which is being paid by one person.

Therefore, the retail stores have to force themselves to join in a competitive race, in which they can try to fulfill all of the customers' need perfectly and as quickly as possible.

The traditional retail experience: Waiting in queue

In the Internet era, consumers have been actively using the contemporary instant services for buying. When shopping online, they prefer their goods to reach to them soon. For example, while choosing a home appliance online, consumers can watch engaging videos and photos, swipe through, tilt to pan and explore images with tagged products – all in a single ad. This experience shortens the distance between customer and store to provide instant experience.

In contrast, for offline stores, the queues at cash counters are often seen growing in traditional stores and waiting could be a bad experience for customers. They often feel that the queue has not moved for half, and it is even more frustrating to see lots of shopping carts in front of them. The process from putting in cart to order, payment, packaging at cash counter makes it more time-consuming. Therefore, this shopping congestion needs to be eliminated to attarct more consumers and provide a smoother shopping experience in retail stores.

Future retailing being shaped by technology

The choice of technology tools has potential to drive buying decision

SKETCH FLOW STYLE

Information technology has been widely used in every aspect of our lives to improve efficiency and experience. When exploring the shape of the store for future, it can be roughly divided into three genres as follows:

The first is the **Bar code scheme**, which belongs to Internet, are traditional schemes that do not add extra costs to the production of goods but simply installs a number of self-service cash counter robots at the outlet of the store. The customer picks out the goods and pays for themselves. This scheme has the lowest investment and has been used in some supermarkets and convenience stores. Self-service settlement can stimulate the subjective initiative of customers, because this is also accepted by consumers. However, the essence of the problem has not been solved yet. Customers still need to take out the goods shopping cart, sweep code, pay the bill, and finally packing. When customers operate on their own, there is no constant increase in efficiency, waiting in line is still inevitable, and congestion is simply being replaced, not eliminated.

The second is the **RFID (Radio-frequency identification scheme)**, which belongs to the Internet of Things (IOT). This scheme consists of two parts; an electronic sub-label that stores commodity information, and a reader that recognizes electronic labels. Traditional barcodes can identify only one category of goods, while RFID can identify each item. When the RFID enters a specific magnetic field area, the system can identify the product information. At present, RFID labels are widely used in clothing products, making it easy to track goods and inventory management. But retail stores have a lot of low-cost items, and RFID tags can significantly increase their costs. In an unmanned cash counter with an RFID scheme, after the customer has selected the item, the item is placed in a designated area for identification so that the system generates the bill and settles the payment. Although the cash counter efficiency has improved, but there are still gaps in the program scheme that has concerns for missing recognition for the retail industry. As a result, RFID scenarios are temporarily not possible for high-traffic oversized and convenience store applications.

The third is the **Video Image Recognition Scheme**, which belongs to the Artificial Intelligence (AI). Using video image recognition and sensor technology, it is easy for customers to selecting goods, get the real-time tracking, identify the interaction process between people and goods, record information. Unlike traditional stores, which have a variety of cash counters at the exit, the store will be fully open under the AI. When a customer steps out of the store, the system automatically settles in the background. It improves the efficiency of the cash counter and simultaneously makes the whole process smooth without any congestion and breakpoints. Although building IT facilities with video image recognition solutions require more initial investment, making CAPEX superior to traditional stores. But this solution enables unmanned intelligent operations, significantly reduces human costs, thereby effectively reducing OPEX, the overall benefits/TCO is worth looking forward to. In an age of customer experience first, AI powered smart retail is the choice for the future.

Key elements of smart retailing

Decode the customers and items

The key task of smart retail stores in the future is critical such as which customer took which commodity. For example, a store is located at a fixed physical location where the shelf position is fixed during the time of construction. The most complex variable in this system is the behavior of the customer. To build an intelligent system for the store, the core function is to know the customers, track and identify their key actions.

When a customer enters into a store, image sensors can capture up to 30 or 60 frame, which can be usually used by the data. However the system needs to track and predict customer movements in real time. In some complex situations, such as two separate customers intertwining in a store, the system needs to provide enough accurate data to keep track of customers.

Most of the customer's actions are sometimes meaningless, as they generally do window shopping just picking up and dropping the items. In this scenario, the camera, distance sensor, and system should recognize the customer's movements. When the system recognizes the customer reaching out, combined with the pressure sensor on the shelf, it is easy to determine whether the customer picks up the item or puts it down. Finally, the system can complete the task of product identification by using the data of the image sensor on the shelf. Thus, decoding of customers and items is a crucial part in smart retail stores.

Customer's shopping experience

Design the stores to maintain instant customer flow

It's not complicated to track the behavior of individual customers, but in practice, there are many customers present at the store. No matter what the size of the store is, either 200 m^2 or 2000 m^2, fixed-over image sensors cover every activity space in the store. So the number of images the system needs to process per second is fixed. As the number of customers increases, the tracking and identification work to be done increases gradually. With the emergence of machine learning algorithms, intelligent systems will be provided the ability to train and optimize themselves and continuously improve the efficiency of computing.

These are the core functions of intelligent system of the retail store in the future. On this basis, we will continue to expand the function of the systems you can complete the identification of complex scenes and interactions, and improve the robustness and flexibility of the system.

Camera → Image Processing → Human detection → Identification → Action recognition

How to build a smart store

Competition in the retail industry mostly depends on customer's shopping experience. Brand, supply chain management and cost control are the key competitive forces in it. The construction of smart retail stores depends on the rise in technology creates a new shopping experience and also significantly save human costs, reduce the size of settlement areas, improve supply chain efficiency, enhance brand value. Therefore, smart retail stores are the focus of the whole system construction.

The brain of an intelligent retail store is an AI image recognition system, whose core task is to complete the identification and response of customers and goods, and finally to make the correct charges for the customer behaviors. In order to complete the task, system needs to continuously carry out data collection, transmission, processing and analysis. There are currently two programs in place to perform these tasks.

The first scenario is to locally deploy the GPU to complete image data processing, estimated to require 30 cameras to complete a 100 square-meter, store coverage, sampled at 30 fps, with 900 images per second to be processed. According to the latest image object detection algorithm, on the common Nvidia T4 GPU platform, 70 ms is required to complete the detection of people in one image. It can be calculated that 63 T4 GPUs are required to complete the customer detection. When the system detects people in the image, it starts to identify people using face or step recognition. T4 GPU can handle 50 detection events per second assuming there are 100 people in the store with a sample rate of 30 fps. 60 T4 GPUs are required to complete the identification process. Once identity of customer is recognized, the human action needs to be find out, and the data that needs to be processed in the last step has been significantly reduced, with an estimated 20 T4 GPUs required to complete the person's movement recognition. These are ideal workload estimatation with peaks and lows in actual store traffic. It also increases redundancy by 30% to meet peak-hour workloads. The total number of GPUs required for the entire system is 167. The Nvidia T4 GPU has 75 W of power, so the core module that tracks and identifies customers has 12.5 kW of power alone. With other devices that are not core modules, this constitutes a typical high-performance edge computing.

Another option is cloud approach and on-premises GPU investment. However, the investment in network bandwidth costs the same price, and most of the video and images in the store processed data do not need to be backed up in the cloud. Only the billing and other key information to be processed and archived in the cloud. The retail store requires a data-intensive, computation-intensive near objects and users in which tracking and action recognition of customers need to be completed in real-time. However, the system has very high delay requirements. Therefore, choosing to do most of the data processing locally is useful for both economic cost reasons and for real-time system performance and latency requirements. In addition, involving business transactions and user privacy, image data remains in place while scrolling to clear can make consumers more trustworthy.

Based on these considerations, we recommend deploying a small set of high-performance data centers in the store using an architecture of edge intelligent computing.

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Future-development Edge Data Center

The camera for customer identification tracking already has certain data processing capabilities that can be collected and the image is initially processed. With the distance sensor data, the system can recognize the customer's movement attitude. Images and pressure sensors on the shelves identify the type, quantity and status of items selected by the customer.

The entire system is interconnected by an internal high-speed network and some of the data is stored in a video or image on a local server for a period of time. The system completes the settlement and records all the consumer and the commodity exchange information. Based on this data, retail stores will further enhance intelligent operations in the future. Inventory management, commodity sales analysis, selection, supply chain intelligent management, etc. can be done automatically by the system.

To maximize efficiency, smart retail stores are designed to operate 24x7 for which reliable power and environmental management are essential. The whole system needs to be run online in real-time; grid fluctuations can have unpredictable effects on sensors resulting in data collection errors. The power outages can cause downtime throughout the system causing business disruption. We therefore recommend that to configure an online UPS to protect your system from power outages and grid fluctuations. The real-time operation of high-performance artificial intelligence system makes the single rack power may exceed 10 kW in order to ensure the reliable operation of the system, it is recommended to use precision air conditioning for cooling protection.

The future of retail stores need a stable, reliable, small footprint, rapid deployment and high-performance data center for power distribution and cooling. Modular data center products perfectly match these needs which include integrating UPS, power distribution, thermal management, IT monitoring in a single cabinet, installing servers and other IT equipment. Using the integrated scheme of closed hot and cold ailse not only improves the operation efficiency of the system and saves energy consumption, but also reduces the coupling between the system and environment, thereby improves the reliability of the whole system. Hyper-converged solutions can also reduce maintenance staff and operating costs.

Development recommendations:

Now is the time to act

In recent years, edge computing with machine learning has been developed and at the same time, smart cities have also led to advanced sensor technology such as smart cameras. The market for artificial intelligence is growing and the efficiency changes brought by technology are under full of expectations. The technological and industrial foundations of the retail stores of the future have been established.

According to KPMG and the China Chain Management Association, labor costs account for 60% of retail store operations, and traditional retail giants are eager to find ways to reduce costs, improve operational efficiency, and improve the shopping experience. Smart retail stores deliver a great shopping experience while saving on operating costs. 24x7 hours of uninterrupted and unmanned operation, bringing more revenue to the business. Intelligent operations can improve operational efficiency.

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