Computer Vision for Smart Retail

RealSense

RealSense Technology Automates the Shopping Experience

Spotlight on Cloudpick

Cloudpick is a smart-retail solution provider that helps transform traditional brick-and-mortar stores into highly intelligent, digitized stores. The Shanghai-based company provides AI-based products and solutions to retail partners worldwide.

At a Glance

- With proprietary computer vision, deep learning, sensor fusion, and edge computing technologies, Cloudpick empowers retailers to create cashier-free stores that enable a grab-and-go shopping experience.

- The Cloudpick vision system uses RealSense Depth Camera D455 to generate a virtual representation of everything in the retail space, and applies gesture-recognition algorithms to identify customers as they move around the store.

Challenge

Make in-store shopping easier and more enjoyable, while boosting efficiency for retailers.

Solution

Data from RealSense™ Depth Camera D455 is used to construct a virtual, 3D metaverse. Intel edge computing platforms correlate all of the data and transmit it to a cloud-based billing platform.

Results

RealSense depth cameras enable a 99.5% accuracy rate in tracking shopper activity and purchases, vaulting Cloudpick to the forefront of the smart retail industry.
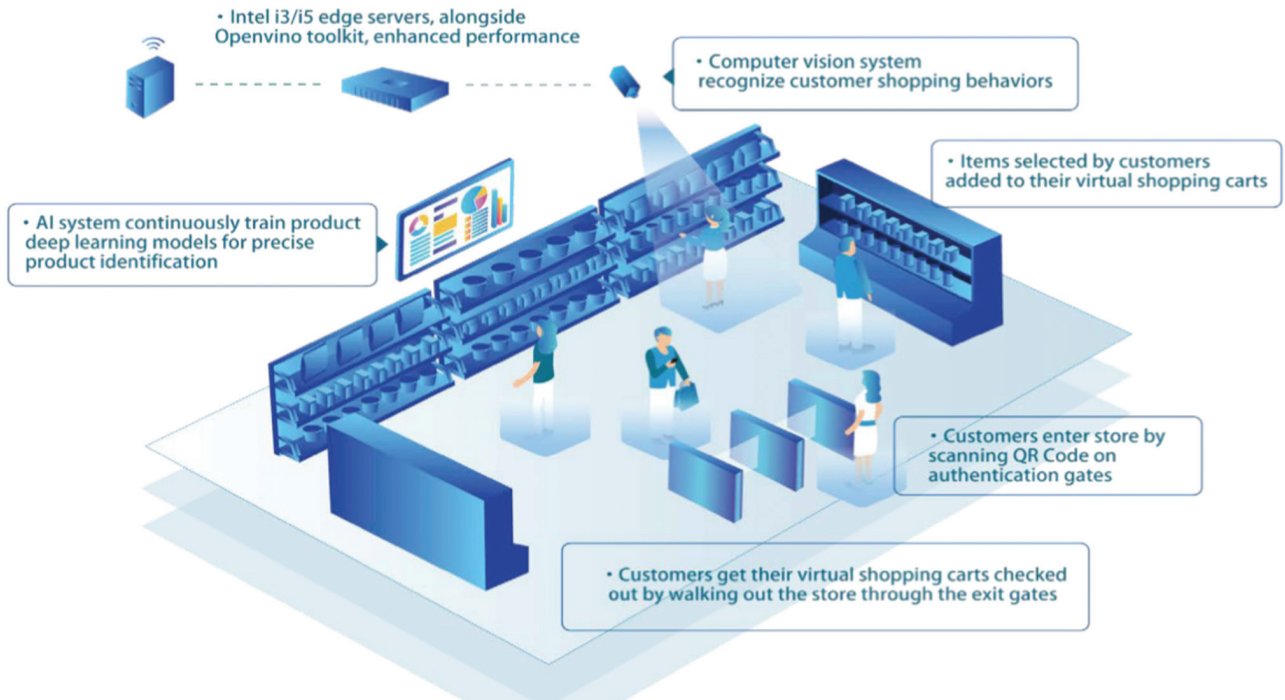
Introduction

Retail technology is changing fast as convenience stores, drug stores, and many other types of quick-service establishments install self-service checkout stands to eliminate staffing shortfalls and improve the customer experience. Cloudpick is at the forefront of this trend with hundreds of autonomous, "smart" stores that eliminate checkout altogether.

Cloudpick uses a combination of AI, computer vision, deep learning, and edge computing technologies to enable a fully automated shopping experience. Depth-perception cameras from RealSense are an important part of its autonomous store solutions.

"RealSense cameras offer high RGB-D picture quality and product stability," says Tingtao Li, co-founder of Cloudpick. "Our vision system builds a three-dimensional digital model for brick-and-mortar stores from multiple cameras. All the people, goods, and shelves are reconstructed to create a unified, virtual representation."

RealSense Depth Camera D455 offers an outstanding detection range on its RGB-D sensor, ensuring tremendous depth quality.

• Intel i3/i5 edge servers, alongside Openvino toolkit, enhanced performance

• AI system continuously train product deep learning models for precise product identification

• Computer vision system recognize customer shopping behaviors

• Items selected by customers added to their virtual shopping carts

• Customers enter store by scanning QR Code on authentication gates

• Customers get their virtual shopping carts checked out by walking out the store through the exit gates

Data from Intel edge servers and RealSense cameras are critical components of Cloudpick's automated retail experience.

RealSense Cameras Enable Cashier-free Payment System

The Cloudpick vision system generates a virtual representation of everything in the retail space, and applies gesture recognition algorithms to interpret shopper behavior. Data from RealSense cameras is used to construct a virtual, 3D metaverse. The cameras constantly monitor the retail environment, feeding data to gesture-recognition algorithms that note when consumers pick up and replace items. These algorithms can also identify common behaviors such as walking, standing, crouching, or running, which helps distinguish one shopper from another.

Customers simply register an account on the Cloudpick mobile app before entering the store, including adding a payment method for their purchases. The application provides a QR code that shoppers use to gain access at store entry gates. The code is then associated with a virtual shopping cart for each shopper in the store.

As shoppers move through the store, products selected from the shelves are automatically added to their virtual shopping carts. The machine vision system, powered by RealSense, uses deep learning algorithms to identify the selected items and add them to the cart. If a customer puts an item back on the shelf, it is removed from his or her virtual cart.

When shoppers exit the store through the smart gates, the items are tallied and charged against whatever payment method they have registered in the app. Intel edge computing platforms correlate all of the data and transmit it to a cloud-based billing platform. Within a few seconds of departing, they receive a receipt on their mobile devices.

A shopper exiting the store through the smart gates.

Building the Smart Store

Cloudpick is powered by an algorithmic engine that works in conjunction with an automated product learning system, store management application, 3D store display system, and immersive interaction system. This AI platform can recognize shopping activities, identify products, and take payments, allowing retail stores to operate autonomously, without the need for human clerks (see figure).

RealSense sensors, located throughout the store, continuously analyze data from the shelves and products, allowing the system to generate statistics on in-store activity. The product recognition system depends on RealSense cameras to recognize thousand SKUs, and can accurately identify in-store products through continuous product learning. "The vision system is smart enough to re-create everything in the store," Li says.

Selecting RealSense for Rapid Development and Deployment

According to Li, Cloudpick selected RealSense Depth Camera D455 because of its low price, excellent field of view (FOV), and overall stability. Not only was RealSense the most affordable option, but Li trusted Intel for its proven stability, outstanding reputation, and deep technology expertise. "Other cameras with a comparable field of view are too expensive," he reports. "For example, RealSense is 30 percent cheaper than Azure Kinect."

Cloudpick's core staff members include senior scientists and engineers from Google, Alibaba, Intel, Amazon and other technology giants. This experienced team used the RealSense software development kit (SDK) to accelerate the development of the machine vision system, along with RealSense open-source software libraries to interface with the cameras via the OpenCV software environment—a library of programming functions that enhances the computer vision system.

Cloudpick's engineering team continues to use the Intel® OpenVINO™ toolkit to optimize, tune, and run its AI inference models. Images of every SKU are labeled in a training database, and the resulting algorithms are deployed into the Cloudpick vision system. This "write once, deploy anywhere" environment gives the software team plenty of flexibility for where they deploy their computer vision applications, and what types of hardware to configure for each store.

"The Intel OpenVINO Toolkit provides all kinds of model zones, which simplifies the evaluation of model performance and accuracy," Li says, adding that the RealSense engineering team provided helpful guidance throughout the development of the machine vision system. "They were quick to respond

Cloudpick's machine vision system offers constant surveillance as shoppers select the items that they need.

when issues arose with both the cameras and the associated software tools," he notes. "The RealSense team answered our technical questions quickly. We continue to appreciate RealSense's help."

Because most of Cloudpick's AI workloads are executed on 8th or 9th generation Intel® Core™ processor-based edge computing platforms, the team has been able to dramatically reduce the amount of data sent to the cloud. And because QR codes are the only information used to track individuals within the virtual rendering of the autonomous store environment, consumer privacy is assured.

Seizing the High Ground in the Smart Retail Space

With more than 500 stores throughout Singapore, Japan, South Korea, UAE, Germany, Hungary, France, China, Malaysia, Oman, Turkey, and the United States, Cloudpick has seized the high ground in the smart retail market, with a dominant share that far exceeds that of its competitors. As Li puts it, RealSense cameras have enabled "a retail brain with the eyes of machines," allowing Cloudpick to roll out practical, AI-driven solutions to the global retail industry.

"Cloudpick has become the leading provider of AI-based smart store solutions worldwide," he concludes. "We have collaborated with e-commerce companies, traditional retailers, and payment partners worldwide to equip brick-and-mortar stores with streamlined, cost-efficient and technically retrofitted properties that support smart retail shopping experiences. Throughout this process, RealSense has helped our team to boost productivity and reduce costs."

Technical components of the solution

- Cloudpick Autonomous Store Solution
- RealSense™ Depth Camera D455
- Intel® Distribution of OpenVINO™ toolkit
- Intel® Core™ processors

Learn More

- **Cloudpick:**

https://en.cloudpick.com/en/Default.aspx

- **RealSense Technology:**

https://www.realsenseai.com