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Computer vision is transforming the transportation industry, making it safer, more efficient and improving the bottom line

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Computer vision is helping to reshape the transportation industry at every level from streamlining the passenger experience to preemptive fleet maintenance to fuel optimization. As the transportation industry continues to evolve, converging technologies such as 5G and powerful edge compute will enable the next generation of prescriptive and adaptive data-driven outcomes benefiting passengers, the industry and sustainability.

Whether moving people or goods, transportation environments are in constant motion. Railways, airports, cargo ships, and public and private transportation are complex use cases for computer vision. They require real-time situational awareness, based on the analysis of many different data points, which taxes compute and storage resources at the edge—defined as where the physical world meets the data world.

The challenge is being met using a real-time federated approach with scalable, high-performance hyperconverged infrastructures (HCI), allowing organizations to capture and process large amounts of data at the edge, and provide real-time insights. The results, not the actual data, are then sent back to a centralized location for re-training of the analytics model which then is pushed back out to all edge locations, thus delivering better quality insights in near real-time.

Although computer vision has not yet been widely adopted industry wide, transportation organizations that have invested are realizing gains in terms of safety, customer experience, operational efficiency, sustainability and revenue generation, and are looking to take advantage of further advances in technology in the future. Automation and touchless processes integrated with computer vision greatly enhance transportation services as well.

Collectively, this has a big impact on adopters, especially when organizations are hard-pressed to maximize profits amidst rising costs and reduced resources.

What transportation industry challenges are addressed or resolved with computer vision?

All facets of the transportation industry have seen tremendous loss in revenue and resources over the last few years. As the economy began to turn around, public and private transportation organizations were under pressure to rebound with lower budgets and labor shortages, spurring efforts to find ways to be more efficient.

In addition, safety is a key requirement across rail, water, air, and roadways, often requiring split-second decisions that can often be enhanced by machine learning. And predictive maintenance, where parts are replaced before equipment and vehicles break down, is extremely valuable to operations but often difficult to do well due to the number of variables involved.

In any of these situations, different data points can be ingested once, and analyzed for multiple uses. A security infrastructure can provide a foundation which captures audio and video data, and data from IoT devices, which the computer vision system then combines and analyzes, producing insights that can be used to positively impact safety, the customer experience, operational efficiencies, sustainability and revenue generation.

How can computer vision improve passenger, personnel and facility safety?

A significant part of passenger and personnel safety is to ensure that the facility and equipment itself is physically secure. Through the use of cameras and sensors, computer vision enables more precise inspection of passenger baggage and cargo.

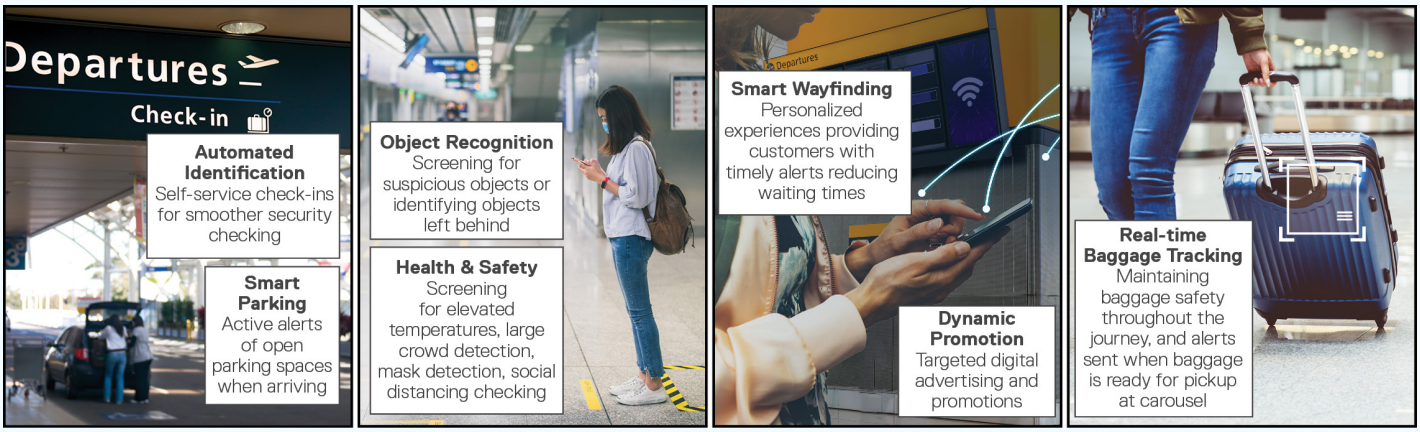
Certain types of behaviors or objects can also be monitored. Electronic devices, such as smartphones and laptops, each have a unique MAC address. Airports today can capture device MAC addresses to track devices throughout a facility. When combined with data from sensors, those devices can be automatically tracked and decisions made in real time. If an unauthorized person enters a secure area, security personnel are alerted to take immediate action. Computer vision systems can also determine how many people are in a location, for example if an evacuation is necessary.

What are examples of how computer vision affects the customer experience and operational efficiencies today, and what's coming tomorrow?

An important focus of airports is to get people through the facility as quickly as possible. Part customer experience and part operational efficiency, computer vision with artificial intelligence can improve queue management by proactively determining when to add customer service personnel to an airport check-in counter or open another security line.

The touchless passenger experience is also gaining traction, which aims to minimize time from curb to gate while enhancing the passenger experience throughout the journey (Figure 1, Page 3). For example, passengers could be automatically checked in upon arrival, prechecked to walk through security, be alerted to gate changes, order a coffee that's waiting at the shop closest to the gate and use frictionless boarding. This scenario is possible through the correlation of data, with the computer vision system making the decision that you are the correct passenger.

Figure 1. Use of computer vision to streamline the passenger experience



We briefly mentioned the value of predictive maintenance to organizations; it also has a considerable impact on fuel consumption and costs, and can reduce an organization's carbon footprint. Cameras and thermal vision technology are used to visually inspect vehicles for wear and tear, and when integrated with IoT sensors, can more accurately identify parts that should be replaced.

Airports can use computer vision to greatly increase the efficiency of ramp operations and plane turnaround. The system monitors the location of planes that just landed and whether the luggage offboarding equipment is in place. It also automatically notifies the catering truck, fuel truck, and ramp personnel.

Public transportation also benefits from the efficiencies brought on by computer vision. As municipal transit agencies look to increase ridership and fuel efficiency, some communities are experimenting with dynamic routing of buses to reduce instances of empty buses on routes. For passenger vehicles, some cities charge a fee when your vehicle enters the city center. Pollution sensors detect elevations in airborne chemicals, such as carbon monoxide, triggering an alert that results in varying fees paid by those vehicle owners.

Railways equip trains with cameras and install them in stations to inspect and monitor parts as the train rolls down the track, increasing safety, efficiency and revenues. For a detailed look at how computer technology is used to inspect railcars, browse this ***Duos Technology Group case study***.

Does computer vision affect sustainability in transportation?

In the context of transportation, sustainability focuses mainly on the consumption and proper management of power and fuel. Airports, for example, deal with large amounts of fuel and are concerned about the release of potentially dangerous amounts of vapors and chemicals that could increase air pollution or contaminate groundwater. Deicing planes also requires the use of chemicals, so cameras and sensors can assist in deicing a plane just enough to make it safe without an excess of chemicals flowing from the tarmac or runway into the ground. Airports and railways deal with vegetation control as a means of fire suppression. Computer vision technology monitors fuel usage, air and ground contamination, and even the height of vegetation around landing strips and railyards.

Similar to smart cities, airports, train stations and cruise ships can use computer vision to control power consumption, water usage, air conditioning and heating. Based on where people are and their usage patterns, smart lighting can be automatically controlled to turn off or use downlighting during the brightest part of the day and light other areas 24/7 for safety purposes.

How exactly can computer vision generate revenue for transportation companies and the public sector?

This gets back to doing more with fewer resources as well as enhancing current revenue streams. For an airport, that means steering passengers toward retail within the facility to maximize their spend and turning aircraft around quickly, to allow more flights per day. A single flight can generate tens of thousands of dollars in fees, so getting one more flight through a gate per hour has a significant impact on revenue.

Depending on how crowded an airport is, dynamic pricing could be implemented automatically to adjust parking pricing. States and local municipalities also benefit from dynamic pricing. Drivers typically need a tag or pass for high-occupancy lanes on freeways. Computer vision technology can increase the fee for high-occupancy lane usage based on the current amount of traffic.

How do mobile edge computing and 5G affect computer vision in transportation?

Real-time actionable insights and learning is critical to situational awareness in the field, and technologies like 5G and mobile edge computing enable faster response times.

Consider rolling stock, like a public bus. The driver needs to focus on the road and passengers. A bus equipped with cameras and a compact hyperconverged infrastructure can use computer vision to create real-time situational awareness for the driver as well as for transit hub staff. As the vehicle approaches a bus stop, the system captures the number of waiting passengers, or passengers with special needs. The increased bandwidth of 5G enables fast transfers of the insights back to a central location for analysis, with the results of the analysis streamed back to the bus in near real time.

Computer vision is truly transforming the transportation industry, aided by automation, touchless technologies and 5G. Edge computing and machine learning capabilities make faster and better-quality decision making and situational awareness in the field possible, which in turn increases efficiencies, makes environments safer, lowers carbon emissions, raises customer satisfaction and helps organizations be more profitable.

Learn more about how computer vision is positively impacting other industries:

- The Future Is Computer Vision – Real-Time Situational Awareness, Better Quality and Faster Insights. ***Read the article.***
- Computer vision is becoming an accelerator for education. ***Read the article.***
- How Computer Vision is revolutionizing the Manufacturing Supply Chain. ***Read the article.***
- How the Sports and Entertainment Industry Is Reinventing the Fan Experience and Enhancing Revenues with Computer Vision. ***Read the article.***
- How the Retail Industry Can Improve the Customer Experience, Increase Safety and Maximize Margins Through Computer Vision and Artificial Intelligence. ***Read the article.***

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