pactera EDGE

Improving The Optics of Operations Through Computer Vision at Airports

Air travel is back. And with it, so are the complications.

According to Airports Council International World, there were nearly 4.5 billion global flight passengers in 2021, which was an increase of 25% from 2020, when the pandemic shut down air travel. The world's ten busiest airports, representing about 10% of all global traffic, transported 463 million passengers in 2021, a 52% increase from 2020.

But air travel has changed considerably.

For one thing, airports and airlines need to manage new travel protocols caused by the pandemic. And airports and airlines everywhere are managing the uptick in travel with fewer people due to a labor shortage. The staff shortage and occasional COVID-19 flare-ups have made air travel more fraught with cancellations and delays.

25%

Increase in global flight passengers from 2020-2021

52%

Increase in traffic from 2020-2021

Airports and the ecosystem of airlines they support are still figuring out how to adapt. With fewer people, airports need to work smarter. And a type of artificial intelligence (AI) known as computer vision can help them in crucial areas such as baggage handling and passenger boarding.

Computer vision is a form of AI that allows computers to analyze visual data such as pictures and video and make intelligent decisions based on that analysis. For example, Google uses computer vision to help people perform visual searches. Autonomous vehicles require computer vision to detect objects, lane markings, signs, and traffic signals to drive safely.

Airport operations powered by AI reduce boarding and baggage handling costs with computer vision. For example:

Baggage handling: Computer vision cameras and sensors can make passenger baggage inspections more accurate. Unsafe and prohibited belongings have less chance of slipping through monitors because smarter cameras can detect and flag more minute, harder-to-find objects.

Security: Cameras can also keep airports more secure by monitoring objects such as smartphones and laptops through their unique MAC addresses. Potential security breaches can be detected faster and more accurately in this fashion.

Passenger experience: We all know how exasperating it can be to stand in long lines at security checkpoints and gates. Computer vision can improve line management by proactively determining when to add customer service personnel to an airport check-in counter or to open another security line. And, an airport can more proactively manage the passenger experience by correlating computer vision with passenger data to verify a person's identity and then authorizing passengers who qualify for pre-check without human intervention.

Use cases that directly enhance the passenger experience:

AUTOMATED IDENFICATION
Self-service check-ins for smoother security checking

OBJECT RECOGNITION
Screening for suspicious objects or identifying objects left behind

SMART WAYFINDING
Personalized experiences providing customers with timely alerts reducing waiting times

SMART PARKING
Active alerts of open parking spaces when arriving

HEALTH & SAFETY
Screening for elevated temperatures, large crowd detection, mask detection, social distancing checking

DYNAMIC PROMOTION
Target digital advertising and promotions

REAL-TIME BAGGING TRACKING
Maintaining baggage safety throughout the journey, and alerts sent when bagging is ready for pickup at carousel

Computer vision encompasses modeling and reproducing human vision utilizing software and hardware to reconstruct, translate, and comprehend videos and images while overlapping image processing and pattern recognition capabilities. Computer vision applications encompass five categories: image classification, object detection, image similarity, image segmentation, keypoint detection, and object detection.

Image classification pertains to the categorization of pictures and the assignment of label annotations to the respective vectors. Image classification applies to many aspects of airport management, such as passenger safety. Airport maintenance, repairs, equipment, and safety procedures may be monitored using computer vision models.

Image similarity is related to classification, although it differs by using cosine similarity with the incorporation of multiple dimensions using contrastive losses, which leverage data annotation information more effectively. This, in turn, improves the efficiency of evaluating similar images. The cosine similarity consists of analyzing the vectors, known as the dimensions, of the images and the color characteristics such as red, green, blue, hue, saturation, and lightness while comparing to known images that have already been identified. Contrastive losses evaluate whether image similarity is working effectively. Contrastive losses use techniques to assess the similarity of images, comparing input images to known images. Image similarity has many applications in an airport. For instance, with image similarity, a computer vision application can distinguish between long and short waiting lines at an airport gate, thus effectively alerting an airport about the need to manage congestion.

Object detection includes recognition and object localization, using convolutional neural network (CNN) models such as “you only look once” or YOLO. CNN is a deep learning model applied to images to comprehend features within images. YOLO is a type of CNN model that increases the robustness and accuracy of object detection by segmenting an image into various numerical grids while calculating the probability that the image of interest is located within the respective grid. In addition, CNN uses bounding boxes – the X and Y coordinates of a rectangular box surrounding an object of interest in order to describe its spatial location. For instance, object detection assists in the ability to distinguish between objects, including things inside of objects – which has obvious value in determining what a security monitor should focus on while excluding objects that are not relevant to a search, such as an object that is not luggage (e.g., a sign in the background).

Image segmentation segregates images into regions utilizing attributes from pixels to identify the boundaries and objects, incorporating cluster algorithms. Segmentation makes it possible to intelligently cluster or categorize an object (say a carry-on bag or suitcase) in order to identify an object and its many different characteristics (such as color). Image segmentation is similar to object segmentation, but object detection gets more granular

Keypoint detection involves localizing key aspects of object sections such as faces, expressions, poses, and others are based on extracting feature maps after iterating through the convolutions of CNN models. For example, in the use case of managing passenger lines, keypoint detection could go beyond simply spotting long lines and reveal details such as the presence of several sitting passengers in one area -- which could mean a corridor is getting dangerously crowded. Keypoint detection could also identify other potential needs, such as passengers seated on the floor because they’re seeking power outlets for their mobile devices but lack access to suitable power stations.

Here is a quick snapshot of computer vision applications:

CHALLENGE

CONGESTION AND LONG WAIT LINES

IMPACTS	KPIS	COMPUTER VISION	COMPUTER VISION METRICS	AI PLATFORM KPIS
High operational costs	Staff cost/passen ger Expenditure / passenger Check-in processing time	Image similarity	True Positive False Positive False Negative Precision Recall	Model reusability Infrastructure cost optimization

CHALLENGE

PASSENGER SAFETY

IMPACTS	KPIS	COMPUTER VISION	COMPUTER VISION METRICS	AI PLATFORM KPIS
High operational costs	# of Incidents	Image classification	True Positive False Positive False Negative Precision Recall F1	Model reusability Infrastructur e cost optimization

CHALLENGE

GROUND ACTIVITY

IMPACTS	KPIS	COMPUTER VISION	COMPUTER VISION METRICS	AI PLATFORM KPIS
High operational costs	Turnaround time Inbound / Outbound efficiency	Image classification	True Positive False Positive False Negative Precision Recall F1	Model reusability Infrastructur e cost optimization

CHALLENGE

DELAYS IN BAGGAGE PROCESSING

IMPACTS	KPIS	COMPUTER VISION	COMPUTER VISION METRICS	AI PLATFORM KPIS
High operational costs	Delivery time	Object detection	True Positive False Positive False Negative Precision Recall F1	Model reusability Infrastructur e cost optimization

Making Computer Vision Succeed

In the past, cameras powered by computer vision required extensive coding and debugging to develop and implement reliably. But deep learning technology has achieved a breakthrough.

In the past, cameras powered by computer vision required extensive coding and debugging to develop and implement reliably. But deep learning technology has achieved a breakthrough.

Deep learning technology uses neural networks to teach computers to learn by example. With deep learning technology, a camera powered by computer vision can teach itself to identify objects more accurately and not confuse them with other objects – understanding, for instance, the difference between a carabiner and a carabiner that contains a fold-out knife.

But deep learning doesn't happen by itself. The AI needs to be trained to know what to look for. And tested. And validated. Just the training challenge alone can seem mind-boggling. Human beings must train AI to understand all the forms of baggage that exist. People need to generate the images manually and, from there, label them correctly and upload them into a central repository. With humans in the loop, active learning accelerates the generation of images, labeling, and data.

This process of training AI is known as data readiness. As we discuss in this blog post, data readiness consists of all the tasks a company needs to manage to ensure that its artificial intelligence (AI) platforms learn from reliable and relevant data sources. With proper data readiness, an airport can overcome the cost and expense of training a camera equipped with computer vision, among other pitfalls.

As our blog post on data readiness discusses, at Pactera EDGE, we helped a global brand improve its computer vision model to 97 percent accuracy. Our client wanted to enhance its computer vision model to better recognize live images of objects and the

text on the objects. The client's goal was to improve the user experience of its cloud-based image and video collection solution to help people easily navigate through thousands of stored pictures from the convenience of their mobile devices. The company approached Pactera EDGE, asking to collect and curate a high volume of high-quality images. Pactera EDGE tapped into its global pool of hundreds of thousands of resources to collect live images and text in specified categories. Since quality was of high importance, Pactera EDGE:

- Developed a customized collection tool to upload, store and classify these live images and a second customized tool to label the text and objects in the images.
- Trained a team of quality assurance and labeling experts to provide the highest quality deliverables.

Pactera EDGE collected and curated images in 19 categories, each with its own target volume and specifications. We delivered thousands of high-quality live images at a 97% accuracy rate in 12 weeks, covering five continents.

Computer vision initiatives are challenging and riddled with pitfalls, resulting in financial impacts that have a ripple effect throughout operations. Outcomes are positive passenger experiences, brand equity, risk reductions for safety, and highly efficient processes. Curating an images repository, using open-source computer vision models, hosting on cloud infrastructure, and expecting to reap the benefits in less than three months are all key attributes of failure. Let's look at hosting on the cloud as an example. It sounds simple and straightforward that anyone could quickly capture images and use any open-source model on any cloud infrastructure – and that assumption is a pitfall. Thousands of images are needed that are captured from different camera angles; identifying the right computer vision model is both art and science, and sometimes many models need to be used together. The right mix of cloud services needs to be chosen along with customization, or else the infrastructure subscription costs will exponentially increase.

Unfortunately, taking the wrong approach with computer vision leads to high project overruns, high costs, and excessively lengthy life cycles of computer models, leading to minimal operational efficiencies with unsatisfactory performance ratings by travelers. Succeeding with computer vision requires design-driven data science and a willingness to learn from best practices. This mitigates risk, improves efficiencies, accelerates the development of computer vision, and improves the traveler experience.

PITFALLS	IMPACTS	MITIGATION
— Condensed project timelines	— Project overrun, delays, high operational costs	— Project planning: camera setup, data pipeline with cleansing and transformation
— Underestimating costs	— High costs of CV model training	— Pre-trained CV models inclusive of hyperparameter tuning, transfer learning, and ML pipelines
— Insufficient high-quality data	— Financial loss, incorrect business decisions, data leakage, data bias	— Data annotation & labeling, synthetic data, and human-in-the-loop with active learning

The journey towards applying computer vision for improving airport operations may begin with a discovery phase through the execution of a proof-of-value that demonstrates the efficacy of the AI models. The proof of value is the initial milestone in evolving a cognitive platform that results in recurring ROI from each investment. This happens as additional AI models are constructed as reusable modular components of the platform, which addresses the challenges in operations, providing cost efficiencies. The solutions are delivered by robust digital engineering services, accelerating business value realization.

Solution Vision

The Pactera EDGE solution vision is tobring an AI solution experience that will improve operational efficiencies & reduce the operating cost across various key areas.

POV

Efficacy

The proof of value, includes Discovery, capturing the key functional areas, success metrics, data characteristics, and exploratory data analysis, comprehendng optimizations followed by rudimentary prototypes.

Utilization; with 15% increase

MVP 1

Application

WebApp solutions provides a user interface to interact with notifications and view reports or hand-held devices.

Efficiencies; with 30% improvement

MVP 2

Optimization

Additional cost optimizations may be revealed by integrating with ERP and other systems.

Reduction; with 20% decrease in operating

MVP 3

Revenue Enablement

Variable passenger demand may be assessed for further effiencies, optimization, and potential revenue activities.

Revenue Enablement; with 15% increase in revenue

Digital Engineering Services

Innovation delivered through cognition. Pactera EDGE applies analytics to design, development, deployment, and managed solutions, reducing cost while enabling revenue.

- Application Modernization
- Cloud
- Fraud Protection
- Articial Intelligence
- Data Engineering
- Intelligent Automation

To speak with one of our computer vision experts, contact us.

Authored by Sanjay Bhakta, VP, Global Head of Solutions

It's time your organization was able to focus on what matters most - delivering exceptional passenger experiences...

The Pactera EDGE White Glove Service
Different by design.

From start to finish, The Pactera EDGE White Glove Service™ enables you to act with agility and accuracy as you enhance your overall business and brand experience. When you're ready, we're ready (because we're always ready).

Unlike the competition, we'll work shoulder-to-shoulder with you to enable rapid and sustained value growth for your stakeholders.