

Case Study

AI/ML for Logistics: **Automating Proof-of-Delivery** **at Scale**



Introduction

Bungii, a rapidly growing last-mile delivery provider created to solve the challenge of on-demand large-item transport, has built its reputation on speed, reliability, and a consumer-friendly service model that makes same-day pickup and delivery as simple as requesting a ride. Serving retailers, wholesalers and distributors, and logistics partners nationwide. The company has scaled from a local startup into a leading provider handling thousands of deliveries daily.

From the earliest stages of building their platform, Bungii has partnered with Creative Capsule to not only architect and develop scalable, high-performance technology, but also to support their long-term technology vision—supporting growth, strengthening operations, and enabling continuous innovation.

As Bungii's delivery volume increased, so did the need for stronger operational controls. In a fast-moving logistics environment, accuracy at scale is critical—especially when validating successful handoffs and ensuring that items reach the right destination. Proof-of-delivery (POD) photos became a key component of quality assurance and customer trust, captured by drivers at both pickup and drop-off points.

However, manually reviewing thousands of images each day quickly became inefficient and error-prone, creating delays and operational bottlenecks. To solve this, Creative Capsule partnered with Bungii to design and implement an AI-powered image validation pipeline that applies machine learning and computer vision to automatically analyze, flag, and verify POD images with speed, accuracy, and reliability.

The Challenge: Ensuring Reliable Proof-of-Delivery Verification

Bungii's existing validation process relied heavily on human review. This time-consuming and error-prone approach was difficult to scale. Key challenges included:



Inconsistent Image Submissions

Delivery pros sometimes uploaded unrelated or duplicate photos, such as vehicles, empty parking lots, or reused images between pickup and drop-off.



Manual Validation Overhead

Operations teams spent a significant amount of time visually comparing photos, leading to subjectivity and slow turnaround times.



Scalability and Cost

As the delivery network expanded, manual verification became untenable, increasing operational costs and compromising quality assurance.

These limitations created a clear need for an automated, intelligent solution capable of identifying image similarity, detecting invalid submissions, and improving consistency across the POD process.

The Solution:

AI/ML-Driven Image Validation Pipeline

Creative Capsule developed a multi-stage AI/ML solution combining deep learning-based similarity scoring, invalid image classification, and continuous model improvement to automate Bungii's proof-of-delivery verification.

1 Image Similarity Validation

The goal was to confirm that the images captured at pickup and drop-off represented the same product. Our approach involved experimenting with feature-extraction and embedding-based models that measure visual similarity through vector space distance metrics.

Model Evaluation and Selection

We tested several open-source pre-trained models: VGGNet, ResNet, ConvNeXt, Vision Transformers (ViT) and Swin Transformers. Swin Transformers yielded marginally higher accuracy but were omitted from the final pipeline owing to their increased inference latency and memory footprint.

After extensive experimentation, ResNet and Vision Transformers (ViT) provided the most balanced performance and robustness. Using ResNet and Vision Transformers models, we:

- Extracted feature embeddings for the pickup and drop-off images
- Computed similarity scores using cosine similarity and threshold-based classification to flag mismatched pairs
- Achieved high accuracy across a representative dataset reflecting typical daily delivery volumes, confirming this approach's suitability for real-world operations

Feature Matching Enhancements

To strengthen performance across different lighting and perspective variations, we integrated traditional computer vision methods with deep-learning features, including:

- SIFT (Scale-Invariant Feature Transform)
- LightGlue and LoFTR (Local Feature Transformer)

These algorithms enhanced the system's ability to recognize distinct product features, such as labels, logos, or surface textures, even under inconsistent capture conditions.

2 Invalid Image Detection

Alongside similarity checks, the team developed a classification component to filter out irrelevant or low-quality uploads that do not qualify as valid POD images.

Amazon Rekognition Custom Labels

We trained a custom Rekognition model on a dataset that represents both valid and invalid image types.

- The model effectively distinguished between genuine delivery photos and anomalies such as blank screens or unrelated backgrounds.
- The model demonstrated reliable classification, accuracy, and scalability potential for production use.

Open-Source Alternatives for Cost Optimization

To enhance cost-efficiency and deployment flexibility, we also evaluated open-source CNN classifiers (based on EfficientNet and MobileNet) for fine-tuning and local inference.

This approach significantly reduced cloud inference costs while maintaining strong accuracy and allowing domain-specific retraining.

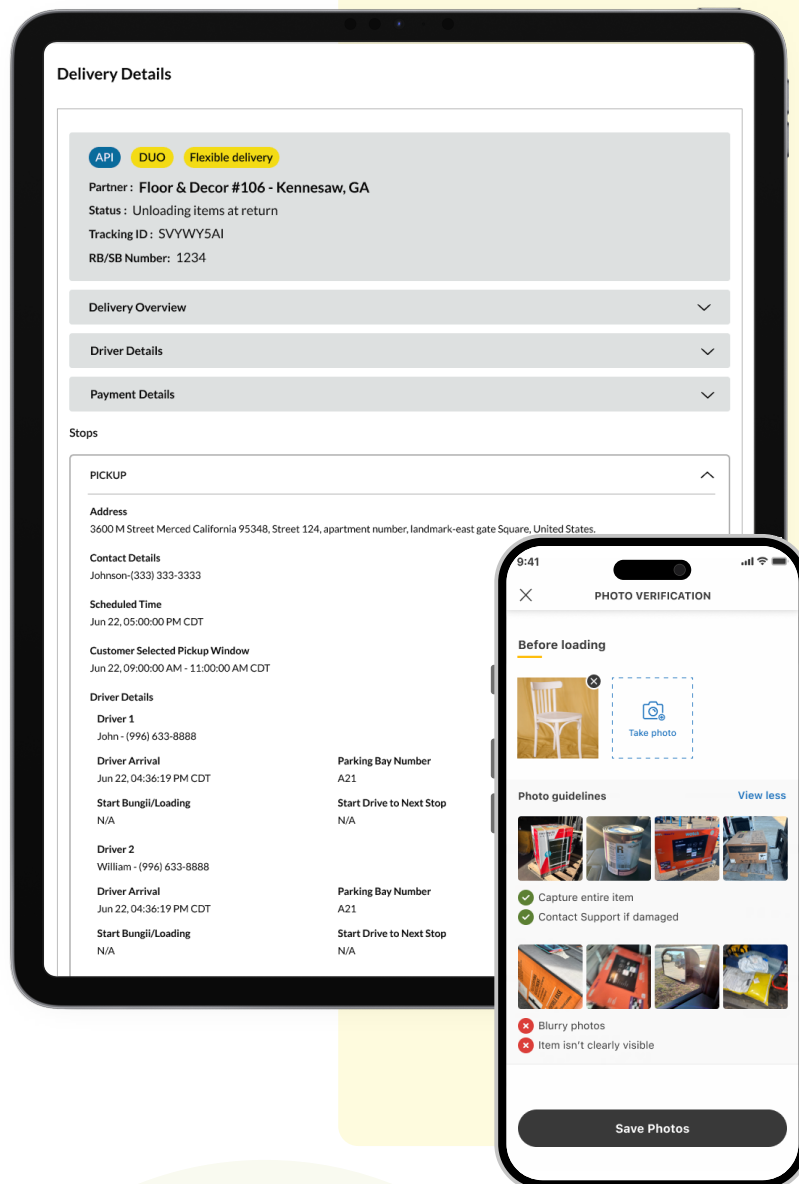
3 Continuous Optimization & Next-Generation Enhancements

To ensure the solution continues to evolve alongside Bungii's growing delivery operations, we incorporate ongoing iterative improvements that strengthen precision, expand model capabilities, and enhance resilience across real-world delivery scenarios.

- **Object-Focused Similarity:** Leveraging YOLO and Faster R-CNN models to detect and isolate the relevant object before similarity scoring, reducing false positives caused by background variations.
- **Siamese Neural Networks:** Training twin networks to map paired pickup and drop-off images into a shared embedding space, where proximity directly represents similarity, enabling fine-grained comparison of subtle differences.
- **Vision-Language Models (VLMs)** Incorporating CLIP-based architectures to align visual and contextual understanding, improving performance on complex scenarios involving varied backgrounds or object types.

Results and Impact

The deployment of this AI/ML pipeline delivered measurable improvements across Bungii's delivery operations:



70% Reduction in Manual Validation Effort through automated image scoring and flagging



Faster Proof-of-Delivery Confirmation with near real-time image analysis



Improved Accuracy and Consistency in identifying valid vs. invalid submissions



Lower Operational Costs by minimizing manual review and cloud-processing overhead

By automating the validation process, the solution enabled operations teams to focus solely on exceptions, thereby improving speed, reliability, and overall customer satisfaction.

Future Outlook: Scaling AI for Smarter Logistics

This initiative represents a foundational step toward an intelligent, scalable proof-of-delivery ecosystem. The next phase focuses on expanding automation and enabling continuous learning through:

- **Model Fine-Tuning and Data Expansion** using diverse, real-world delivery imagery to improve generalization and precision.
- **MLOps Integration** for automated model retraining, drift monitoring, and version control.
- **Real-Time Feedback Loop** integrated within driver and partner applications to provide instant image validation results.
- **Predictive Analytics** to proactively identify potential anomalies, delivery risks, or training needs across routes and driver behavior.

By combining **AI-driven automation with scalable cloud deployment**, Bungii and Creative Capsule are redefining how logistics companies validate deliveries, creating a future where every delivery is confirmed with intelligence, efficiency, and confidence.

Creative Capsule partnered with Bungii to automate and scale proof-of-delivery (POD) validation using AI/ML.

The result:



Faster



More accurate



Cost-efficient
logistics operations



About Us

Creative Capsule LLC was founded in Kansas City, USA, in 2003. It has subsidiaries in Switzerland and India. With over 300 full-time, local, and offshore employees, the company provides cost-effective software consulting and development, DevOps, and cybersecurity services to SaaS companies.

For companies looking to scale up and secure their software operations, we offer a range of advanced services such as AWS Elastic Kubernetes Service, Azure DevOps, Serverless computing, cyber threat prevention, and vulnerability assessment. Our expertise spans diverse industries, including tech startups, financial services, healthcare, and pharma.

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- Predictive Analytics

Our Partnerships and Certifications

