

# Saurabh Khanduja

• Computer Vision Engineer • Backend Engineer

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## ♾️ Summary

Computer Vision and Machine Learning specialist with expertise in real-time multi-camera multi-object tracking, object re-identification, and robust software engineering.

## 💼 Professional Experience

ML Engineer → Head of Perception	Ikara Vision Systems GmbH	Sept 2021 – July 2025
<i>Multi-Camera Multi-Person Tracking (Terraform, Docker, Python, PyTorch, AWS (S3, EC2 &amp; IAM), Pandas, MMLabs, Optuna)</i>		
<ul style="list-style-type: none"><li>Developed real-time multi-camera tracking across 50+ synchronized cameras for secure site monitoring.</li><li>Enhanced multi-camera joins using pose triangulation (RTMPose) and appearance embeddings (Clip-ReID).</li><li>Improved re-identification pipeline with <b>57%</b> mAP error reduction over vanilla Clip-ReID (40% → 74.4% mAP).</li><li>In-house built tools for Multi-Camera Labeling, Visualization and Analysis.</li><li><b>AutoLabel++:</b> A scalable framework to train object detection models to new sites using knowledge distillation.</li></ul>		

*Distributed Computer Vision solutions for Customer Behavioral Analysis (Docker, Python, Celery, Ansible, Mongo, PostgreSQL, InfluxDB, TensorRT, Rabbitmq, Telegraf, Grafana, Jira, SQLite)*

- Core Responsibility - Took ownership of a mismanaged third-party project with over 30K lines-of-code and deployed across 1,000+ stores in 3 countries.
- Led team of 7 engineers to demystify the monolithic application, introduced structure to undocumented processes, resolved high volumes of client complaints, and restored product stability and client confidence.
- Redesigned high demand components of application from a centralized management server to a distributed management system.
- Redesign periodic polling with event-driven push, reducing read requests by ~94%.
- Improved long-term product robustness and stability with unit and integration testing of critical code regions.
- Achieved a complete **100%** resolution of client complaints related to software (non-ML) issues.
- Improved the core computer vision product with state of the art models and tracking algorithm tuned to specific sites using anonymized feed collection and automated labeling with human-in-the-loop.
- Successfully deployed solutions across 1000+ stores using a cost-effective in-house deployment manager.

*Cargo Volume measurement for an airline (Docker, Python, C++, Open3D, Qt, Depth Cameras - Helios & Nerion)*

- Multi-process real-time pipe & filter architecture for 3D Reconstruction, pointcloud cleaning and contour fitting.
- Anonymization Software (FastAPI, Milestone VMS, AI Bridge, Pytorch, Tensorrt, PyNvVideoCodec, C++)*
- Implement low-latency face and license plate detection software to anonymize RTSP streams.
- Improved load balancing to ensure high GPU utilization using shared decoders and batching.

Work Student	Terraloupe & ECR GmbH	April 2018 – August 2021
<i>Improving Core ML Products and Production Infrastructure (Python, Go, Docker, Kubernetes)</i>		

- Implement serving and testing of PyTorch models over Kubernetes pods.
- Implement tracking metrics to benchmark multi-object tracking associators.
- Designed benchmark to evaluate internal defect predictors on real data as well as synthetically introduced defects.
- Designed 4 new safety performance indicators to measure safety of autonomous vehicles.

*Training Data Management Tool (Python, Django, PostgreSQL, PostGIS)*

- Development of PostgreSQL-based inventory database with geo-coordinate support for world map datasets and a query service for sampling datasets from the database.

*Core Deep Learning Pipeline (Docker, Python, Keras, Tensorflow)*

- Development of single pipeline supporting Image Classification, Object Detection and Semantic segmentation tasks.
- Optimization of training and inference phase with resulting GPU utilization of over 90%.

Image Team Lead	Roposo, India	Nov 2015 – Oct 2017
<i>Image Processing Service Development (Java, AWS, OpenCV, ffmpeg)</i>		
<ul style="list-style-type: none"><li>Optimizations to efficiently use servers, leading to 70% cost reduction.</li></ul>		

- Enable dynamic compression of media using SSIM metric.
  - Quantifying social posts ownership by measuring plagiarism using image metadata analysis.
  - Implemented Beauty filter based on variational approach by Farbman, Zeev, et al. [1]

<b>Software Development Engineer</b>	<b>Amazon, India</b>	<b>Oct 2014 – Nov 2015</b>
<i>Resell Product Form (Java, DynamoDB)</i>		
<ul style="list-style-type: none"><li>• Development of data model to reduce user interaction for form completion and data payload for mobile usage.</li><li>• Improved form completion rate by <math>5\times</math> with reduction of data payload by 99.5%.</li></ul>		
<i>Catalog Labeling Quality Platform (Python, Apache Spark)</i>		
<ul style="list-style-type: none"><li>• Developed a platform to cluster Amazon catalog data with Human-in-the-Loop analysis, reducing catalog quality check time from several weeks (previously infeasible) to under an hour.</li></ul>		
<b>Software Development Engineer</b>	<b>KritiKal Solutions Pvt. Ltd., India</b>	<b>June 2012 – Oct 2014</b>
<i>Atmosphere Turbulence Removal Module (C++, Cuda, DLib, OpenCV, Qt, libpthread)</i>		
<ul style="list-style-type: none"><li>• Development of Atmosphere Turbulence Removal Module based on Non-Rigid Registration method [2].</li><li>• Optimizations added using Pipe-And-Filter architecture and cuda implementation, achieving <b>240x</b> speedup.</li></ul>		
<i>Wide Area Tracking Module (C++, OpenCV, Qt)</i>		
<ul style="list-style-type: none"><li>• Designed and implemented a module for controlling Pan and Tilt Device.</li><li>• Real time stitching of multiple CCD/Infrared Cameras to produce a wider view.</li><li>• Change Detection and Tracking module to detect and track objects of interest.</li></ul>		

## Academic Projects

Master Thesis	CAMP*, Technical University of Munich	Dec 2020 – June 2021
<i>Weakly Supervised Semantic Segmentation using Low-level neural network features</i>		
	<ul style="list-style-type: none"><li>• We proposed a novel approach for dissecting classification neural networks to extract semantic maps.</li><li>• The method improves the mIOU metric by more than 20% on the vgg and resnet backbone models w.r.t. class activation maps.</li></ul>	
<b>Research Assistance Project</b> <b>Technical University of Munich</b> <b>Dec 2019 – May 2020</b>		
<i>Neural Response Interpretation through the Lens of Critical Paths, CVPR 2021 (Pytorch, python) [3]</i>		
<ul style="list-style-type: none"><li>• <b>CVPR 2021</b> - Improving interpretability using path selection via neurons' contributions to the response.</li></ul>		

## Education

<b>Munich, Germany</b>	<b>Technical University of Munich</b>	<b>Oct 2017 – July 2021</b>
	<ul style="list-style-type: none"><li>• M.Sc. in Informatics with <i>Distinction</i>, GPA: 1.3/1.0</li><li>• Graduate Coursework: Machine Learning; Deep Learning; Principles of Computer Vision; Multiple View Geometry; Tracking and Detection in Computer Vision; 3D Scanning &amp; Motion Capture; Protein Prediction.</li></ul>	
<b>Dhanbad, India</b>	<b>Indian Institute of Technology</b>	<b>July 2008 – May 2012</b>
	<ul style="list-style-type: none"><li>• B.Tech. in Computer Science and Engineering, CGPA: 7.51/10.0</li></ul>	

## Technical Skills

- Programming Languages: Python, C, C++ with minor dabbles in Go, Matlab, HTML, CSS, JS.
  - ML/CV Toolkits: PyTorch, OpenCV, Open3D, Numpy, Pandas and many more.
  - Application Development: Docker, Kubernetes, Rabbitmq, Redis, Telegraf, Grafana, Celery, Ansible, Terraform, PyQt, MongoDB, PostgreSQL, InfluxDB.
  - Project and Team Management - Jira, Linear.

## References

- [1] Zeev Farbman et al. “Edge-preserving decompositions for multi-scale tone and detail manipulation”. In: *ACM Transactions on Graphics (TOG)* 27.3 (2008), pp. 1–10.
  - [2] Daniel Rueckert et al. “Nonrigid registration using free-form deformations: application to breast MR images”. In: *IEEE transactions on medical imaging* 18.8 (1999), pp. 712–721.
  - [3] Ashkan Khakzar et al. “Neural Response Interpretation through the Lens of Critical Paths”. In: *CVPR*. 2021.

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\*<http://campar.in.tum.de/Chair/ResearchIssueComputerVision>