Kunal Rajendra Chaugule

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Professional Summary

ML and Image Processing Engineer, National Hackathon Champion (1st/200k+), and Co-founder of Orlume Vision Labs. My work bridges the gap between **Signal Processing**, **Deep Learning**, and **Extended Reality (XR)**. From architecting **WebGPU PBR engines** to developing **sparse-view 3D reconstruction** pipelines, I specialize in building end-to-end systems that merge computer vision with interactive graphics.

Education

Saraswati College of Engineering (University of Mumbai) *Navi Mumbai, India*
Bachelor of Engineering in Computer Science & Engineering (Data Science) *Nov 2021 – July 2025*

- **CGPA:** 8.81/10 (Recent Semesters) | **Overall:** 8.18/10
- **Honors Program:** Cyber Security (Selective track for high academic performers)
- **Relevant Coursework (ECTS Mapping):**

Mathematics & Statistics (42 ECTS Equiv.)	Computing & Imaging (145 ECTS Equiv.)
• Eng. Mathematics I-IV (Theory + Tutorials)	• Computer Graphics (Theory + **Lab**)
• Probability & Statistics for Data Science	• Deep Learning (Theory + **Lab**)
• Discrete Structures & Graph Theory	• Machine Learning (Theory + **Lab**)
• Linear Algebra (Integrated)	• Digital Logic & Computer Architecture
• Cryptography (Mathematical Foundations)	• Analysis of Algorithms

Professional Experience

Co-Founder & Lead Software Engineer *Jan 2025 – Present*
Orlume Vision Labs *Mumbai, India*

- **System Architect:** Architected a scalable **WebGPU/WebGL2** imaging engine, integrating 'Depth Anything V2' for dense monocular depth estimation and dynamic mesh generation.
- **Edge AI Optimization:** Optimized client-side inference using **ONNX** & **Transformers.js**, deploying SegFormer B0 for semantic material mapping directly in the browser.
- **Product Engineering:** Built the production-grade **React/Three.js** architecture, scaling the tool from prototype to deployment for active users.

Machine Learning Research Assistant *Dec 2024 – June 2025*
Dept. of Computer Science (SCOE) | Supervisor: Dr. Gauri Deshpande *Navi Mumbai, India*

- **Real-Time Vision:** Optimized **CNN architectures** for object detection and segmentation, significantly reducing latency for **real-world** embedded implementations.
- **Data-Centric AI:** Engineered robust preprocessing pipelines to handle noise and class imbalance, ensuring model reliability in dynamic environments.
- **Research Output:** Designing a custom signal restoration pipeline to mitigate high-contrast artifacts.

Machine Learning Engineer *Sep 2024 – Mar 2025*
The Analyzing Company *Mumbai, India*

- **Anomaly Detection:** Developed CNN-based pipelines for intelligent surveillance, identifying rare events and structural irregularities in video streams.
- **Edge Deployment:** Optimized inference for **constrained hardware** using TensorFlow Lite and quantization, achieving real-time alert capability on edge devices.

Scientific Projects

Real-Time 3D Relighting System | *WebGPU, WebGL2, GLSL, Three.js* **Jan 2025 – Present**

- Engineered a physically-based rendering (PBR) pipeline using **GGX specular distribution**, **Fresnel-Schlick reflectance**, and **HBAO** (Horizon-Based Ambient Occlusion) to simulate realistic light-matter interaction on 2D photographs.

- Implemented a **dithered ray-marching soft shadow algorithm** (48-step) with pseudo-random per-pixel offset and 9-tap Gaussian depth smoothing, adapted for ML-estimated depth maps to eliminate banding artifacts common in screen-space shadow techniques.
- Integrated monocular depth estimation (**Depth Anything V2**) and semantic segmentation (**SegFormer B0**) via **Transformers.js** to enable real-time 3D scene reconstruction from single 2D images.

Ultra-Low Latency (<5ms) Virtual Piano: Vision-Driven HCI | *OpenCV, Medi*-**Nov 2024 – Dec 2024**
aPipe
- Engineered a markerless motion capture system tracking 21 hand landmarks with **<5ms latency**, enabling seamless real-time musical interaction.
- Developed velocity-based triggering algorithms to simulate key-press intensity, bridging the gap between computer vision tracking and tactile musical expression.

Sparse-View Dynamic 3D Reconstruction | *Python, Colab, Gaussian Splatting* **Oct 2024 – Dec 2024**
- Designed a low-cost volumetric capture pipeline using a heterogeneous array of three smartphone sensors.
- Solved temporal synchronization of **un-genlocked devices** using audio-waveform alignment algorithms.
- Implemented histogram matching to unify RGB distributions across disparate camera ISPs.

Honors Awards

National Champion - Smart India Hackathon 2023 | *Ministry of Education* **Dec 2023**
- Winner of the World's Largest Open Innovation Model (Software Edition) out of **200,000+ participants**.
- Led the development of "FITLIFE," a real-time computer vision system for exercise correction.

Conference Presentations Publications

K. Chaugule et al., "Vision-Driven Virtual Piano: Monocular Hand Tracking, Dynamic Calibration, and Velocity-Based Note Triggering," *Intl. Conf. on Computing, STEM and Applied Sciences*, Mar 2025.

K. Chaugule et al., "Stereo Vision with ESP32-CAM: Depth Estimation for Autonomous Driving Applications," *Intl. Conf. STEM for Sustainable Development*, Feb 2025.

Technical Skills Interests

Core Domains: Computational Imaging, Computer Vision, Signal Processing, Deep Learning, PBR, HCI
Languages: Python, C++, MATLAB, GLSL (OpenGL), WGSL (WebGPU), JavaScript
Scientific Computing: PyTorch, TensorFlow, NumPy, SciPy, OpenCV, Scikit-Image, ONNX
Imaging & Graphics: Ray Tracing, Gaussian Splatting, Photogrammetry, Color Science, Fourier Analysis
Tools: Git, Linux, LaTeX, Blender (Synthetic Data), Google Colab, MediaPipe
Interests: Wildlife Photography (Portfolio), Cinematography, Endurance Sports

Certifications

- **Linear Algebra for Machine Learning and Data Science** (DeepLearning.AI)
- **3D Reconstruction - Single Viewpoint** (Columbia University)
- **Physics of Light and Materials** (Rice University)
- **Neural Networks and Deep Learning** (DeepLearning.AI): *DNN, backpropagation, optimization.*
- **User Experience & Interaction Design for AR/VR/MR/XR** (University of Michigan)
- **Understanding Research Methods** (SOAS Univ. of London): *Research methodology and academic writing.*

Leadership Volunteering

Team Lead - Digital Marketing & Photography | *Student Council (SCOE)* **Jun 2023 – May 2024**
- Led the creative team in managing the college's digital presence and executing event coverage campaigns.
- Directed photography and media strategies for major festivals, significantly increasing student engagement.

Core Member - Coding Club | *Saraswati College of Engineering* **Dec 2022 – Present**
- Organized coding events and hackathons to promote programming and ML-CV applications.
- Mentored juniors in algorithms and problem-solving, fostering a strong technical community.