

# Mohammad Tajwar Chowdhury

Computer Vision Engineer · Video Analytics · Deep Learning · Python

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## Summary

Computer Vision Engineer specializing in real-time video analytics, multi-object tracking, and perception system development. Proven ability to design, train, and deploy end-to-end CV pipelines — from dataset preparation and model training to inference optimization and production-quality output. Comfortable working across the full stack of a CV system: detection, segmentation, tracking, ReID, anomaly detection, and crowd analysis.

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## Project Experience

### Computer Vision Engineer — Independent Projects | 2024 - Present

Designed and shipped 12+ production-quality CV systems across tracking, ReID, anomaly detection, segmentation, and crowd analysis. All projects built with modular Python, rigorous evaluation, and real benchmark datasets.

#### **Multi-Camera People Tracking & BEV Mapping** *Python · YOLOv8m · StrongSORT · OSNet · OpenCV · Homography · FAISS*

- Built an end-to-end multi-camera surveillance pipeline maintaining consistent person identities across 3 synchronized camera views (EPFL dataset)
- Implemented cross-camera ReID via cosine similarity with EMA prototype updates; projected real-time positions onto a bird's-eye-view floor map using homography calibration
- Achieved CMC@3: 90.0% cross-camera ReID accuracy with full annotated video and BEV trajectory export
- [GitHub](#)

#### **Advanced Multi-Object Tracking on MOT17** *Python · YOLOv8m · StrongSORT · OSNet · ByteTrack · TrackEval · boxmot*

- Developed a state-of-the-art MOT pipeline with YOLOv8m detection and StrongSORT + OSNet appearance embeddings, evaluated against ByteTrack baseline on MOT17
- Implemented track lifecycle management, velocity overlays, camera motion compensation, and per-sequence JSON analytics

- Achieved HOTA: 41.6 / MOTA: 38.1 / IDF1: 50.8 — +3.4 HOTA improvement over baseline
- [GitHub](#)

### **Person Re-Identification on Market-1501** *Python · PyTorch · ResNet-50 IBN-a · BNNeck · FAISS · YOLOv8m · Colab T4*

- Built a full Re-ID system from scratch: ResNet-50 IBN-a with label smoothing cross-entropy and hard-mined triplet loss, FAISS flat index for cosine gallery search
- Evaluated zero-shot generalization on DukeMTMC-reID; built video demo pipeline with YOLOv8m detection, ReID embedding, IoU-anchored tracking, and t-SNE visualization
- Achieved Rank-1: 81.80% / mAP: 60.38% on Market-1501
- [GitHub](#)

### **Video Tracking Analytics Pipeline** *Python · YOLOv8 · ByteTrack · OpenCV · PyTorch MPS · SciPy*

- Built a real-time multi-object tracking and counting pipeline supporting live webcam streams, video files, and batch processing
- Includes trajectory trails, Gaussian-blurred movement heatmaps, virtual IN/OUT counters, live HUD, and full CSV/JSON export
- Runs at 24.1 FPS on Apple M1 with MOTA ~97%
- [GitHub](#)

### **Crowd Anomaly & Panic Detection** *Python · PyTorch · ConvLSTM · CSRNet · Optical Flow (Farneback/RAFT)*

- Built a dual-stream anomaly detection system combining density (CSRNet) and optical flow streams into a ConvLSTM temporal classifier to detect crowd panics, surges, and dispersals
- Trained on ShanghaiTech Campus; auto-extracts flagged clips at 30 FPS on M1 MPS
- Achieved AUC-ROC: 0.9648 / F1: 0.8538
- [GitHub](#)

### **Unsupervised Anomaly Detection in Surveillance Video** *Python · PyTorch · Convolutional Autoencoder · Optical Flow · scikit-learn*

- Built a fully unsupervised anomaly detection system (no anomaly labels at any stage) using a dual-channel autoencoder on grayscale frames and Farneback optical flow
- Per-sequence score normalization improved AUC from 0.617 → 0.855; inference renders JET heatmap overlays and auto-extracts flagged clips
- Evaluated on UCSD Ped2: AUC-ROC: 0.8546 / EER: 20.96%

- [GitHub](#)

## Additional Projects

- *Crowd Density Estimation with CSRNet* — pixel-wise density regression on ShanghaiTech; Part A MAE: 87.85, Part B MAE: 21.12 with real-time heatmap overlay | [GitHub](#)
  - *Semantic Segmentation on PASCAL VOC 2012* — DeepLabV3+ with ASPP and ResNet-50 backbone, live webcam inference | [GitHub](#)
  - *Instance Segmentation with Mask R-CNN on COCO* — fine-tuned with custom AP/AR evaluation and interactive webcam demo | [GitHub](#)
  - *Medical X-ray Classification on CheXpert* — multi-label DenseNet with Grad-CAM explainability for chest pathology detection | [GitHub](#)
  - *Traffic Sign Recognition on GTSRB* — EfficientNet-B0 across 43 classes, 98.1% accuracy, webcam demo | [GitHub](#)
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## Technical Skills

**Languages:** Python, Shell/Bash

**CV / DL Frameworks:** PyTorch, torchvision, timm, Ultralytics YOLOv8, segmentation-models-pytorch, boxmot, OpenCV

**Computer Vision:** Object detection, multi-object tracking, person re-identification, semantic & instance segmentation, anomaly detection, crowd density estimation, optical flow, medical imaging

**Model Architectures:** YOLOv8, ResNet-50 IBN-a, CSRNet, ConvLSTM, Convolutional Autoencoder, EfficientNet-B0, DeepLabV3+, Mask R-CNN, DenseNet

**Tracking & ReID:** StrongSORT, ByteTrack, OSNet appearance embeddings, FAISS similarity search, cross-camera ReID, homography-based BEV projection, TrackEval

**Training Techniques:** Transfer learning, metric learning (triplet loss), hard negative mining, class-weighted loss, cosine LR decay, Grad-CAM, unsupervised learning

**Evaluation:** HOTA/MOTA/IDF1, CMC/mAP, AUC-ROC, mIoU, AP/AR, MAE/RMSE, TensorBoard, scikit-learn

**Tools & Infra:** Git/GitHub, Conda, Google Colab (T4 GPU), Apple MPS (M1), FAISS, Kaggle API, VS Code

**Optimization & Export:** ONNX export, MPS/CPU inference optimization, real-time pipeline design (24+ FPS)

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## Education

**Bachelor of Science in Computer Science**

BRAC University · Dhaka, Bangladesh · Class of 2025

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## Reference

**Dr. Jannatun Noor Mukta**

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