

MUHAMMAD HASNAIN

Machine Learning Engineer | Applied AI & Audio Forensics

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PROFESSIONAL SUMMARY

Recent BS Computer Science graduate with hands-on experience across the full ML lifecycle: dataset engineering, deep learning model design in PyTorch, rigorous evaluation, and production deployment. Owned the ML system end-to-end for FASSD, a multi-axis forensic audio-authenticity system trained on a 1.9M-sample dataset and deployed as a live web platform. Comfortable owning a project's ML pipeline end-to-end — from raw data through a deployed, user-facing API — and honest about model limitations rather than overselling results.

PROJECTS

FASSD — Forensic Acoustics for Synthetic Speech Detection (Final Year Project) | [Live Platform: deepfakedetection.dev](#)

- Owned the ML system end-to-end within a 2-person team (IST Cyber and Information Security Lab, supervised by Faran Mahmood); teammate built the Next.js frontend and Firebase-based sign-in/accounts.
- Designed and trained multiple deep learning architectures in PyTorch — CNN, ResNet (2.8M parameters), and a hybrid ResNet + environmental-feature model — iterating from a 9.68% EER baseline down to a 0.57% clean-domain EER ResNet.
- Built and curated a unified, speaker-independent dataset of 1.89M audio samples spanning ASVspoof (LA/DF/PA) and real-world broadcast/podcast/social sources, with LFCC and log-mel spectrogram feature pipelines backed by HDF5 for efficient training I/O.
- Diagnosed a critical generalization failure — a high-performing ResNet (2.61% augmented EER on ASVspoof) misclassified 100% of real broadcast audio samples as fake — and drove the project's pivot toward environmental acoustic features and real-world data collection.
- Rearchitected the system from a single binary classifier into a multi-axis forensic pipeline (origin, replay, mixer/channel, partial-fabrication, and segment-level evidence axes), after rigorously testing and rejecting HybridResNet fine-tuning and AASIST as standalone solutions through controlled forensic evaluation.
- Built and deployed the ML inference backend (FastAPI on DigitalOcean behind Caddy) that powers the live platform, integrating with the teammate-built frontend.
- Delivered a formally validated release package (184-file evaluation matrix, documented per-model cards, evidence-band calibration) and explicitly scoped the system as an experimental decision-support tool rather than a conclusive detector.

ML-Integration Pipeline — Building Defect Detection (Freelance Client, NDA)

- Built the production integration layer that consumes a client-provided, pre-trained defect-detection model's outputs — not the model itself — and renders them as a 3D inspection tool.
- Designed a data-driven marker-placement system that maps model detections (defect type, location, confidence score) onto a 3D building model across front, back, left, and right wall surfaces.
- Built the pipeline to be model-agnostic, so updated detection outputs from the client's model could be visualized without pipeline changes.

TECHNICAL SKILLS

- Languages: Python
- Machine Learning / Deep Learning: PyTorch, CNN & ResNet architectures, Transformers (AASIST, Wav2Vec) model evaluation (EER, AUC, precision/recall), scikit-learn (Random Forest, Isolation Forest)
- Audio & Signal Processing: LFCC & log-mel/MFCC spectrogram features, HDF5 data pipelines, SSL embeddings, VAD-aware segmentation
- Data Engineering: Large-scale multi-source dataset curation, speaker-independent train/test splitting, feature engineering at 1M+ sample scale
- Backend & Deployment: FastAPI, Next.js, Firebase (Auth, Firestore), DigitalOcean, Vercel, Caddy, Gradio (rapid UI prototyping)
- Tools: Git

SOFTWARE ENGINEERING EXPERIENCE

Software Engineer — Remote *Sep 2023 – Present*

Knoduct Coaching Learning LLC, Minnesota, USA · project-based; regular ongoing engagement since Dec 2024

- Independently designed, built, and shipped 30+ production software products end-to-end for a US-based client, from requirements through deployment, sustaining a 2+ year client relationship.
- Built and maintained multi-cloud deployment infrastructure (AWS S3/CloudFront/IAM, Vercel, Cloudflare Pages/R2) supporting 30+ live releases.

EDUCATION

Bachelor of Science in Computer Science *Sep 2022 – Jul 2026*

Institute of Space Technology, Islamabad · Final Year Project: FASSD (see above)