Muhammad Turab

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GitHub | LinkedIn | Google Scholar | Website

Summary

I specialize in audio/speech recognition, image processing, LLMs, and agentic AI based methods with hands-on developing agentic ai applications for various use cases.

Skills

Core Expertise: Computer vision, medical imaging, image/video/scene understanding, LLMs, LangChain, LangGraph, image quality assessment, image/video restoration, eXplainable AI, domain generalization, and fairness.

Languages & Tools: Python, Java, JavaScript, Matlab, Numpy, Pandas, OpenCV, Scikit-Learn, Tensorflow, Keras, Matplotlib, Seaborn

Work Experience

Dublin City University, Dublin. Oct 2025 - Present

PhD Researcher in Explainable Medical Imaging

- The goal of my phd is to develop neurosymbolic based methods in the field of medical imaging to make the neural network decisions more explainable, and transparent.

Laboratory Hubert Curien, University of Jean Monnet, Saint-Etienne, France. Jan 2025 - Current

Master's Thesis Student

- 3D Pose estimation, and human body modeling of dancers.
- 3D scene reconstruction to estimate the floor on which dancers are moving.
- Evaluation of human body movements using trajectory of different joints or bodies.
- Development of novel feature descriptors for movement description and analyzation.
- Evaluation of the feature descriptors using Machine learning models and their **explainability** using SHAP and LIME.
- Investigated how the mover utilizes space, the quality of the movement, and which joint initiates the movement.

Colourlab, NTNU, Norway Jul 2024 - Aug 2024

Research Intern

- Worked on the colorization of old black-and-white negative films using generative AI, specifically a Pix2Pix-based GAN model for colorization.
- Developed a custom palette matching algorithm with super-pixel segmentation and color transfer for enhanced accuracy. Achieved performance surpassing state-of-the-art models like DeOldify.
- Tested on a century-old painting from the 1930s, achieved promising and accurate colorization results.

University of Galway, Ireland. Jan 2022 - Jul 2023

Research Intern

- Optimized data preprocessing workflows by integrating 5 innovative data augmentation methods, which increased training data diversity and improved model robustness, leading to a notable reduction in overfitting by 15%.
- Developed a multi-feature selection algorithm for audio classification that integrated 5 distinct spectral and temporal features; improved model accuracy by 12%, enabling more precise audio recognition in real-time applications.
- Developed AudRandAug, a novel random augmentation technique for audio classification, combining weighted and non-weighted strategies to enhance model robustness.

Department of Computer Systmes Engineering, MUET Jan 2022 - Oct 2022

Research Assistant

- Conducted research on detecting forged characters in personal documents, such as passports and driver's licenses, addressing challenges in digital image forensics.
- Collaborated with professors and peers to develop machine learning techniques, including synthetic datasets and deep learning models for forgery detection.
- Created algorithms to generate datasets for forged character detection, tackling the lack of publicly available data.
- Publicly released three datasets, each containing 15000 images.

Education

Oxford Machine Learning Summer School Jul 2024
University of Oxford and AI for Global Goals
Studied Statistical and Probabilistic Machine Learning, Representation Learning (Generative AI), and Geometric Deep Learning. Gained insights into cutting-edge developments in Computer Vision, Natural Language Processing, Large Language Models (LLMs), Knowledge Graphs, and Neuro-Symbolic AI.

Erasmus Mundus Joint Masters Degree Program (Norway, France, Finland) Aug 2023 - Present (Aug 2025)
Computational Color and Spectral Imaging
Relevant Coursework: Image Processing, Machine Learning, Computer Vision, Deep learning, Color Science, Spectral Imaging, Hyperspectral Imaging

MUET, Hyderabad Aug 2018 - Sep 2022
B.E in Computer Systems Engineering CGPA: 3.62/4.0
Relevant Coursework: Object Oriented Programming, Databases, Data Structures and Algorithms, Operating Systems, DBMS, Web Engineering, Machine Learning, Data Mining, Advance Data Structures and Algorithms, Image Processing

Publications

- A Trémeau, **Turab, M**, D Muselet, P Colantoni. Movements analysis in performing arts from human body pose estimation. Invited paper. Proceedings of the 2nd International Conference on Signal Processing and Computer Vision (SIPCOV-2025) August 8-9, 2025, Silchar, India. To be published in Springer Nature, series: Advanced Engineering Research
- **Turab, M**, P Colantoni, D Muselet & A Tremeau. Emotion Recognition in Contemporary Dance Performances using Laban Movement Analysis. Submitted to: 21st International Conference in Computer Analysis of Images and Patterns (CAIP) 22 - 25 Sept 2025, Canary Islands, Spain.
- **Turab, M**, P Colantoni, D Muselet & A Tremeau. Dance Style Recognition using Laban Movement Analysis and Machine Learning. Submitted to: Advanced Concepts for Intelligent Vision Systems (ACIVS). July 2025, Tokyo, Japan.
- **Turab, M.**, & Jamil, S. (2023). A Comprehensive Survey of Digital Twins in Healthcare in the Era of Metaverse. *BioMedInformatics*, 3(3), 563–584. Link
- Kumar, T., **Turab, M.**, Mileo, A., Bendechache, M., & Saber, T. (2023). AudRandAug: Random Image Augmentations for Audio Classification. *arXiv preprint arXiv:2309.04762.* Link
- **Turab, M.**, Kumar, T., Bendechache, M., & Saber, T. (2022). Investigating Multi-Feature Selection and Ensembling for Audio Classification. *International Journal of Artificial Intelligence & Applications.* Link
- Kumar, T., **Turab, M.**, Talpur, S., Brennan, R., & Bendechache, M. (2022). FORGED CHARACTER DETECTION DATASETS: PASSPORTS, DRIVING LICENCES AND VISA STICKERS. *International Journal of Artificial Intelligence & Applications.*Link
- Khan, W., **Turab, M.**, Ahmad, W., Ahmad, S.H., Kumar, K., & Luo, B. (2022). Data Dimension Reduction Makes ML Algorithms Efficient. *International Conference on Emerging Technologies in Electronics, Computing and Communication (ICETECC) 2022.* Link
- Memon, Z., **Turab, M.**, Narejo, S., & Korejo, M.T. (2023). An Ensemble of CNN Architectures for Early Detection of Alzheimer's Disease Using Brain MRI. *Mehran University Research Journal of Engineering & Technology* Link

Projects

- **3D Reconstruction of Static Scenes from Multiview Images:** (PDF Report)
  - Implemented a complete pipeline for 3D reconstruction using multiple camera views. Performed camera calibration, feature detection, and matching using SIFT and FLANN. Applied stereo rectification, disparity mapping, and depth estimation techniques. Used Semi-Global Block Matching (SGBM) for improved disparity maps.
  - Experimented with various approaches including classical geometric methods and deep learning (DUST3R).
  - Achieved successful 3D point cloud generation and scene reconstruction. Analyzed and compared results from different stereo pairs and multiview setups
- **Real-time Virtual Object Insertion via Depth Estimation and Environment Mapping**
  - Developed techniques for realistic object insertion into images using advanced deep learning models such as DistDepth, DPT, DepthAnything, and ZoeDepth.
  - Used depth estimation, environment mapping, and light estimation to achieve accurate object scaling, placement, and lighting within scenes.
  - Applied iterative inpainting and DiffusionLight methods to enhance the realism of object integration.
  - Surpassed traditional techniques in both performance and visual quality, delivering highly realistic results.
- **Image Signal Processing Approaches for Low-Illumination Image Enhancement**
  - Conducted an extensive review of image signal processing methods to enhance images captured under low-light conditions.
  - Classified and analyzed traditional techniques (denoising, automatic white balancing), deep learning-based methods (CNNs, GANs), and hybrid approaches.
  - Evaluated the strengths and limitations of each method in improving visual quality and noise reduction in low-

illumination images.
  - Provided insights and recommendations for future research directions in the field of low-light image enhancement.
- **Image Super-Resolution using Generative Adversarial Networks (GANs)**
  - Developed a Super-Resolution GAN (SRGAN) model to enhance the resolution of low-quality images, restoring finer details and improving visual quality.
  - Implemented both content loss and adversarial loss functions to generate high-quality, perceptually realistic images. Trained the model on high-resolution image datasets, applying image degradation techniques for simulating low-resolution inputs. Achieved significant improvements in image sharpness and detail restoration, outperforming traditional interpolation methods.
- **Spectral-Based Contrast Enhancement and Camera Simulation for Biological Imaging**
  - Developed spectral-based contrast enhancement techniques for better visualization of biological tissues using data from the Dental Spectroscopy Database. Simulated camera performance by analyzing spectral response and applied spectral estimation to enhance contrast in images of human skin and mucous membranes.
  - Created a spectral camera simulation tool to test endoscopic imaging capabilities, using spectral data from rectal membranes for improved medical imaging accuracy.
- **Smart Contact Manager:** (Youtube, GitHub) Developed a secure web application for efficient contact management using Spring Boot.
  - CRUD operations for contacts, User authentication with sign-up and sign-in, Password recovery via email OTP, Responsive front-end using HTML, CSS, Bootstrap, and Thymeleaf, Back-end powered by Spring Boot, Spring MVC, and Spring Security, Data persistence with Spring Boot Data JPA, and Email functionality for password recovery.
- **City Mall Management System:** (Youtube, GitHub) Developed a desktop software for a shopping mall.
  - Implemented core functionalities such as account management, product catalog, order processing, and order details. Designed and integrated user management system with role-based access control and permission settings.
  - Created modules for purchase management, including purchase details logging and transaction history tracking.
  - Developed sales transaction history feature for improved financial monitoring and reporting.
  - Used Java Swing for building a user-friendly interface with intuitive navigation.