

# Muhammad Turab

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## Summary

Innovative and dedicated professional specializing in image processing, image quality assessment, computer vision, and deep learning, with extensive hands-on experience in spectral and hyperspectral imaging. Proven ability to develop cutting-edge solutions for complex visual data challenges. Actively pursuing advanced research opportunities, bringing expertise in developing models for image analysis, enhancement, and spectral data interpretation, with a strong focus on improving image quality and using deep learning techniques.

## Skills

Image processing, Image quality, Computer vision, Deep learning, Medical Imaging, Data Augmentation, Spectral Imaging, Hyperspectral imaging, Color science

## Work Experience

**Colourlab, NTNU, Norway**

Jul 2024 - Aug 2024

### Research Assistant

- 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 - Jun 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.

## Education

**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

- **Investigating Multi-Feature Selection and Ensembling for Audio Classification** (Link) M Turab, T Kumar, M Bendeche, T Saber, CRT AI, Published in: International Journal of Artificial Intelligence & Applications
- **A Comprehensive Survey of Digital Twins in Healthcare in the Era of Metaverse** (Link) M Turab, S Jamil, Published in: BioMedInformatics
- **Forged Character Detection Datasets: Passports, Driving Licences and Visa Stickers** T Kumar, M Turab, S Talpur, R Brennan, M Bendeche, Published in: International Journal of Artificial Intelligence & Applications
- **Data Dimension Reduction makes ML Algorithms efficient** W Khan, M Turab, W Ahmad, SH Ahmad, K Kumar, B Luo, Published in: International Conference on Emerging Technologies in Electronics, Computing and Communication (ICETECC) 2022
- **AudRandAug: Random Image Augmentations for Audio Classification** T Kumar, M Turab, A Mileo, M Bendeche, T Saber
- **An ensemble of CNN architectures for early detection of Alzheimer's disease using brain MRI** Z Memon, M Turab, S Narejo, MT Korejo, Published in: Mehran University Research Journal Of Engineering & Technology, 2023/10/1

## Projects

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- **Color Conversion and Spectral Analysis of Biological Tissues**
  - Analyzed spectral reflectance of human skin and mucous membranes using color conversion models and Principal Component Analysis (PCA) to identify key pigments like melanin and hemoglobin.
  - Developed a Python-based solution to calculate and visualize spectral reflectance across 31 wavelength bands (400 nm to 700 nm) for various biological tissues.
  - Applied multiple regression models to map spectral reflectance under different illumination conditions and improve color accuracy in biological tissue imaging.
- **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.
- **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.

## Awards and Certificates

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- **Oxford Machine Learning Summer School (Jul 2024)**
  - Studied advanced topics in Statistical and Probabilistic Machine Learning.
  - Gained expertise in Representation Learning, including Generative AI.
  - Explored Geometric Deep Learning methodologies.
  - Engaged with the Latest Developments in Computer Vision and Natural Language Processing, including Large Language Models (LLMs).
  - Worked with Knowledge Graphs, Knowledge-Aware Machine Learning, and Neuro-Symbolic AI.
- **AWS Machine Learning Foundations 2022 (Nano-Degree)** (Certificate) Received AWS ML nano-degree scholarship foundation course.
  - Introduction to AWS ML services (cloud computing), along with hands on practice on DeepRacer.
  - Writing clean & modularized code, testing, logging, refactoring, data management and much more.
  - Object-oriented programming in python, packages, virtual environment, building packages and uploading on PyPi.
- Java Programming Beginner to Advanced, Udemy.

## Extracurricular activities

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- **Conference Volunteer:** Actively contributed as a volunteer at the EUVIP 2023 Conference held at NTNU, Norway, supporting over 200 attendees and facilitating technical sessions.
- **MUET Big Event:** Planted trees and promoted the importance of cleanliness in one of the largest hospitals.
- **Flood camp donation 2020:** Organized a flood camp donation for families affected by floods, helping over 50 families with food, shelter, and necessities.
- **Speed Programming:** Achieved second place in Tech Arena, a competitive speed programming event held at the Department of Software Engineering, MUET, Jamshoro. Demonstrated exceptional problem-solving skills and coding proficiency under time constraints.