Mahmoud Salman

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Education

Western University — **Sep. 2024 – Present**
MESc in Biomedical Engineering — ML in Health Specialization — Grade: 93.5% *London, Ontario, Canada*
Coursework: Biomedical Application of Neural Networks, ML in Health, BME Foundations.
Thesis: Automatic Segmentation of Neonatal Hippocampal Subfields for Early Neurological Diagnosis.
- Built **preprocessing pipeline** combining whole-brain and **hippocampal tissue** labels; cropped hemispheres.
- Synthesized **neonatal MRIs** using **SynthSeg** with **domain randomization** to address **contrast variability**.
- Benchmarked 3 U-Net variants trained on synthetic data; selected best for inference-accuracy **tradeoff** due to use of **AMP** and **DALI** GPU-powered preprocessing; achieved **60% Dice**, aimed for **Dice>70%** on clinical data.
- *Supervised by Dr. Ali Khan and Dr. Emma Duerden.*

Cairo University — **Sep. 2019 – July 2024**
BSc in Biomedical and Systems Engineering — Grade: 80.4% *Giza, Egypt*
Graduation Project: AI-based Brain Tumor Segmentation with Motion Artifact Correction and Active Learning.
- Ranked **top student** in the class for graduation projects; awarded **Distinction** with highest group average.
- Achieved superior image quality metrics vs. SOTA: **SSIM +16%**, **PSNR +7.8dB**. Journal paper in progress.
- Developed an active learning framework with uncertainty estimation to reduce annotation effort; **integrated AI models** into a cloud-based platform in collaboration with a local hospital for pediatric GBM segmentation.
- *Supervised by Dr. Meena M. Makary and Dr. Mohammed Al-masni.*

Experience

Robarts Research Institute, Western University — **Sep. 2024 – Present**
Research Assistant *London, Ontario*
- **Amygdala Atlas Project:** Built a **preprocessing pipeline** aligning **9.4T post-mortem MRI** to **7T and MNI space**. Enhanced **image quality** and **anatomical fidelity**. Supervised undergraduate students for **manual segmentations**, **registration**, and refined **in-house amygdala sub-nuclei segmentation protocol**. Deployed **semi-automated tools**, reducing segmentation time by **80%**.
- **Fetal dMRI Masking Project:** Simulated motion artifacts using **TorchIO** and trained a **Motion-Agnostic Fetal Brain Segmentation U-Net** achieving **91% Dice**. Currently developing a **multi-stage pipeline** for joint segmentation and motion correction.

Faculty of Engineering, Western University — **Sep. 2024 – Dec. 2024**
Teaching Assistant *London, Ontario*
- Assisted with **ES1050: Foundations of Engineering Practice**. Supported **labs in 3D printing** and **Arduino prototyping**, held **office hours**, and **graded assignments and final projects**.

Ezz Medical Industries — **Sep. 2023 – Sep. 2023**
Data Scientist Intern *Giza, Egypt*
- Proposed an **83% cost reduction** by leveraging QLoRA to fine-tune LLM, enhancing BME R&D workflow.

Cyshield — **Jul. 2023 – Aug. 2023**
AI & Software Engineer Intern *Cairo, Egypt*
- Built ML/NLP/CV solutions and full-stack apps (Next.js + Nest.js).

Technocolabs Softwares — **Aug. 2022 – Sep. 2022**
Data Analyst Intern *Indore, India [Remote]*
- Promoted to **lead** the team; managed an end-to-end ML project: Spotify Recommendation System.

Ezz Medical Industries — **Aug. 2022 – Aug. 2022**
R&D Engineer Intern *Giza, Egypt*
- Audited mechanical ventilator design for **IEC 60601-2** compliance; created QA checklist and report. Proposed a **database software** to support biomedical engineering workflows.

Publications

ISMRM 2025 (Abstract) — May 10 - 15, 2025
Digital Poster — ISMRM Annual Meeting, Honolulu, Hawaii

- *"Retrospective Motion Artifact Correction Using Refinement U-Nets with Wavelet Affine Transformations and Adaptive Multi-Losses Normalization."*
- Proposed a novel motion correction framework for **T1-weighted brain MRI** using **Wavelet Affine Transformation (WAT)** blocks and **Adaptive Multi-Losses Normalization**.
- Achieved significant improvements: **SSIM increased from 76.85% to 92.92%**, **PSNR from 24.96dB to 32.78dB**, and enhanced downstream **brain tumor segmentation (BraTS)** Dice score.

Projects

VisionX: Advanced Computer Vision Toolkit | *Qt C++, OpenCV* | GitHub — May 2023

- Developed a toolkit for image processing: noise addition, filtration, edge detection, histogram equalization, **frequency domain filtering**, Hough transform, active contour model, feature extraction (**SIFT, Harris**), feature matching (**SSD, NCC**), thresholding, unsupervised segmentation (**k-means, agglomerative**), and face detection (**PCA/Eigen**).

VR Therapist: Virtual Mental Health Experience | *Unity, Flask, LLM, AWS Polly* | GitHub — April 2023

- Created an **AI-driven VR therapy app** for immersive mental health sessions, integrating LLM for real-time therapeutic voice interactions, developing a virtual environment for **place and plausibility illusions**.

AudioPrint: End-to-End Audio Fingerprint Detection | *Flask, FFT, scikit-learn* | GitHub — March 2023

- Engineered a **voice-activated door lock** web app for speech command recognition and voice verification.
- Implemented ML pipeline: data acquisition, EDA, feature extraction (**Temporal and Spectral**), dimensionality reduction, model building (Random Forest), and deployment with Flask. Achieved **84% accuracy** in voice verification.

Skills

Programming Languages: Python, Cpp, Java, SQL, Bash, MATLAB
AI/ML: Data Analysis, ML (Scikit-learn), DL (PyTorch, TensorFlow, MONAI, Lightening AI, DALI)
Tools: FSL, ITK-SNAP, Freesurfer, Apptainer/Docker, SLURM, FastAPI, Flask, Django, Streamlit, Git, Unity
Domain Expertise: Neuroimaging, Image Segmentation/Registration, Medical Image Analysis, HPC, CV, NLP

Leadership, Mentorship & Teaching

Research Mentorship

- **Katie Sun** (Jan. 2025 – Present) – **NSERC USRA recipient**, supervised by me to continue research on the Amygdala Atlas Project.
- **Eugenio Tannikas** (Jan. 2025 – Present) – Supervised on the Amygdala Atlas Project.

Instructor – MONAI Workshop, Brainhack Western University — Mar. 2025

- Delivered a hands-on workshop for graduate students and postdocs on **deep learning for neuroimaging** using **MONAI**, covering pre-trained models and automated segmentation/classification pipelines.

Chair – IEEE EMBS, Cairo University Student Branch — Jul. 2023 – Sep. 2024

- Revived a dormant student chapter, leading initiatives that impacted **600+ students** through technical workshops, career development training, and community outreach.
- Organized and led **high-impact events** focused on advancing biomedical engineering, professional growth, and interdisciplinary collaboration.

References

Available upon request.