# Anika Tahsin

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## RESEARCH INTERESTS

Computer Vision, Cognitive science, Vision Language Model, Natural Language Processing, Large Language Model, AI in Healthcare and Bioinformatics

## EDUCATION

**BRAC University**, Dhaka, Bangladesh — June 2025 — Present (Expected Graduation in May 2026)
Masters of Science in Computer Science

**BRAC University**, Dhaka, Bangladesh — April 2020 — May 2024
Bachelor of Science in Computer Science
Cumulative GPA: 3.87/4.00 (Last 60 Credit: 3.92/4.0 with Highest Distinction)
Thesis Title: Unsupervised Semantic Segmentation for Localization of WetLand Area Fluctuations
Supervisor: Dr. Md. Golam Rabiul Alam [Google Scholar], Professor, School of Data Science, BRAC University

## WORK EXPERIENCE

**Research Assistant**, BRAC University, Dhaka — August 2024 — Present
As a Research Assistant at BRAC University, under the supervision of Dr. Md. Golam Rabiul Alam, I conduct advanced research in computer vision, Language Models, and Reinforcement Learning. My work involves collaborating on and contributing to multiple research projects and academic publications, including studies on image segmentation, object detection, AI-driven data analysis, and review papers. Also, I assist in mentoring junior researchers.

**Vice President**, Computer Vision and Intelligent Systems Research Lab (CVIS Lab), BRAC University — July 2025 — Present
Conducted and facilitated the *CVIS Hands-on Training on Development of Machine Learning and Deep Learning Models* for undergrad students, focusing on practical skills for designing, implementing, and evaluating different models. Provided step-by-step guidance, curated datasets, and supervised participants through end-to-end project workflows.

**Student Tutor**, BRAC University, Dhaka — February 2024 — April 2024
*MAT 110: MATH I Differential Calculus and Co-ordinate Geometry of Mathematics and Natural Science Department*
Providing tailored assistance to fellow students, employing a personalized approach to address their unique learning needs.

**Student Tutor**, BRAC University, Dhaka — February 2023 — April 2023
*PHY 111: Principles of Physics I of Mathematics and Natural Science Department*
Actively assisted fellow students in comprehending complex topics within the field of physics.

## RESEARCH PAPERS AND PUBLICATIONS

**GeoSemantic Flux: Unsupervised Semantic Segmentation for Localization of Wetland Area Fluctuations from Satellite Image** — GithubLink
Submitted for journal review to the *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*

- Developed GeoSemantic Flux (GSF), a novel unsupervised semantic segmentation methodology integrating RAM, SAM, and Grounding DINO, combined with CLAHE and NDWI preprocessing, to localize annual wetland fluctuations from satellite imagery.
- Validated GSF on the MLRSNet dataset and Google Earth data, achieving a high Intersection over Union (IoU) of 0.90.
- Forecasted future wetland fluctuations for 2025 using Gaussian Hidden Markov Models (GHMM) and Gemini 2.5 Pro.

**Q-learning based Automated Message Multicast in Gossip Protocol for Node Confirmation in IOTA Tangle**
Accepted at the *27th International Conference on Computer and Information Technology (ICCIT'24)* — Link

- Proposed a Q-learning–driven multicast framework using Consensus Mana (cMana) rewards to optimize IOTA Tangle's gossip protocol, reducing message flooding and improving scalability.
- Achieved faster message dissemination (1.36s → 1.10s), higher Approval Weight (0.70 → 0.875), and increased throughput with lower resource usage, enhancing IoT blockchain efficiency and robustness.

**A Real-Time ETP Outlet Monitoring Framework Leveraging Environmental IoT, Colorimetry, and Learning Theory**
Accepted at *IEEE Access* Link

- Designed an Environmental IoT (E-IoT) system using STM32 and Raspberry Pi modules with integrated sensors to monitor ETP operations and water quality in real time.
- Applied CNN for video-based ETP state detection (98.3% accuracy), KNN for water quality classification (97%), and LSTM for seasonal WQI forecasting (94.9%), providing a scalable, low-cost solution for industrial wastewater management.

**Explainable Multimodal Fusion for Breast Carcinoma Diagnosis: A Systematic Review, Open Problems, and Future Directions**
Submitted for journal review to the *Clinical Imaging*

- Conducted a PRISMA-guided review of 49 peer-reviewed studies (2015–2025), categorizing multimodal fusion strategies (feature concatenation, attention-based, gated, hybrid) and model designs (transformers, GNNs, autoencoders, ensembles).
- Analyzed the role of XAI methods (Grad-CAM, SHAP, attention weights) in clinical interpretability, highlighting dataset scarcity, inconsistent benchmarks, and the need for accurate, transparent, and trustworthy AI in oncology.

**A Systematic Review on Machine Learning Paradigms: Taxonomy, Models, Purposes, Applications, Comparative Benefits, and Future Research Opportunities**
Submitted for journal review to the *PeerJ Computer Science*

- Conducted a systematic review of 81 peer-reviewed ML papers (2017–2024), proposing a unified taxonomy of paradigms, abstraction layers, learning strategies, and training philosophies.
- Analyzed applications across healthcare, finance, education, and smart infrastructure, highlighting benefits, limitations, and ethical challenges such as bias, privacy, and interpretability.

**A Comprehensive Review on Statistical and AI-Driven Approaches for Time-Series and Time-Sequential Data**
Submitted for journal review to the *SN Computer Science*

- Conducted a systematic review of 89 papers (1996–2024) on statistical (ARIMA, Exponential Smoothing, STL, Prophet) and AI-driven (RNN, LSTM, CNN, Transformers, SVR, GANs) approaches for time-sequential data.
- AProvided cross-domain insights in business, healthcare, and finance, identifying limitations such as computational complexity and data scarcity, and outlining future research directions for robust, generalizable models.

**A Diversiform Brain Tumor Classification Leveraging Hybrid Recursive MRI Image Enhancement Pipeline for T1, T2, and T1C+ Images and Utilizing A Coalition of CoatNet-HorNet Transformers**
Submitted for journal review to the *Biomedical Signal Processing and Control*

- Designed a lightweight hybrid model combining CNN (MobileNet) and Transformers (CoAtNet, HorNet) for classifying 15 brain tumor classes across T1, T2, and T1C+ MRI scans.
- Introduced a recursive MRI preprocessing pipeline (Laplacian, Kalman, CLAHE, High Pass, Motion Correction) to enhance input quality without extra model complexity.
- Achieved 94.7% accuracy on T1C+ MRI with only 3.7M parameters, outperforming CNN, Transformer, and traditional ML baselines.

**A Lightweight Dual Attention Multi-Axis Vision Transformer for Ocular Toxoplasmosis Classification**
Preparing for Submission to Journal

- Proposed Da-Max-ViT, a hybrid of Dual Attention ViT (DaViT) and Multi-Axis ViT (MaxViT), for automated OT classification from fundus images.
- Achieved state-of-the-art performance (up to 98.8–100% accuracy) with only 2.4M parameters, surpassing CNN and Transformer baselines.
- Incorporated LIME explainability to highlight clinically relevant regions (e.g., inflamed areas, macula, optic disc), enhancing trust and interpretability.

**Wildfire Scale Prediction Using Regression and Neural Network Models: An Experimental Study with MTBS Dataset**
Accepted at *International Conference on Multidisciplinary Computer Science, Electrical, Business & Literature (ICMCEL2025)*

- Conducted an experimental study on the MTBS dataset (1984–2021), applying regression models. Found Random Forest and XGBoost achieved the best performance (RMSE $\approx 0.94$), demonstrating the value of ML for wildfire early warning and mitigation.

**Biologically Plausible Learning for NLP Using Spiking Neural Networks**
Accepted at *International Conference on Multidisciplinary Computer Science, Electrical, Business & Literature (ICMCEL2025)*

- Developed SFF-RSTDP, a hybrid of Reward-Modulated STDP and Forward-Forward algorithms, for sentiment and emotion classification without backpropagation. Achieved competitive accuracy on IMDB (73.2%) and CARER (48.5%) with far fewer operations, demonstrating potential for efficient, low-power NLP systems.

**Generative AI Meets Responsible AI and Affective Computing**
Accepted at *International Conference on Multidisciplinary Computer Science, Electrical, Business & Literature (ICMCEL2025)*

- Developed a multimodal framework (text, audio, facial cues) with majority-vote fusion, Responsible AI safeguards, and FLAN-T5 summaries, achieving 81% accuracy (F1= 0.94 for anger, 0.90 for disgust).

## PROJECTS

**MRI Segmentation with U–Net (MobileNetV2 Encoder)** Project Link
Developed a lightweight medical image segmentation pipeline on Kaggle's MRI dataset for detection and analysis. Converted 3D NIfTI volumes to 2D slices, applied z–score normalization, and binarized masks (nearest–neighbor). Trained a U–Net with a MobileNetV2 encoder (PyTorch/SMP) using BCE+Dice, mixed precision (AMP), gradient clipping, cosine LR, and early stopping. Evaluated with Dice/IoU/Precision/Recall/F1, performed a threshold sweep to optimize inference, and produced clear overlay visualizations. Demonstrates strong skills in deep learning for medical imaging, data preprocessing, and reproducible ML engineering.

**Multiple Sequence Alignment (MSA) with Genetic Algorithm + Qwen2.5** Project Link
Lightweight GA-based MSA on Kaggle's Sequence Alignment (Bioinformatics) Dataset, with GPU-accelerated fitness in PyTorch. Implemented affine gaps (PAM250/BLOSUM62), tournament selection, residue-preserving crossover, and improving mutations; computed entropy, gap, and identity metrics; generated heatmaps, dendrograms, and CLUSTAL/FASTA outputs. Integrated a local LLM (Qwen2.5-1.5B via llama-cpp, no API keys) to produce validated JSON reports of conserved regions, gap clusters, and closest/divergent sequence pairs.

**Ship Detection in Aerial Images Using YOLOv10** Project Link
Undertook a project to detect ships in aerial images using the YOLOv10 object detection model. Leveraged a curated dataset to train the model, optimizing its performance to identify and localize ships in complex maritime environments. Designed a custom DataLoader and fine-tuned the model's hyperparameters to improve accuracy. This project demonstrates advanced proficiency in computer vision, model training, and handling real-world datasets for impactful applications like maritime monitoring and environmental safety.

**Predicting Wildfires Using Machine Learning Models** Project Link
Led a project focused on utilizing machine learning models to predict wildfires. Investigated the efficacy of regression and neural network models in predicting the scale of wildfires by employing historical data to forecast wildfire occurrences and severity. The project aims to contribute to disaster prevention and environmental protection efforts by enhancing wildfire forecasting capabilities.

**Intended Sarcasm Detection in English** Project Link
Spearheaded a project aimed at detecting sarcasm in English text, understanding its crucial role in analyzing sentiments and opinions. Considering the intricacies of sarcasm in online conversations, especially on social media, this project devised creative approaches to label data more accurately and reduce bias. This project aimed to empower computational systems to grasp better and interpret subtle forms of communication, ultimately driving progress in natural language processing and associated disciplines.

## AWARDS

**First Runner Up in Natural Language Processing Hackathon in Bangladesh 2023** January 2023
Developed two models for Named Entity Recognition: one harnessing deep learning with the XLM-RoBERTa model fine-tuned on our dataset and another using a feature-based approach with RandomForest. Evaluation was based on Macro F1 alongside documentation and source code quality. GithubLink Link

**Received Scholarship on the Merit Scholarship Based on BracU Academic Results** Summer 2021 — Spring 2024

**27th International Conference on Computer and Information Technology (ICCIT 2024)** December 2024
Received the '2024 ICCIT Best Technical Presentation of the Session - 29 IOS' award Link

**Best Thesis Award, BRAC University** February 2025
Recognized for outstanding undergraduate thesis based on panel evaluation, supervisor's recommendation, and publication quality. Link

## OTHER EXPERIENCES

**Intra University Programming Contest, Fall 2022** — BRAC University
Participated in the contest and was in the top 7. — November 2022

**DL Sprint 2.0 - BUET CSE Fest 2023** — kaggle Competitions
Participated in Bengali Document Layout Analysis Competition — September 2023

**Robi Datathon 3.0, 2024** — kaggle Competitions
Participated in the Qualifier Round — April 2024

**RSNA 2024 Lumbar Spine Degenerative Classification** — kaggle Competitions
Participated in the Competition — May - November 2024

## ONLINE COURSE CERTIFICATIONS

**DataCamp Machine Learning Scientist with Python Track** — Certification Link
Completed an extensive machine learning course on DataCamp covering regression, classification, clustering, and data cleaning. Engaged in multiple projects that provided hands-on experience with applying algorithms to real-world problems, resulting in a strong foundation in machine learning principles and techniques.

## SKILLS

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| **Languages** | Python, JavaScript, C#, C++, HTML, CSS, SQL, Assembly |
| **Machine Learning** | PyTorch, Tensorflow, Keras, OpenCV, Transformers, BioPython, LlamaCPP |
| **Software** | LATEX, Bash, Flex |
| **Frameworks** | FastAPI, Django, Flask, Laravel |
| **Databases** | MySQL, PostgreSQL, MariaDB, MongoDB |
| **OS** | Linux, Windows |

## REFERENCES

**Md. Golam Rabiul Alam, Ph.D.**
*Professor, Department of Computer Science and Engineering, BRAC University, Dhaka, Bangladesh*
*Director of Computer Vision and Intelligent Systems Research Lab (CVIS Lab)*
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