Fatema Tuj Johora Faria

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Research Interests

Large Language Models, LLM Agents, NLP for Social Good, Vision-Language Models, Multimodal AI, Trustworthy AI, Multimodal Agents, Large Vision Models, Computer Vision.

Education

B. Sc. in Computer Science and Engineering *July 2019 – December 2023*
Ahsanullah University of Science and Technology *Dhaka, Bangladesh*
Undergraduate Thesis Title: *Generative Adversarial Networks for Crop Disease: A Case Study with Potato Disease Classification and Instance Segmentation*
Supervisor: *Dr. Mohammad Shafiul Alam, Professor, Department of CSE, AUST*
CGPA: *3.302*

Research Experience

Remote Research Assistant *June 2024 – Present*
Supervisor: *Dr. Laith H. Baniata, Research Professor, Gachon University, South Korea*

- Carried out research on **"SentimentFormer: A Transformer-Based Multi-Modal Fusion Framework for Enhanced Sentiment Analysis of Memes in the Under-Resourced Bangla Language"**. This work was supported by the Basic Science Research Program of the National Research Foundation of Korea (NRF) under grant NRF-2022R1A2C1005316.
  - Implemented the SentimentFormer framework using intermediate fusion of SwiftFormer and mBERT, which led to a notable boost in performance, with the Weighted F1 Score improving from 64.3 to 73.28, significantly outperforming previous baseline models in multimodal Bangla sentiment analysis of memes.
- Conducted research on **"Investigating the Predominance of Large Language Models in Low-Resource Bangla Language Over Transformer Models for Hate Speech Detection: A Comparative Analysis"**. This work was supported by the Basic Science Research Program of the National Research Foundation of Korea (NRF) under grant NRF-2022R1A2C1005316.
  - Applied Zero-Shot and Few-Shot Learning approaches (including 5-Shot, 10-Shot, and 15-Shot) using GPT-3.5 Turbo and Gemini 1.5 Pro for Bengali hate speech detection, which eliminated the need for extensive task-specific training data, enabled adaptability to low-resource scenarios, and achieved a 6.28% accuracy gain over baseline techniques across multiple datasets.
- Currently working on the research titled **"Dissecting the Reasoning Capabilities of Vision-Language Models in Medical Visual Question Answering: An Zero-shot Chain-of-Thought Approach"**.

Work Experience

Dexian (Bangladesh) Limited. *May 2024 – Present*
Application Developer (AI/ML) *Dhaka, Bangladesh*

- **Project 1: Org Info**
  - Implemented a multimodal agent for extracting organizational hierarchical information from organograms, utilizing in-context learning with tree-of-thought prompting to preserve the correct parent-child structure
  - Applied multipath reasoning and Breadth-First Search (BFS) to resolve conflicts and ambiguities in relationships for accurate role placement, and stored the extracted hierarchical information in a relational database
  - Designed an LLM-based agent that converted natural language queries into SQL using self-consistency with chain-of-thought prompting, which enabled contextual reasoning to retrieve relevant organizational data and integrated the results into the OrgChart framework for hierarchical visualization
  - Developed a dynamic Agentic RAG-guided chat interface that enabled users to interact with a specific organizational hierarchy by utilizing predefined query types, roles, and goals, and delivered context-aware, natural language responses
    Technologies Used: Python, LangChain, LangGraph, Azure OpenAI, OpenCV, Azure SQL, React JS, FastAPI

- **Project 2: RFPMatcher**
  - Developed a Retrieval-Augmented Generation (RAG) solution using Chain of Thought prompting to extract key information from Request for Proposal (RFP) documents
  - Built a Past Experience Matcher system that uses Automatic Chain-of-Thought prompting alongside in-context learning and preset questions to extract requirements from RFPs, then matches them against a master database of prior proposal responses
  - Enabled the system to generate Yes/No decisions with detailed explanations of how similar requirements were addressed in the past, aiding in the prediction of potential win/loss outcomes for new proposals
  - Generated dynamic Tables of Contents (TOC) based on extracted key information and historical experience to streamline and structure the proposal writing process for new bids
    Technologies Used: Python, LlamaIndex, Azure OpenAI, AlloyDB, CouchDB, React JS, FastAPI
- **Project 3: CaseAligner**
  - Built an LLM-based application using zero-shot prompting to generate PowerPoint presentations for case studies based on selected practice areas and industries
  - Implemented an interactive chat interface allowing users to query specific slide content and receive instant contextual responses
  - Developed comprehensive search functionality to locate information across all generated case studies
  - Created export capabilities for downloading slides in company's official template
  - Designed an admin panel for authorized users to download and edit the knowledge base of case studies
    Technologies Used: Python, LlamaIndex, Azure OpenAI, React JS, FastAPI
- **Project 4: KnowledgeEngine**
  - Developed an LLM-based, multi-document RAG Q&A system for internal document information retrieval
  - Implemented a chat conversation interface with document page references for information sources
  - Maintained session-based dedicated knowledge bases to ensure data isolation and user-specific context management
  - Created an admin panel with document upload functionality and comprehensive document management capabilities
    Technologies Used: Python, LlamaIndex, Azure OpenAI, AlloyDB, React JS, FastAPI

Publications (denotes equal contribution) [Google Scholar]*

Journals

- **Fatema Tuj Johora Faria**, Laith H. Baniata, and Sangwoo Kang. **"Investigating the Predominance of Large Language Models in Low-Resource Bangla Language over Transformer Models for Hate Speech Detection: A Comparative Analysis."** Mathematics 2024, 12, 3687. https://doi.org/10.3390/math12233687. *(Q1, IF: 2.3)*
- **Fatema Tuj Johora Faria**, Laith H. Baniata, Mohammad H. Baniata, Mohannad A. Khair, Ahmed Ibrahim Bani Ata, Chayut Bunterngchit, and Sangwoo Kang. 2025. **"SentimentFormer: A Transformer-Based Multimodal Fusion Framework for Enhanced Sentiment Analysis of Memes in Under-Resourced Bangla Language."** Electronics 14, no. 4: 799. https://doi.org/10.3390/electronics14040799. *(Q2, IF: 2.6)*
- **Fatema Tuj Johora Faria**, Mukaffi Bin Moin, Zayeed Hasan, Md Arafat Alam Khandaker, Niful Islam, Khan Md Hasib, and M. F. Mridha. **"MultiBanFakeDetect: Integrating Advanced Fusion Techniques for Multimodal Detection of Bangla Fake News in Under-Resourced Contexts."**
  [Accepted in International Journal of Information Management Data Insights] *(Q1, IF: 19.2)*
- **Fatema Tuj Johora Faria**, Mukaffi Bin Moin, Busra Kamal Rafa, Swarnajit Saha, Md. Mahfuzur Rahman, Khan Md Hasib, and M. F. Mridha. **"BanglaCalamityMMD: A Comprehensive Benchmark Dataset for Multimodal Disaster Identification in the Low-Resource Bangla Language."**
  [Under Review in International Journal of Disaster Risk Reduction (Q1)]
- **Fatema Tuj Johora Faria**, Mukaffi Bin Moin, Pronay Debnath, Asif Iftekher Fahim, and Faisal Muhammad Shah. **"Explainable Convolutional Neural Networks for Retinal Fundus Classification and Cutting-Edge Segmentation Models for Retinal Blood Vessels from Fundus Images."** arXiv preprint arXiv:2405.073 38 (2024). **[Under Review in Journal of Visual Communication and Image Representation (Q1)]** **[Preprint]**
- **Fatema Tuj Johora Faria**, Mukaffi Bin Moin, Ahmed Al Wase, Mehidi Ahmmed, Md Rabius Sani, and Tashreef Muhammad. **"Vashantor: a large-scale multilingual benchmark dataset for automated translation of bangla**

regional dialects to bangla language." arXiv preprint arXiv:2311.11142 (2023).
[Under Review in Neural Computing and Applications (Q1)] **[Preprint]**

Conference Proceedings

- **Fatema Tuj Johora Faria***, Mukaffi Bin Moin*, Rabeya Islam Mumu, Md Mahabubul Alam Abir, Abrar Nawar Alfy, and Mohammad Shafiul Alam., **"Motamot: A Dataset for Revealing the Supremacy of Large Language Models Over Transformer Models in Bengali Political Sentiment Analysis,"** 2024 IEEE Region 10 Symposium (TENSYMP), New Delhi, India, 2024, pp. 1-8, doi: 10.1109/TENSYMP61132.2024.10752197.
- **Fatema Tuj Johora Faria**, Mukaffi Bin Moin, Md Mahfuzur Rahman, Md Morshed Alam Shanto, Asif Iftekher Fahim, and Md Moinul Hoque. **"Uddessho: An Extensive Benchmark Dataset for Multimodal Author Intent Classification in Low-Resource Bangla Language."** arXiv preprint arXiv:2409.09504 (2024).
[Presented at 18th International Conference on Information Technology and Application (ICITA 2024)] **[Preprint]**
- **Fatema Tuj Johora Faria**, Mukaffi Bin Moin, Asif Iftekher Fahim, Pronay Debnath, and Faisal Muhammad Shah. **"Unraveling the Dominance of Large Language Models Over Transformer Models for Bangla Natural Language Inference: A Comprehensive Study."** arXiv preprint arXiv:2405.02937 (2024).
[Presented at ICCCNet 2024] **[Preprint]**
- Mukaffi Bin Moin, **Fatema Tuj Johora Faria**, Swarnajit Saha, Bushra Kamal Rafa, and Mohammad Shafiul Alam. **"Exploring Explainable AI Techniques for Improved Interpretability in Lung and Colon Cancer Classification."** arXiv preprint arXiv:2405.04610 (2024). **[Presented at ICCCNet 2024]** **[Preprint]**
- **Fatema Tuj Johora Faria**, Mukaffi Bin Moin, Ahmed Al Wase, Md Rabius Sani, Khan Md Hasib, and Mohammad Shafiul Alam. **"Classification of potato disease with digital image processing technique: a hybrid deep learning framework,"** 2023 IEEE 13th Annual Computing and Communication Workshop and Conference (CCWC), Las Vegas, NV, USA, 2023, pp. 0820-0826, doi: 10.1109/CCWC57344.2023.10099162.
- **Fatema Tuj Johora Faria**, Mukaffi Bin Moin, Asif Iftekher Fahim, Pronay Debnath, and Faisal Muhammad Shah. **"BanglaMemeEvidence: A Multimodal Benchmark Dataset for Explanatory Evidence Detection in Bengali Memes."** **[Under Review in 2025 9th International Conference on Vision, Image and Signal Processing]**
- Saidur Rahman Sujon, Ahmadul Karim Chowdhury, **Fatema Tuj Johora Faria**, Mukaffi Bin Moin, and Faisal Muhammad Shah. **"Enhancing Bangla NLP Tasks with LLMs: A Study on Few-Shot Learning, RAG, and Fine-Tuning Techniques"** **[Under Review in 2025 IEEE 9th ICSECS]**

Ongoing Research Projects

- MindSpeak-Bangla: A Domain-Specific Dataset for Automatic Chain-of-Thought Adaptation in Mental Health Support for Low-Resource Bengali Language Settings
- BanglaMedQA: A Comprehensive Dataset for Adapting Zero-Shot Chain-of-Thought Reasoning in Bengali Medical Question Answering

Technical skills

Programming Languages	Python (NumPy, SciPy, Matplotlib, Pandas, Seaborn), Java, C++
Web Development	HTML5, CSS3, JavaScript, FastAPI, Flask, React, Streamlit
Database	MySQL, MongoDB
Deep Learning Frameworks	TensorFlow, Keras, PyTorch
LLM Application Frameworks	LangChain, LangGraph, LlamaIndex
Cloud Services	Azure OpenAI, Azure SQL Database, Azure App Service
Others	Vector Database, Apache Airflow, Docker, CrewAI, OpenCV

Awards & Achievements

Poster Presentation *5th August 2023*
RESEARCH SYMPOSIUM 2023: AN INTRA-AUST RESEARCH EXHIBITION *Dhaka, Bangladesh*
Classification of Potato Disease with Digital Image Processing Technique: A Hybrid Deep Learning Framework, secured 1st position in **"RESEARCH SYMPOSIUM 2023"** organized by AUST Research and Publication Club. **[Poster Link]**