

## SUMMARY

Innovative Ph.D. candidate with deep expertise in machine learning, AI integration, and real-time health monitoring. Proven track record developing and deploying state-of-the-art ML solutions with edge-computing capabilities. Experienced in working cross-functionally in fast-paced environments, delivering high-impact, production-ready solutions. Passionate about bridging advanced AI research with practical, scalable applications.

## WORK EXPERIENCE

### **Texas Tech University**

**Position Title:** Research Assistant

**Lubbock, TX**

**Aug 2022 - Current**

#### **Projects:**

##### **1. CardioHelp Health Monitoring System:**

- Developed an edge-computing application for real-time monitoring of cardiac and respiratory signals, ensuring low latency and secure on-device data processing.
- Created an intuitive user interface to display heart rate and respiratory trends, supporting rapid decision-making by healthcare providers. Achieved over 95% accuracy in system performance.
- Conducted beat-by-beat ECG analysis for early detection of cardiac events and extracted insights from respiratory patterns to support comprehensive care.
- Built and deployed scalable ML pipelines on edge devices, optimizing inference speed by over 40% for real-time cardiac event detection.
- Integrated wireless protocols for reliable data transmission between sensors and edge devices.
- Collected patient data with IRB approval, maintaining ethical standards and regulatory compliance.

##### **2. Algorithms for Cardiac Beat and Respiratory Pattern Detection in Real-Time:**

- Designed and implemented algorithms to detect cardiac beats and respiratory patterns using edge-computing technology for continuous monitoring.
- Utilized deep learning models on the MIT-BIH Arrhythmia, Apnea-ECG, and MIT-BIH Polysomnographic databases to classify cardiac beats and respiratory patterns with over 96.5% accuracy.
- Integrated ML and reinforcement learning techniques to improve decision-making in dynamic environments, achieving a 6-7% improvement in algorithm accuracy and reliability.
- Identified breathing patterns from respiratory signals to enable comprehensive monitoring of heart and lung functions.
- Deployed pre-trained TensorFlow Lite models in a mobile application, incorporating fine-tuning and optimization to enable real-time inference with low latency and high accuracy for processing cardiac and respiratory signals.

##### **3. Inkjet Printing Technology:**

- Worked on Internet of Things (IoT) and bio-inspired micro-robotics, focusing on efficient data transmission using inkjet-printed circuits.
- Developed flexible dry electrodes through inkjet printing to collect ECG signals comfortably from the chest for prolonged use and reusability.
- Developed a stacked Metal-Insulator-Metal (MIM) supercapacitor on 25  $\mu\text{m}$  thin polyimide films, where a single MIM capacitor achieved a capacitance of more than 1.2nF, offering high energy density, flexibility, and safety for applications in wearables, drones, renewable energy storage, and electric vehicles.

### **Fiftytwo Digital Ltd.**

**Position Title:** Software Engineer

**Bangladesh**

**Aug 2021 – Jun 2022**

- Planned, designed, and developed key features for the 52Retail POS software to enhance the usability and performance of the point-of-sale system.
- Delivered robust features for 52Retail POS using C++ and JavaScript, deployed to thousands of clients, improving transaction speed by 15%.
- Collaborated with cross-functional teams to gather requirements and align technical solutions with business goals.
- Oversaw Git repositories and supported collaborative development through Bitbucket, leveraging branch permissions and CI/CD integrations.
- Created and documented test cases using TestRail and Zephyr to ensure software quality.

### **Emerging IT Bangladesh Ltd.**

**Position Title:** Software Engineer

**Bangladesh**

**Feb 2021 – Jul 2021**

- Architected scalable RESTful backend with Java and Spring Boot, supporting seamless integration with mobile platforms.
- Streamlined end-to-end connectivity between backend services and Android applications, enhancing user experience.
- Facilitated collaborative troubleshooting and iterative testing, promoting cross-functional problem-solving and improvement.

## EDUCATION

**PhD in Computer Science**

*Texas Tech University (CGPA – 4.0)*

**Aug 2022 - Current**

**BSc. in Computer Science and Engineering**

*Bangladesh University of Engineering and Technology*

**Feb 2016 – Feb 2021**

## TECHNICAL SKILLS

- **Programming Languages:** Python, Java, C, C++, R, PHP, C#, JavaScript, MATLAB, SQL, Assembly
- **Databases:** PostgreSQL, MySQL, MongoDB, SQLite, VectorDBs
- **Frameworks and Libraries:** TensorFlow, PyTorch, LLAMA, Hugging Face, Spring Boot, Streamlit, Foolbox, Folium, Django, Angular, React, Node.js, Laravel
- **Operating Systems & Version Control:** Linux (Ubuntu), Windows, macOS, Git, Bitbucket, GitHub
- **Cloud & CI/CD Tools:** AWS, Google Cloud, Docker, Kubernetes, Jenkins, GitHub Actions
- **Project Management & Testing Tools:** Jira, Trello, TestRail, Zephyr, Postman

## SELECTED PUBLICATIONS

### JOURNALS

- **Utsha, U. T., & Morshed, B. I. (2025).** GAN-Enhanced Hybrid Deep Learning Model for Real-Time Cardiac Beat Detection in the CardioHelp App with Edge Computing. Smart Health (Revision)
- **Utsha, U. T., & Morshed, B. I. (2024).** CardioHelp: A smartphone application for beat-by-beat ECG signal analysis for real-time cardiac disease detection using edge-computing AI classifiers. Smart Health, 31, 100446.  
<https://doi.org/10.1016/j.smhl.2024.100446>

### CONFERENCES

- **Utsha UT, Morshed BI.** Multi-Stage Real-Time Classification of Breathing Patterns Using ECG and Respiratory Signals. In2025 IEEE 6th World AI IoT Congress 2025. IEEE.
- **Utsha UT, Salman T, Morshed, B. I.** Securing AI-Driven ECG Classification with Robust Defense Against Boundary Attacks. In2025 IEEE Conference on Secure and Trustworthy CyberInfrastructure for IoT and Microelectronics (SaTC 2025) 2025. IEEE.
- **Utsha UT, Morshed BI.** Edge-Computing Enabled Real-Time Respiratory Monitoring and Breathing Pattern Detection. In2024 IEEE 20th International Conference on Body Sensor Networks (BSN) 2024 Oct 15 (pp. 1-4). IEEE.
- **U. T. Utsha and B. I. Morshed,** "A Smartphone App for Real-time Heart Rate Computation from Streaming ECG/EKG data," 2023 IEEE International Conference on Electro Information Technology (eIT), Romeoville, IL, USA, 2023, pp. 1-6, doi: 10.1109/eIT57321.2023.10187337.
- **Utsha, U.T., Hua Tsai, I., Morshed, B.I. (2024).** A Smart Health Application for Real-Time Cardiac Disease Detection and Diagnosis Using Machine Learning on ECG Data. In: Puthal, D., Mohanty, S., Choi, BY. (eds) Internet of Things. Advances in Information and Communication Technology. IFIP IoT 2023. IFIP Advances in Information and Communication Technology, vol 683. Springer, Cham. [https://doi.org/10.1007/978-3-031-45878-1\\_10](https://doi.org/10.1007/978-3-031-45878-1_10)

## SELECTED PROJECTS

### Smart Health App [Tools: JAVA, Android Studio]

- Developed a mobile app to visualize real-time ECG and respiratory signals, providing users with instant insights into vital signs while detecting cardiac irregularities and respiratory patterns.

### CardioHelp Visualizer [Tools: Node.js, JavaScript, MongoDB, GeoJSON]

- Visualizes the geographic distribution of cardiac patients using interactive maps, enabling users to explore real-time patient data, regional trends, and demographic patterns in cardiovascular health.
- Provides users with personalized heart and respiration guidance for actionable health insights.

### Silent Speech Recognition Using LLM [Tools: Python, PyTorch, LLAMA 3.2B]

- Created an EMG adaptor to convert silent EMG signals into LLAMA 3.2B embeddings for speech decoding.
- Designed efficient preprocessing and fine-tuning pipelines in PyTorch for EMG-to-text conversion using LLMs.

### AI-Driven Defense Against Boundary Attacks [Tools: Python, PyTorch, Foolbox]

- Built a defense system using adversarial training and boundary detection to guard against black-box attacks.
- Created automated Foolbox workflows to test model robustness and enable adaptive defenses.

### On-Demand Professor Q&A Bot [Tools: Python, OpenAI, Chainlit, Chroma DB]

- Built a Q&A bot leveraging NLP and vector-based retrieval to assist professors in accessing lecture materials.
- Integrated OpenAI embeddings and PyPDFLoader for accurate query responses and real-time interaction with GPT-3.5 Turbo.

### Apnea-Non-Apnea Analysis [Tools: Python, TensorFlow, Google Colab]

- Developed machine learning models to analyze respiratory signals for sleep apnea detection.

### Sleep Stage Detection using Polysomnographic Data [Tools: Python, Google Colab]

- Identified respiratory patterns, sleep stages and cardiac events to support sleep disorder diagnosis and analysis.

### Adversarial Machine Learning [Tools: Python, PyTorch, Jupyter Notebook]

- Implemented adversarial attacks (FGSM, PGD, C&W) and defenses like adversarial training to improve model robustness.

## KEY ACCOMPLISHMENTS

- Selected for the Distinguished Graduate Student Assistantship (DGSA) at Texas Tech University.
- Received a travel award from the 2024 IEEE BSN Conference.
- Awarded two additional travel grants from the Texas Tech University Graduate School.
- Actively engaged in problem-solving, focusing on algorithm challenges on [Leetcode](#)