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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 **Lubbock, TX**
Position Title: Research Assistant **Aug 2022 - Current**

Projects:

1. **CardioHelp Health Monitoring System:**
   - **a.** Developed an edge-computing application for real-time monitoring of cardiac and respiratory signals, ensuring low latency and secure on-device data processing.
   - **b.** 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.
   - **c.** Conducted beat-by-beat ECG analysis for early detection of cardiac events and extracted insights from respiratory patterns to support comprehensive care.
   - **d.** Built and deployed scalable ML pipelines on edge devices, optimizing inference speed by over 40% for real-time cardiac event detection.
   - **e.** Integrated wireless protocols for reliable data transmission between sensors and edge devices.
   - **f.** Collected patient data with IRB approval, maintaining ethical standards and regulatory compliance.
2. **Algorithms for Cardiac Beat and Respiratory Pattern Detection in Real-Time:**
   - **a.** Designed and implemented algorithms to detect cardiac beats and respiratory patterns using edge-computing technology for continuous monitoring.
   - **b.** 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.
   - **c.** Integrated ML and reinforcement learning techniques to improve decision-making in dynamic environments, achieving a 6-7% improvement in algorithm accuracy and reliability.
   - **d.** Identified breathing patterns from respiratory signals to enable comprehensive monitoring of heart and lung functions.
   - **e.** 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:**
   - **a.** Worked on Internet of Things (IoT) and bio-inspired micro-robotics, focusing on efficient data transmission using inkjet-printed circuits.
   - **b.** Developed flexible dry electrodes through inkjet printing to collect ECG signals comfortably from the chest for prolonged use and reusability.
   - **c.** Developed a stacked Metal-Insulator-Metal (MIM) supercapacitor on 25 µm thin polyimide films, where a single MIM capacitor achieved a capacitance of more than 1.2 nF, offering high energy density, flexibility, and safety for applications in wearables, drones, renewable energy storage, and electric vehicles.

Fiftytwo Digital Ltd. **Bangladesh**
Position Title: Software Engineer **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.
- Utilized C, C++, and JavaScript in a Linux environment to build robust and efficient software components.
- Managed tasks and tracked project progress using Jira to ensure smooth coordination and timely delivery.
- 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.
- Conducted code reviews, debugging, and testing to maintain high standards and support seamless software releases.

Emerging IT Bangladesh Ltd. **Bangladesh**
Position Title: Software Engineer **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 **Aug 2022 - Current**
Texas Tech University **(CGPA – 4.0)**
BSc. in Computer Science and Engineering **Feb 2016 – Feb 2021**
Bangladesh University of Engineering and Technology

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. Physiological Stress Monitoring with Chest-Worn ECG and Respiratory Sensing. In2025 IEEE 21st International Conference on Body Sensor Networks (BSN) 2025. IEEE. (Submitted)
- **Utsha UT**, Morshed BI. Smartphone-Based Real-Time Respiration Tracking with Dual-Sided Inkjet-Printed Wearable Electrodes. In2025 IEEE 21st International Conference on Body Sensor Networks (BSN) 2025. IEEE. (Submitted)
- **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. IFIPIoT 2023. IFIP Advances in Information and Communication Technology, vol 683. Springer, Cham. https://doi.org/10.1007/978-3-031-45878-1_10
- Mitra, Nabonita, **Utsha, U.T.**, and Morshed, B. I. (2024). "Inkjet-printed Dry Flexible Electromyography Electrode Array for Classifying Various Finger Movements with AI Algorithms", IEEE Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON).

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.
- Implemented algorithms to calculate heart and respiration rates and optimized the app for mobile devices to ensure smooth performance and reliable monitoring.

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.
- Delivers personalized health guidance and educational resources, allowing users to gain actionable insights into their own risk factors while promoting greater awareness and understanding of heart health across the community.

ECG Classification using Deep Learning [Tools: Python, Google Colab, TensorFlow]

- Developed machine learning models to classify different cardiac beats using the MIT-BIH Arrhythmia database.
- Introduced Generative adversarial networks (GANs) to generate synthetic data for rare beats which improve model performance and accuracy.

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

- Developed an EMG adaptor module that transforms unvoiced EMG signals into embeddings interpretable by LLAMA 3.2B, enabling context-aware, zero-audio speech decoding on a closed-vocabulary task.
- Built robust preprocessing and neural fine-tuning pipelines using PyTorch to extract EMG features and seamlessly integrate them with LLAMA, demonstrating LLM-driven silent speech capabilities with minimal training data.

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

- Built a robust defense system that combines adversarial training with boundary-based detection to protect models from black-box boundary attacks, maintaining high classification performance.
- Designed automated evaluation workflows with Foolbox to systematically test model resilience and trigger adaptive defenses against suspicious, low-confidence inputs.

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 from the Apnea-ECG database for sleep apnea detection.
- Extracted respiratory features to identify apnea events and improve classification performance.

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

- Extracted and analyzed respiratory and ECG features from the MIT-BIH Polysomnographic database.
- 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.
- Conducted experiments on image classification tasks, analyzing vulnerabilities and strengthening resilience against attacks.

Compiler Design [Tools: C, C++, Flex, Bison]

- Completed multiple projects focused on compiler design, including lexical analyzers, parsers, and syntax checkers.

Room Renting Platform [Tools: PHP, Laravel]

- Created a web-based platform where clients can book suitable rooms in hotels/hostels. Hotel/hostel owners can also add their properties and manage bookings.

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***