NASIM MAHMUD NAYAN

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SUMMARY

I am a researcher working on developing trustworthy AI methods for healthcare in resource-limited settings. My research spans multimodal medical AI systems processing diverse data types, including tabular clinical records, medical imaging (chest X-rays, ECG), and IoT sensor streams. Notably, I have developed open-source bias mitigation frameworks for medical AI, maternal health prediction systems, multimodal diagnostic platforms, and demonstrated cross-modal bias amplification in clinical AI systems

EDUCATION

- **University Of Information Technology And Sciences |** Dhaka, Bangladesh
  B.Sc. in Computer Science Engineering| Feb 2023 | GPA: 3.62/4.0
  Thesis: A Multi-Disease Prediction Framework: Leveraging Machine Learning and Real-Time Applications for Improved Health Outcomes
  Relevant Coursework: Machine Learning, Data Mining, Information Retrieval, Image Processing, Advanced Data Structures & Algorithms, Computer Networks, Operating Systems

PUBLICATIONS

Total: 9 publications | 80+ citations | h-index: 4 | Full list on Google Scholar.

Selected Peer-Reviewed Journal Articles

- Hossain, M. M., **Nayan, N. M.**, et al. "A Medical Cyber-Physical System for Predicting Maternal Health in Developing Countries Using Machine Learning." Healthcare Analytics 2024, 100285. (Scopus-indexed, **Cited 38 times**). Link

- Alam, M., Islam, M.M., **Nayan, N. M.**, et al. "An IoT-Based Real-Time Environmental Monitoring System for Developing Areas." JARASET 2025, 52(1):106–121. (Scopus indexed, **Cited 8 times**). Link

- Sahidullah, Md, **Nayan, N. M.**, et al. "Date Fruit Classification with Machine Learning and Explainable Artificial Intelligence." IJCA 2023, 975:8887. (DOAJ indexed **, Cited 13 times).** Link

Conference Proceedings

- **Nayan, N. M.**, et al. "SMOTE Oversampling and Near Miss Undersampling Based Diabetes Diagnosis from Imbalanced Dataset with XAI Visualization." IEEE ISCC 2023, pp. 1–6. (Scopus-indexed, **Cited 13 times**). Link

- Hossain, M. M., Kashem, M.M., **Nayan, N. M.**, et al. "Artificial Intelligence-Driven Approach for Predicting Maternal Health Risk Factors." IEEE SEEDA-CECNSM 2024, pp. 153–158. (Scopus indexed, **Cited 3 times).** Link

- Hossain, M. M., **Nayan, N. M.**, et al. "Enhancing the Security of Pregnancy Health Data Transmission through Homomorphic Encryption: An Advanced Model." Auerbach IoT Applications 2023, pp. 146–169. (Scopus-indexed).**.** Link

Under Review Papers

- **Nayan, N. M.**, et al. "A Multi-Disease Prediction Framework: Leveraging Machine Learning and Real-Time Applications for Improved Health Outcomes." PLOS ONE. (Under review, Scopus-indexed).

- **Nayan, N. M.**, et al. "Machine Learning-Based Parkinson's Disease Prediction Utilizing SMOTE and Explainable AI Techniques." PLOS ONE. (Under review, Scopus-indexed).

RESEARCH EXPERIENCE

- **Research Assistant | Medical Cyber-Physical Systems**
  Shanto-Mariam University of Creative Technology | Jul 2022 – Present
  Advisor: Prof. Mohammad Mobarak Hossain

  - Architected an ensemble learning framework for maternal health risk stratification, achieving 99% prediction accuracy across 5,000+ patient records while reducing algorithmic bias by 34% through novel fairness constraints
  - Implemented homomorphic encryption on IoT devices to securely transmit pregnancy health data to the cloud, ensuring privacy, performance, and regulatory compliance.
  - Published 3 co-author papers in high-impact venues with combined 45+ citations, establishing new benchmarks in maternal health AI
  - Systematically reviewed 100+ papers on IoT healthcare applications, identifying critical gaps in low-resource deployment strategies

- **Research Assistant | Healthcare AI & IoT Systems**
  Rising Research Lab | Aug 2022 – Feb 2025

  - Developed multi-disease prediction system integrating 4 disease models (Diabetes, Parkinson's, Heart Disease, Breast Cancer) with 92% average accuracy and real-time inference capabilities
  - Engineered IoT air quality monitoring device capturing 8 environmental parameters, deployed across 5 locations with 99.5% uptime
  - Implemented AutoML pipeline reducing model development time by 60% while maintaining performance benchmarks

- **Research Assistant | Computer Vision in Medicine**
  EMPATHY LAB, Independent University Bangladesh | Jan 2023 – Dec 2024

  - Reviewed 125+ papers on healthcare CV applications, highlighting key domains like surgical assistance, disease detection, and remote monitoring
  - Identified deep learning, especially CNNs and Vision Transformers, as leading techniques for medical imaging and predictive analytics

KEY RESEARCH PROJECTS

M-TRUST: Medical AI Bias Mitigation Framework |Open-Source Python Package | PyPI | GitHub
- Developed a comprehensive bias detection toolkit for medical AI with 4 fairness metrics: demographic parity, equalized odds, calibration, and disparate impact.
- Achieved 30.8% reduction in demographic bias while maintaining 98% model accuracy
- Published open-source package with documentation, tutorials, and example notebooks

Technologies: Python, PyTorch, NumPy, Pandas, Scikit-learn, Matplotlib, Seaborn

Multimodal Chest X-ray Diagnosis System with Bias Analysis | GitHub | Demo
- Built CheXNet-based diagnosis system for 14 thoracic diseases, integrating image and text modalities
- Discovered 4.3× bias amplification when combining visual and textual medical data
- Implemented fairness constraints, reducing diagnostic disparities from 7.6% to 4.5% across demographic groups
- Developed explainable AI visualizations using Grad-CAM for clinical interpretability

Technologies: Python, TorchVision, Transformers (BioBERT), Streamlit, OpenCV, Grad-CAM, Docker

Trustworthy ECG Analysis Platform | GitHub | Demo
- Engineered multi-modal ECG analysis system supporting real-time monitoring, file upload, and paper ECG digitization
- Implemented fairness-aware training achieving >0.9 fairness score while maintaining 95% accuracy
- Integrated uncertainty quantification and lead-specific abnormality detection with clinical explanations
- Optimized for edge deployment with model size <30MB and inference time <100ms

Technologies: Python, PyTorch, Streamlit, Transfer Learning (ResNet), SciPy (signal processing), Plotly

Maternal Health Risk Prediction System | GitHub | Research Paper | Demo
- Developed ML-based risk stratification system achieving 99% accuracy using XGBoost ensemble methods
- Integrated homomorphic encryption for privacy-preserving computation on sensitive health data
- Published in Healthcare Analytics with 28 citations, establishing benchmark for maternal health AI
- Designed for low-resource settings with offline capability and minimal computational requirements

Technologies: Python, XGBoost, Scikit-learn, Streamlit

PROFESSIONAL EXPERIENCE

Machine Learning Engineer (Remote)
Programming Hero | Dec 2023 – Present
Zenyora AI Wellness Platform
- Architected and deployed a production-level AI wellness platform on Microsoft Store, serving 100+ active users.
- Engineered a computer vision system for real-time posture detection, achieving 95% accuracy and reducing user eye strain by 40%.
- Developed and integrated context-aware productivity coaching using behavioral analytics and real-time interventions, intelligently distinguishing between focused work and distractions.

Technologies: PyTorch, OpenCV, MediaPipe, OCR, LLM, FastAPI, Docker, Git

Automated Real Estate Sales Agent
- Developed a voice-based virtual salesperson using a RAG (Retrieval-Augmented Generation) architecture and LangChain framework. The system integrates GPT-4 and Whisper to handle complex inquiries and has a retrieval system that utilizes a Pinecone vector database for 95% query relevance. This automation reduced response time from hours to seconds and increased lead engagement by 3x.
- Deployed the conversational AI pipeline with ElevenLabs voice synthesis and real-time streaming responses with sub-2-second latency.

Technologies: LangChain, RAG, Pinecone, OpenAI GPT-4, Whisper, ElevenLabs, FastAPI, Docker, Vector Embeddings

Student Performance Predictor
- Created an ML system predicting student assignment scores before submission, identifying knowledge gaps with 85% accuracy. Enabled personalized feedback, helping 10k+ students improve grades by an average 15% through targeted recommendations.

Technologies: XGBoost, Scikit-learn, PostgreSQL, REST API, Fine-tuning

TEACHING AND MENTORING EXPERIENCE

AI Trainer | Enhancing Digital Government Economy (EDGE) Project | May 2023 - Nov 2023.
- Trained 50+ students in ML/AI through hands-on projects, developing curriculum covering supervised learning, clustering,
- regression techniques, and model evaluation metrics
- Created educational materials with clear explanations of complex ML concepts, demonstrating strong metacognitive communication skills
- Evaluated student ML models, providing detailed feedback on error modes and improvement strategies

Research Mentor
UITS Summer Research Program | Summer 2023, 2024
- Mentored 2 research groups (total 7 students) on machine learning and IoT projects
- Guided teams from conception to publication: literature review, experimental design, implementation, and paper writing
- Achieved research outcomes: 1 paper accepted at a Scopus-indexed journal, 1 under review

AWARDS & HONORS

- **1st Place** | Inter-university PowerPoint Presentation Competition | UITS 2020
- **2nd Place** | Inter-university Programming Contest (45 teams) | UITS 2022
- **Fastest Problem Solver** | UITS Victory Day Programming Contest | 2021
- **Employee of the Month** | Primacy Infotech LTD | August 2023

TECHNICAL SKILLS

Programming: Python, C/C++ | **300+** competitive problems solved **| Codeforces:** NM Nayan. **Beecrowd:** NMNAYAN.
ML/AI: Supervised/Unsupervised Learning, Deep Learning, NLP, Computer Vision, LLM, RAG, XAI, Fairness ML, Multimodal AI
Frameworks: Streamlit, OpenCV, LangChain, Pandas, NumPy, Docker, Git
Research Methods: Experimental Design, Statistical Analysis, Systematic Reviews, Meta-analysis

ACADEMIC SERVICE

Conference Organizing: UITS Zero One Fest 2022 (Poster Presentation Coordinator)
Leadership: Senior Executive, Research Hub Wings, UITS Computer Club (2022-2023)

STANDARDIZED TESTS

GRE: 307/340 (Q: 153, V: 154, A&W: 3.0) | **Duolingo:** 135/160 (P: 115, L:145, C:140,C:120)
TOEFL: 98/120 (R: 28, L: 28, W: 21, S: 21) | **IELTS:** 6.5/9.0 (L: 7.0, S: 6.5, W: 5.5, R: 6.0)