Md. Raisul Islam Rifat

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Chittagong, Bangladesh

EDUCATION

• **Bachelor of Science in Electrical and Electronic Engineering** *August 2025*
Chittagong University of Engineering and Technology Chittagong, Bangladesh
  ◦ CGPA: 3.48/4.00;

• **Higher Secondary Certificate** *May 2019*
Chittagong College Chittagong, Bangladesh
  ◦ GPA: 5.00/5.00

• **Secondary School Certificate** *March 2017*
Nasirabad Govt. High School Chittagong, Bangladesh
  ◦ GPA: 5.00/5.00

PUBLICATIONS C=CONFERENCE, J=JOURNAL

[J.1] **QSAC: Quantum-assisted Secure Audio Communication using Quantum Entanglement, Audio Steganography, and Classical Encryption**. *(Published in Engineering Science and Technology, an International Journal [Q1, IF: 5.4]. Article reference: https://doi.org/10.1016/j.jestch.2025.102167)*
Md. Raisul Islam Rifat, Md. Mizanur Rahman, Md. Abdul Kader Nayon, Md Shawmoon Azad and M.R.C. Mahdy.

- Designed a novel scheme of secure audio communication by incorporating **E-91** Quantum Key Distribution with **SHA-3** Hashing Algorithm, **ChaCha20-Poly1305** AEAD and **LSB** steganography.
- Implemented **entanglement-based** key generation with SHA-3 hashing and validated security using the **CHSH** inequality to detect eavesdropping.
- Engineered an LSB-based audio steganography module to **embed** and reliably **extract** secret audio while maintaining **audible imperceptibility** through constrained sample-level modification.
- Achieved high cryptographic robustness, demonstrating near-maximum **entropy (15.9984)**, high **UACI (49.9977%)** and **NSCR (99.9985%)**, and low **correlation (1.4627×10^{-5})** in encrypted audio signals.
- Ensured **end-to-end confidentiality, integrity**, and **authenticity** through authenticated encryption and steganographic concealment.

[J.2] **Detection of Hallucination in Multimodal Large Language Models Across the Modalities: A Comprehensive Review**. *(In Preparation.)*
Md. Mizanur Rahman, Md. Raisul Islam Rifat.

- Systematically analyzed **hallucination detection benchmarks for multimodal LLMs** across **text, image, audio, and video**, identifying critical gaps in existing literature related to audio and video modalities.
- Developed a novel taxonomy to categorize and analyze over **50 benchmarks**, including over **10 benchmarks** for audio and video addressing a critical gap in existing literature, focusing on text and image hallucinations.
- Compiled and analyzed key benchmarks attributes (e.g. dataset size, task type, evaluation metrics) across **4 detailed tables**, facilitating direct comparison and offering researchers valuable insights to guide the development of more robust MLLMs and effective mitigation strategies

[C.1] **Design of a Negative Refractive Index THz Metamaterial Biosensor For Cancer Cell Detection**.
(Accepted and prsented at EICT, 2025. Published in IEEE Xplore (https://doi.org/10.1109/EICT68394.2025.11355514))
Md. Abdul Kader Nayon, Md. Raisul Islam Rifat, Nipa Dhar.

- Designed a **non-invavisve Biosensor** capable of detecting **Cancer Cells** by utilizing the **Negative Refractive Index** of **Double Negative Metamaterials** in the **THz**region.
- Conducted full-wave **THz electromagnetic simulations** of the biosensor made up of **rectangular, orthogonal SRRs** on an **FR4 substrate** in CST Microwave Studio **(0.5–2.0 THz)**.
- Retrieved and analyzed **effective constitutive parameters** ($\epsilon_{\text{eff}}, \mu_{\text{eff}}, n_{\text{eff}}$), confirming **simultaneous negative permittivity and permeability** over the **0.6–1.8 THz** band.
- Quantified biosensing performance via **resonance shift, sensitivity (≤ 0.4125 THz/RIU), Q-factor (≤ 12.64)**, and **Figure of Merit (≤ 3.30)**.
- Demonstrated **cell-type discrimination** (normal vs. cancerous cervical, blood, breast, and skin cells) through **spectral redshift** and **refractive index analysis**.

RESEARCH EXPERIENCE

- **Photonic Implementation and Security Analysis of MDI-QKD** *2025-Ongoing*
  Supervisor: Dr. Md. Istiaque Reja, Associate Professor,Department of EEE, Chittangong University of Engineering and Technology.
  - Conducting a research on photonic Measurement-Device-Independent Quantum Key Distribution (MDI-QKD), focusing on optical system modeling, security assumptions, and mitigation of detector-side-channel attacks, with particular emphasis on multi-party and extended MDI-QKD schemes through analytical modeling and simulation.

- **Familiarization with Quantum Computing, Quantum Key Distribution & Post-quantum Cryptography.** *2024-2025*
  Supervisor: Dr. Mahdy Rahman Chowdhury, Professor, Department of ECE, North South University. [O]
  - Learned about Quantum Matrix Mechanics and implemented BB84, B92 and E91 Quantum Key Distribution protocols as well as Quantum-safe Cryptography schemes such as Lattice-based cryptography using QISKIT SDK.

- **Design of a Negative Refractive Index THz Metamaterial Biosensor for Cancer Cell Detection** *2024-2025*
  Supervisor: Nipa Dhar, Assistant Professor, Department of EEE, Chittangong University of Engineering and Technology. [⊕]
  - Learned about the Negative Refractive Index property of metamaterials and attempted to implement this property in THz frequency range using CST Microwave Studio.

INTERNSHIP EXPERIENCE

- **Bangladesh Telecommunications Company Ltd. (BTCL)** *24th November, 2024 - 12th December, 2024*
  BTCL Regional Exchange, Nandankanon, Chittagong [⊕]
  - Participated in a 15-day long internship training program hosted by BTCL as part of the academic curriculum.
  - Studied carrier-grade telecommunication systems, including PSTN and GPON-based access networks, and IMS-controlled voice transmission architecture.
  - Analyzed national internet service infrastructure, covering IIG–BRAS–AAA workflow, cache and NIX servers, and router–switch hierarchy in ISP operations.
  - Gained exposure to optical transmission technologies, including PDH/SDH/DWDM systems, single-mode vs multimode fiber, and wavelength windows used in long-haul communication.

KEY PROJECTS

- **Design and Deployment of a Self-Hosted, Containerized Service Infrastructure.** *2022-Ongoing*
  Tools: Docker, Docker Compose [O]
  - Designed and maintaining a **Docker Compose–based homelab** hosting 25+ containerized services across networking, security, media, and productivity domains.
  - Implemented **reverse proxy–based internal routing** and **private DNS infrastructure** using Pi-hole and Unbound to minimize attack surface.
  - Deployed **secure secrets management** and access control for internal services using Vaultwarden and environment-based configuration.
  - Automated service lifecycle management and updates using Portainer and Watchtower.
  - Emphasized **reproducibility and documentation**, publishing sanitized configurations, architecture diagrams, and operational screenshots.
  - Built the system as **private-by-default**, with no public IP exposure or port forwarding.

- **Implementation of Neural Reasoning Models from First Principles** *2025-Ongoing*
  Tools: Python, PyTorch [O]
  - Forked and explored Sebastian Raschka's *reasoning-from-scratch* project to study **neural reasoning mechanisms** beyond standard language modeling.
  - **Implemented reasoning-oriented model components**, focusing on structured computation, intermediate representations, and step-wise inference behavior.
  - Analyzed the **limitations of end-to-end learning** for reasoning tasks and explored architectural design choices that influence reasoning performance.
  - Conducted controlled experiments to observe how model structure affects **generalization and reasoning depth**.
  - Maintained a focus on **educational and research-oriented experimentation**, prioritizing transparency and interpretability.

- **Implementation and Analysis of Large Language Models from First Principles** *2024*
  Tools: Python, PyTorch, NumPy [O]
  - Forked and **systematically studied** Sebastian Raschka's *LLMs-from-scratch* implementation to understand transformer architectures from foundational components.
  - **Implemented and analyzed core LLM building blocks**, including tokenization, embeddings, self-attention, positional encoding, and transformer blocks.
  - **Experimented with training dynamics**, loss behavior, and scaling considerations using small-scale models for educational and research-oriented analysis.
  - Extended and modified code to **improve clarity, modularity, and experimentation**, focusing on interpretability rather than performance optimization.

- **Design and Implementation of a PIC Microcontroller-Based Capacitance Measurement System.** *2023*
  Tools: MikroC Pro, PICKit, Proteus [⟳]
  - Developed a **digital capacitance meter** using the **PIC16F628A** microcontroller, capable of measuring capacitors in the **1 nF to 1 μF** range, leveraging built-in analog comparators and TIMER2 module for precise measurements.
  - Implemented a method to **charge a capacitor through a series resistor** and calculate capacitance based on the **time to reach a defined voltage threshold**.
  - Verified functionality through **simulation on Proteus** and fabricated a **PCB prototype**, demonstrating practical system integration.
  - Evaluated the system's **accuracy** and **reliability**, providing a cost-effective and versatile tool for electronic testing and educational purposes.

- **Design and Performance Analysis of a Medium-Voltage Three-Phase Distribution Transformer.** *2023*
  Tools: AutoCAD Electrical, MATLAB [⟳]
  - Designed a 470 kVA, 6.6 kV / 415 V, 3-phase, 50 Hz distribution transformer with high-voltage tap settings of ±2.5% and ±5% and self-oil cooling (Oil Natural Air Natural(ONAN)).
  - Ensured **temperature rise over oil below 60°C** and **load loss limited to 6 kW**, meeting design specifications.
  - Calculated **percentage impedance (%Z = 4.5%)**, and evaluated **efficiency** at **full load, 75% load, and 50% load** under unity power factor.
  - Assessed **voltage regulation** at **full load** for both **unity** and **0.8 lagging power factor**, verifying reliability.
  - Integrated **electrical and thermal design considerations** to develop a practical, functional distribution transformer suitable for power distribution applications.

- **Design and Implementation of an Optical Heart Rate Monitoring System using Atmel microsontroller.** *2022*
  Tools: Arduino, C++, Proteus [⟳]
  - Designed and implemented a **ATmega328P microcontroller-based biomedical monitoring system** for real-time heart rate (BPM) measurement using **photoplethysmography (PPG)** principles.
  - Developed an **end-to-end sensing pipeline** using the **MAX30102 pulse sensor** and **Arduino Uno**, including signal acquisition, basic conditioning, and BPM computation.
  - Performed **software-level validation and debugging** through **Proteus simulation**, integrating Arduino firmware and virtual instrumentation (LCD and oscilloscope outputs).
  - Implemented a **hardware prototype on PCB**, integrating sensor, display, power management, and alert components into a compact embedded system.
  - Gained early exposure to **biomedical instrumentation, embedded systems, and experimental validation**, forming a foundation for later research-oriented coursework and projects.

RELEVANT COURSEWORK

- **Quantum Computing & Quantum Information:** Quantum Information Theory; Quantum Computing (Matrix Mechanics–Based Formalism); Quantum Algorithms; Quantum Communication; Quantum Key Distribution; Post-Quantum Cryptography; QISKIT-Based Quantum Simulation. *(Private Research Thesis Course, Mahdy Research Academy; supervised by Dr. Mahdy Rahman Chowdhury — completed first half with >80% performance)*.
- **Mathematics & Theoretical Foundations:** Differential and Integral Calculus; Differential Equations; Linear Algebra & Matrices; Vector Calculus & Complex Variables; Engineering Statistics.
- **Core Electrical & Electronic Engineering:** Electrical Circuits I–II; Electromagnetic Field Theory; Signals and Systems; Control Systems; Semiconductor Physics and Devices.
- **Electronics, Devices & VLSI:** Electronics I–II; Digital Electronics; Microprocessor and Interfacing; VLSI Technology; Power Electronics.
- **Communication, RF & Photonics:** Electronic Communication; Telecommunication Engineering; Microwave and Antenna Engineering; Optoelectronics *(Elective)*.
- **Power Systems & Energy Engineering:** Electrical Machines I–II; Power Transmission and Distribution; Power System Analysis; Switchgear and Protection; Power Stations; Renewable Energy Conversion *(Elective)*.
- **Interdisciplinary Systems:** Biomedical Instrumentation *(Elective)*.
- **Computing & Numerical Methods:** Computing Methods for Engineering Analysis; Object-Oriented Programming; Digital Signal Processing; Numerical Methods.

UNDERGRADUATE THESIS

- **Design of a Negative Refractive Index THz Metamaterial Biosensor for Cancer Cell Detection** *2024-2025*
  Supervisor: Nipa Dhar, Assistant Professor, Department of EEE, Chittangong University of Engineering and Technology [⊕]

SKILLS

- **Programming Languages:** C, C++, C#, Python, Assembly, Verilog.
- **Quantum SDKs:** QISKIT, QRISP.
- **Data Science & Machine Learning:** NumPy, Pandas, Matplotlib, Scikit-Learn, TensorFlow, Keras.
- **VLSI Design Tools:** Cadence, LTSpice, ModelSim.
- **Operating System:** Arch Linux, Ubuntu, Debian, Linux Mint, Windows.
- **Other Tools & Technologies:** MATLAB, Multisim.

CERTIFICATION

- **IQM Quantum School Certificate** *2nd December, 2025– 4th December, 2025*
  IQM Quantum Computers [🌐]
- **Digital Design for Industrial Control** *2024-2025*
  Enhancing Digital Government and Economy (EDGE) Project of Bangladesh Computer Council, ICT Division [🌐]
- **Networking Basics** *2025*
  Cisco Networking Academy [🌐]
- **Introduction to Cybersecurity** *2025*
  Cisco Networking Academy [🌐]
- **Introduction to Packet Tracer** *2025*
  Cisco Networking Academy [🌐]

AWARDS

- **Education Board Scholarship**
  Board of Intermediate & Secondary Education, Chittagong Chittagong, Bangladesh
  ◦ Received General Grade Scholarship in Secondary School Certificate (2017-2019).
  ◦ Received General Grade Scholarship in Higher Secondary Certificate (2019-2025).

LANGUAGE PROFICIENCY

- **English:** Proficient
- **German:** CEFR level: *A1*
- **Bengali:** Native Language

REFERENCES

Nipa Dhar
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