Irfan Nafiz Shahan

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RESEARCH INTERESTS

Robotics, Computer Vision, Autonomous Vehicles

EDUCATION

Bachelor of Science (BSc) in Electrical and Electronic Engineering, **Jan 2020 - Present**

Shahjalal University of Science and Technology (SUST), Sylhet, Bangladesh

CGPA: 3.85 out of 4.00 (Rank: 1st out of class of 56) | 2x SUST STEM Scholarship (Merit) Recipient
10,000 USD Grant for Top 10 Most Innovative Engineering Projects in Bangladesh – ICT Division Bangladesh
Nominee for University Student Scholarship 2024 by Vice-Chancellor (In progress)
Dissertation Title: CARLASnowScenes: Towards Solving Adverse Weather – An analysis and approach to Synthetic Snow Road Scenes for Autonomous Driving
***Advisor*:** Dr. Md. Rasedujjaman (PhD. Aix-Marseille Université and Institut Fresnel), Head of EE

A-Level (Edexcel) Certificate **July 2017-2019**

Anandaniketan School and College, Sylhet, Bangladesh

1 A* and 3 As (GPA 5.0/5.0 Higher School Certificate Equivalent)
Further Pure Mathematics Track

O-Level (Edexcel) Certificate **July 2016-2017**

Anandaniketan School and College, Sylhet, Bangladesh

8 A*s and 1 A (GPA 5.0/5.0 Secondary School Certificate Equivalent)
Science Track | ***+Achieved O-Level Country Highest in Fine Arts***

RESEARCH EXPERIENCE

- **Research Asst., STEMX-365** **May 2024 - Present**
  Supervisor: *Mizanul Haq Chowdhury, MIT SPHERES/Astrobee Architect*
  Project Title: *Development, Verification and Testing of Robust Nested Virtual Machines for NASA Astrobee Simulation*

- **Undergraduate Dissertation, Shahjalal University of Science and Technology** **Jan 2024 - Present**
  Supervisor: *Dr. Md. Rasedujjaman, Head of Dept. of Electrical and Electronic Engineering, SUST*
  Project Title: *CARLASnowScenes: Development of Synthetic Snow Weather Data for Autonomous Driving*

- **Research Asst., Shahjalal University of Science and Technology** **Mar 2023 – Present**
  Supervisor: *Dr. Md. Rasedujjaman, Head of Dept. of Electrical and Electronic Engineering, SUST*
  Project Title: *Development of Secure RFID Based Data Logging System for Large Institutions*

- **Research Trainee, Shahjalal University of Science and Technology** **Sep 2022 – July 2023**
  Supervisor: *Dr. Pabel Shahrear, Professor, Dept. of Mathematics, SUST*
  Training: *Implementation of Dynamical Systems in MATLAB*
  Project Title: *Expeditions on Time-Series Machine Learning Architectures for Dengue Outbreak Prediction*
  (Data Provided by Institute of Epidemiology Disease Control And Research (IEDCR), Bangladesh)

- **Team Lead & Researcher, Shahjalal University of Science and Technology** **Mar 2021 – Dec 2022**
  Supervising Committee: *Advisors from EE, CS, ME, Architecture, and Civil Engineering Dept of SUST.*
  Project Title: *Development of Affordable Braille Display for the Visually and Auditory Impaired in Developing Countries*
  Achievement: *Top 10 Most Innovative Engineering Ideas Award of 10,000 USD Student Grant in International Conference of 4th Industrial Revolution and Beyond 2021 (IC4IR). Grant awarded by ICT Division, Bangladesh.*

PUBLICATIONS

Journals: *(In Preparation)*

- **Shahan, et al.** "A Survey on Synthetic Approach to Autonomous Vehicles in Adverse Weather Conditions" *International Journal of Computer Vision*
- Md. Rasedujjaman, **Shahan et al.** "A Secure, Cost-Effective Approach to RFID Attendance Systems for Large Institutions" *IEEE Internet-of-Things Journal*
- **Shahan, et al** "TinyRecycler: A low-cost smart trash segregation system for developing countries utilizing Tiny ML"
- **Shahan, et al "**Towards better Braille Displays – An analysis and proposition for affordable braille displays**"**

Conferences: *(In Preparation)*

- **Shahan, et al. "**CARLASnowScenes: Towards Solving Adverse Weather Driving – An analysis and approach to Synthetic Snow Road Scenes for Autonomous Driving**"** *Computer Vision and Pattern Recognition 2025*
- **Shahan, et al. "**SUSTsat-1: A Low Cost Raspberry Pi based Multifunctional SmallSat capable of FSK, POCSAG, SSTV Telemetry"

Preprints:

- **Shahan, et al. "**A Real-Time DETR Approach to Bangladesh Road Object Detection for Autonomous Vehicles.**"** Preprint on arXiv [Ref]
- **Shahan, et al.** "Towards Speaker Identification with Minimal Dataset and Constrained Resources using 1D-Convolution Neural Network" Preprint on arXiv [Ref]

SCHOLARSHIPS, GRANTS AND FELLOWSHIPS (Received 10,000+ USD Student Grants)

1. **SUST STEM "Professor Guaranga Deb Roy Memorial Scholarship" 2024 (Merit) |** Awarded for Merit, potential and contribution to STEM
2. **SUST STEM Scholarship 2023 Recipient (Merit) |** Awarded to top 5 meritorious STEM students on campus. [Ref]
3. **Grant Funding 10,000 USD | IC4IR 2021 |** Top 10 Most Innovative Ideas [Ref]
4. **IBM Quantum's Introduction to Quantum Computing 2022 |** Full Scholarship - 8-month course awarded to 1000 applicants worldwide

WORK EXPERIENCE

➢ **Technical Asst., Student Mentor | STEMX-365, MA, USA** **May 2024 – Present**

JAXA (& NASA) *org. Kibo-Astrobee ISS Robot Programming Challenge*
International Project Coordinator: Mizanul H. Chowdhury (MIT Lincoln Lab, NASA Astrobee/SPHERES Scientist)

STEMX-365 is a nonprofit organization committed to providing accessible, immersive, and interactive STEM education to every child, starting in Bangladesh. It is affiliated with NASA, JAXA and MIT through its founder. Mr. Mizanul H Chowdhury, Engineer at MIT Lincoln Laboratory, MIT ZeroRobotics Technical Expert and NASA Astrobee Scientist.
Key Responsibilities:

- **Lead development and testing teams** - nested virtual machines for simulation deployment, ROS, Docker and Android Programming
- **Make and develop robust Virtual Machines and online platform for ISS Astrobee Simulation** for training purposes
- **Mentor prospective students** on NASA Astrobee and core astronomy and robotics concepts, autonomously operate Astrobee (a free flying robot) inside ISS, avoiding obstacles with 3D perception, and image processing.
- **Conduct presentation sessions and webinars** to facilitate student learning
- **Maintain wiki for stemx-365.org**

➢ **Teaching Asst. | Dept. of EEE, SUST** **Feb 2023 - Present**
Under Dr. Md. Rasedujjaman, Head of Department, EEE, SUST

Courses: Digital Signal Processing I,
Digital Signal Processing I Lab,
Signals and Linear Systems,
Electronics II Lab

- **In-charge of writing questions** for assignments, lecture content
- **Making solution sheets and supplementary materials** for examinations and coding assignments
- **Set up and troubleshooting laboratory computers** for coding and simulation

➢ **Team Director | FrontierSatellites** **Oct 2024 - Present**

Chief Advisor: Mizanul Chowdhury (MIT Lincoln Lab, NASA Astrobee/SPHERES Scientist)

- **Stealth Student Satellite Engineering Group**
- **Focused on making cost-friendly SmallSat Systems for space democratization**
- **First principles engineering approach**

➢ **Industrial Trainee | ULKASEMI, CA, USA** **Oct 2024 - Nov 2024**

- **Analog and IC Layout Design and Post Layout Verification**
- **Physical Design (PnR), IC development lifecycle, CTS, and design sign-off using EDA tools.**
- **Industry Practices:** IC design workflows, layout challenges, power integrity analysis tailored to real-world.

➢ **Industrial Trainee | TICI, Bangladesh** **Nov 2024 - Dec 2024**

Key Achievement: Ranked 1st out of 60 trainees *[Dec 19th 2024]*

- **PLC Design and Verification**
- **Distributed Control Systems (DCS)**
- **Factory Automation with SCADA**
- **Process Control, Protection and Contingency**

LEADERSHIP EXPERIENCES

➢ **Founder, President | Columbia University NEBDHub NSDC SUST Chapter** **Jul 2023 – Present**

Previously Held Position:
General Secretary (1 Year)

The community of National Student Data Corps (NSDC) is operated by Northeast Big Data Innovation Hub (NEBDHub), affiliated with Columbia University, which drives innovation in big data. It connects academia, industry, all over the world advancing research and education in data science.
Key Achievements:

- **Pioneered the first, 2-month long event data-literacy event DATADRIVE 1.0 A Speedrun to Advanced Machine Learning**
- **Collaborated with international companies eg. HerWILL, to provide workshops on Natural Language Processing and Semantic Analysis**

➢ **Director of Robotics | RoboSUST** **Jul 2021 – Present**

Previously Held Positions:
Research and Development Secretary (1 Year)
Asst. Research and Development Secretary (2 years),

RoboSUST is the only robotics-based student organization in my university. As Director of Robotics, I spearhead the organization's technical and competitive success, fostering innovation and excellence in robotics.
Key Achievements:

- **Mentee Team Global Nominee in NASA Space Apps Challenge 2024**

- **Introduction to Python Workshop**
- **SUSTsat-1 –** Initiated the SUSTsat Megaproject
- **JAXA KRPC 2023 2nd Runner Up**

➢ **Co-Founder, CTF Lead | NMOSS Research Group** **Jan 2022 – Jan 2024**

NMOSS, was a SUST-based Independent Computer Security Research and Competitive Group. As CTF Lead, I lead our teams in International and National CTF Competitions.

Key Achievements: [Link]

- **Conducted first CyberSecurity Competition and Workshop in SUST**
- **Ranked 14th in 2022 throughout Bangladesh in ctftime.org** within 8 months of the establishment of NMOSS. [ctftime]
- **Top 3% of all teams internationally on Hack the Box: CyberApocalypse 2023 | 2nd Position in Bangladesh Region**

➢ **Vice Chair of Research and Development | IEEE SUST Student Branch** **Jan 2023 – Present**

Previously Held Position:

Vice Chair of IEEE Robotics and Automation Wing (1 Year)

IEEE SUST Student Branch is the leading IEEE student initiative, working on STEM education, engineering and publications support. The overarching goal is to provide a platform for student researchers to flourish in a academically encouraging environment.

Key Achievements:

- **Promoted several conferences such as BECITHON 2024, ICCIT 2024, RAAICon 2024, IEEE WIE BD Summit 2024, etc.**
- **Promoted and guided on contests such as Robo Tech Olympiad 2024**
- **Attended seminars on RF Design for Ultra-Low Power Communications Systems, Graz University of Technology, Austria**

INVITED TALKS

1. NSDC Bi-Annual Meeting May 2024
2. Annual Report – RoboSUST Annual General Meeting 2024
3. NSDC Bi-Annual Meeting Nov 2023
4. "Meet Team I-Braille – An Experience Sharing Session" by STUDIO XI, Dept. of Architecture, SUST 2021

PROFESSIONAL SERVICES

- **Technical Assistant** in International Science, Technology, Engineering, Mathematics and Education Conference 2023, Huston-Tillotson University, TX, USA [Ref]
- **Judge** in "The Data Forge" Natural Language Processing Contest 2023 presented by HerWILL (USA), NSDC Chapter [Ref]

STUDENT RESEARCH SUPERVISION

- **CERN, A Beamline for Schools (BL4S)**, Team Invicta Coach, **"Effect on Quantum Particles on Microcomputers"** | First Bangladeshi Shortlisted Team [Ref][Cert]
- **JAXA Asian Try Zero Gravity Challenge 2023,** Mentor, **"Finding the Shape of Magnetic Field Lines in Microgravity"** | Winner Category A, First Bangladeshi Experiment performed in Kibo Module, ISS [Ref]
- **JAXA Kibo ABC-Award 2023, (Co-Supervisor with Mizanul Chowdhury, Saba J. Chowdhury) |** (Category A) 1st Place [Ref]

HIGHLIGHT PROJECTS [+Linked]

Robotics, IoT and ML Projects:

+**KiboxIcarus** | *A ROS based simulation of NASA's Astrobee for unmanned space robot used for repairs during an ammonia leak on the ISS*

- **2nd Runner Up Project in JAXA Kibo RPC National Round**, a JAXA based international space robotics competition which included 3 rigorous methods of testing and judgement undertaken by industry and academic experts in JAXA
- **Utilized a Ray Tracing (RT) algorithm paired with Floyd Warshall** to minimize time of travel within KIZ KOZ zones
- **OpenCV preprocessing enhances detection of defects**

+**iBraille** | *An Prototype Affordable Braille Display for the Visually Impaired*

- **Project received 10,000 USD in seed funding** from ICT Division Bangladesh which was a process that included 5 rigorous methods of testing and judgement undertaken by industry and academic experts
- **Champion Project in Mujib 100 Idea Contest 2021**, Champion in IC4IR Conference 2021, out of 1000+ academic and industry teams nationwide
- **Utilized financial analysis, and logistic analysis to reduce average product cost by 400%** of an average braille display

+**SUSTsat-1** | *A Low Cost Raspberry Pi based Multifunctional SmallSat capable of FSK, POCSAG, SSTV Telemetry*

- **Utilizes POCSAG, SSTV and FSK Telemetry** for instrumentation and camera data
- **Ground up electrical, software and mechanical design**
- **SDR based ground station,** utilizes an RTL-SDR to decode telemetry.

+**TinyRecycler** | *A TinyML based, cost-friendly Smart Trash Segregator, with its own custom 2D-ConvNet, integrated with Edge Impulse API.*

Course Project: Microprocessor and Interfacing Lab – EEE-334

- **Utilizes Edge Impulse API and Framework to maximize model performance with Validation and Test Accuracies of 86% and 84%**
- **Built a custom minimal dataset of 250+ images containing 5 recyclable classes**, preprocessed and curated for the computer vision classification
- **Reduced SRAM (85kB), for deployment on an edge embedded device,** namely Arduino Nano BLE Sense 33 and TinyML Shield.

+**RecMe** | *A Signal Processing and Machine Learning Model Optimized for Speaker Identification with Minimal Dataset in Embedded ML Systems.*

Course Project: Digital Signal Processing I Lab– EEE-332

Supervisor: Dr. Md. Rasedujjaman, Head of Department, EE, SUST

- **Custom Minimal dataset model of 1d-ConvNet** to enable deployment on edge embedded devices with low power consumption.
- **Conducted Model Architecture Optimization** to ensure speech features are captured and classification accuracy is highly accurate even on minimal dataset.

VR Projects:

+**Project Icarus** | *A VR/AR Based Space Simulator made with Unity Engine*

- **Led a team of 6**, constituting 3 collaborating national universities in Bangladesh – IUT, SUST and DU
- **Competed against 220,000+ registrants globally**, and secured global top 420 position as **'Global Nominee' on NASA Space Apps Challenge 2022**
- **Elected as Regional Champion of NASA Space App Challenge 2022**, among 100+ teams nationwide
- **Uses a robust N-Body Simulation Algorithm** to create an Immersive Space Experience \

+**Perseverance Re-imagined** | *A VR Based Recreation Perseverance Rover Launch, Landing and Deployment in Mars Terrain developed on Unity Engine.*

- **Led a team of 6**, constituting 3 collaborating national universities in Bangladesh - RUET, SUST and DU
- **Competed against 1,000+ registrants nationally in NASA Space Apps Challenge 2023**, securing global top 50 position
- **3D mapping, 3D audio and localization**
- **WebGL and webVR deployment**

Electrical Design Projects:

Buck-Boost Converter | A N-Channel MOSFET based 4V to 0.5-12V Buck-Boost conversion for PVT Systems
Course Project: Power Electronics Lab – EEE-340

12V Dual DC Power Supply | *E-I Shell Core Transformer for 12V Dual Power Supply*
Course Project: Electrical Machines 1 Lab – EEE-224

WORKSHOPS

1. **Instructor | Engineering Advanced LFRs,** RoboSUST Training of Trainers 2024 [Ref]
2. **Instructor | Introduction to Python Programming**, NSDC SUST "DataDrive 1.0" 2024
3. **Instructor | Road to Object Oriented Programming**, NSDC SUST "DataDrive 1.0" 2024
4. **Lead Technical Guide | PyChamp 2.0,** 5-day Workshop on Beginner to Advanced Python Programming 2024
5. **Instructor | "Cyber 101: Beginner's Guide to CTFs",** NMOSS Research Group 2023 [Ref]
6. **Instructor | "Introduction to CTFs: Cryptography, Forensics and Hardware Hacking"** NMOSS Research Group 2022 [Ref]

CERTIFICATIONS

7. **STANFORD University and DEEPLEARNING.AI |** Neural Networks and Deep Learning [Ref]
8. **EDGE IMPULSE ADVOCATE |** Introduction to Embedded Machine Learning [Ref]
9. **MICROSOFT Student Learn Ambassador |** Object Detection with Azure Custom Vision [Ref]
10. **IBM QUANTUM COMPUTING CERTIFICATION |** Introduction to Quantum Computing [Ref]
11. **AUTODESK FUSION 360 CERTIFICATION|** Introduction to Autodesk Fusion 360 [Ref]

AWARDS AND HONORS

International:

- **2nd Runner Up** | Kibo Robot Programming Challenge 2023 organized by JAXA and NASA [Ref][Video]
- **Global Top 3% [Rank 179th], 2nd in Bangladesh Region |** CyberApocalypse 2023 CTF organized by Hack the Box [Ref]
- **Regional Champion, Global Nominee |** NASA Space Apps Challenge 2022 organized by NASA and BASIS, BD [Ref]
- **Gold Medalist, Top 2% Worldwide** | International Astronomy and Astrophysics Competition 2021 (IAAC) organized by Edu.Harbour, Germany [Ref]

National:

- **Ranked 1st out of all Trainees** | Industry Training, TICI, Bangladesh
- **Top 10 Most Innocative Engineering Projects**
  Poster Presentation: Mowaz M. and **Shahan et al.** "I-Braille: An Affordable Internet-of-Things based Braille Display" in *Mujib 100 Idea Contest, International Conference on 4th Industrial Revolution 2021* | **Top 10 Most Innovative Ideas Award – 10,000 USD Grant** [Poster] [Certification][Video]
- **6th in DL Enigma 2024 |** A Nation-wide Computer Vision Competition based on Autonomous Vehicle, Road Vehicle Detection. [Ref]
- **Runner Up |** RoboSUST Senior Project Hunt 2022
- **Finalist | BIKIRON Sustainable Energy Innovation Challenge 2021**
- **Bangladesh Physics Olympiad 2019 |** Category C | 16th
- **Bangladesh Physics Olympiad 2018 |** Category B | 2nd Runner Up

COMMUNITY SERVICE

1. **Radio Musician,** Bokultola Music School, Bangladesh Radio Sylhet
2. **Volunteer |** Kid's Campus Pre-school, Sylhet

ACTIVITIES

Idea Contests. Case Contests, Line Follower Robot Competitions, Capture the Flag (Jeopardy) Cybersecurity Contests

REFERENCES

1. **Mr. Mizanul Haq Choudhury, MIT Space Systems Lab, NASA Astrobee/SPHERES Scientist**
   STEMX-365 Project Coordinator, FrontierSatellites Chief Advisor
   Massachusetts, USA
   Contact: mizanul@mit.edu
2. **Dr. Md. Rasedujjaman, Professor and Head of Dept of EEE, SUST**
   BSc. Dissertation Supervisor, Research Supervisor
   PhD. Aix-Marseille Université and Institut Fresnel
   Sylhet, BD
   Contact: mrased@sust.edu
3. **Dr. Farzana Hussain, Professor and Chair, Dept of Mathematics, HTU**
   Research Supervisor, SUST STEM Scholarship Coordinator
   Austin, TX, USA
   Contact: fhussain@htu.edu
4. **Dr. Pabel Shahrear, Professor, Dept. of Mathematics, SUST**
   Research Trainer and Supervisor,
   Sylhet, BD
   Contact: pabelshahrear@yahoo.com