Neeraj Prabhu

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neerajsprabhu

Education

2020 – 2022* **Indian Institute of Technology Bombay, India** 8.78 CPI
B.Tech. with Honours *Electrical Engineering*
Minor in *Artificial Intelligence and Data Science* offered by CMInDS, IIT Bombay

2018 – 2020 **Pace Junior Science College, Thane** 93.69%
Intermediate/+2

2008 – 2018 **Billabong High International School, Thane** 97.00%
Matriculation

Key Projects

2022 **Student Satellite Program** | **IIT Bombay**
A 70+ member team with the vision of making IIT Bombay a centre of excellence in space technology
Communication Subsystem | **Ground Station Segment**
Involved in setting up an autonomous ground station to receive data from satellites and missions
- Developed an SSTV module which implements the PD90 protocol to transmit images of the resolution 320x256 using an EEPROM, a waveform generator and an FM modulator
- Performed extensive **component level** testing to ensure proper working of the EEPROM and waveform generator when interfaced with the ATmega32 microcontroller
- Implemented **SPI**, **I²C** and **UART** protocols between ATmega microcontrollers
- Designed and simulated a dipole, **Yagi-Uda** and horn antenna to get parameters such as S11 and radiation pattern

Payload Subsystem | **CubeSat**
A nanosatellite mission to be proposed to ISRO for launch
- Conducted extensive literature survey to search for possible scientific and technology demonstration payloads that can be implemented in the CubeSat
- Looked into the feasibility of **hyperspectral imaging** and the CubeSat onboard computing required for the transmission of the large quantity of data produced

Microprocessor Architecture Design | **Course Project**
Guide: Prof. Virendra Singh, Department of Electrical Engineering, IIT Bombay
- Designed a **multicycle** and a **6 stage pipelined**, 16-bit microprocessor to implement a 17 instruction **RISC** architecture using a detailed datapath and efficient controller
- Used **behavioral** and **structural modelling** to create components such as the **ALUs**, **register banks** and **memory**, and integrate them onto the datapath in VHDL
- Mapped out a suitable datapath and delineated hardware flowcharts for each of the instructions and designed a **control status word** and a **finite state machine** to implement the same
- Optimized the pipelined architecture by using blocks for **hazard detection** and implemented **mitigation** techniques using forwarding blocks and branch prediction tables

Decoupled L1 Caches in GPGPUs
Guide: Prof. Virendra Singh, Department of Electrical Engineering, IIT Bombay
- Conducted extensive literature survey regarding analyzing and leveraging **decoupled L1 caches** in different configurations and implementing it on **GPGPU-Sim**
- Studied the **SIMT 3 loop approximations** related to GPGPU Architecture and the interface of the memory and caches with the SIMT cores
- Simulated multiple operations on GPGPU-Sim and analysed the **benchmark** outputs

Key Projects (continued)

Control Electronics for a Portable Magnetic Field Sensor
Guide: Prof. Kasturi Saha, Department of Electrical Engineering, IIT Bombay
• Conducted extensive literature survey regarding **spin quantum systems, nitrogen vacancies in diamond** and **microwave generation** and **detection** to build a compact quantum magnetic field sensor using classical components
• Programming a **RedPitaya** board using the **PyRPL** Library to implement a **lock-in amplifier** and process the signal obtained to display it and find the magnetic field
• Involved in selecting **RF ICs** for the detection circuit and designing a PCB for the same

Distributed Beamforming via Drone Swarm Network
Guide: Prof. Dwaipayan Mukherjee, IIT Bombay, Prof. Shashiranjan Kumar, IIT Bombay
• Investigated concepts such as **UAV swarm controls** and **distributed beamforming** along with their applications in highly pertinent fields such as **electronic warfare**
• Working on the implementation of particle swarm optimization algorithms for UAV swarm cooperative control
• Proposed the project outline to **ISRO** as a part of the **RESPOND Basket 2022** program

Analytical Model and Dynamics of Histone Occupancy | Research Project
Guide: Prof. Sibi Raj B Pillai, Department of Electrical Engineering, IIT Bombay
• Simulated the process of nucleosome marking in a histone protein chain based on the **kinetics of nucleation, propagation** and **turnover** and verified the results from a research paper
• Studied the dynamics of **inherently bounded histone modification domains** and related stochastic models that can be used to explain the behavior of histone marking
• Working on developing a **stochastic model** to capture the trajectory of nucleosome marking in a histone protein chain

Text to Image Synthesis with Stacked GAN
Guide: Prof. Biplab Bannerjee, Centre for Machine Intelligence and Data Science, IIT Bombay
• Modelled **generator** and **discriminator** blocks consisting of **embedding compressors** and multiple **convolutional layers**
• Conducted literature survey to understand **GANs** and the purpose of using multiple GANs
• Developed a **2 stage GAN model** to generate bird images from their text description

Microprocessors Lab
Guide: Prof. Saravanan Vijayakumaran, Department of Eletrical Engineering, IIT Bombay
• Designed an **ATM Simulator** incorporating a system to manage account balances and passwords which gives the number of notes to be withdrawn from the total amount
• Wrote the code to generate **morse code** using **assembly language** and tested it using a speaker and a **Pt-51 Board**

2021 **Digital Logic Design in VHDL**
Guide: Prof. Maryam Shojaei Baghini, Department of Electrical Engineering, IIT Bombay
• Implemented **Mealy** and **Moore FSMs** in various models using **behavioral modelling**
• Described an **Arithmetic Logic Unit** capable of executing a **multiplier**, adder and binary logic functions and verified the correctness of the model using **Scanchain** on a Krypton Board
• Developed an ATM machine in the form of a digital circuit to output the number of denomination notes and coins

Football Match Predictor
Guide: Prof. Amit Sethi, Centre for Machine Intelligence and Data Science, IIT Bombay
• Developed an **end-to-end model** that predicts the results of future matches based on previous statistics and compiled the learnings and results in a 4-page IEEE format report
• Analysed statistics such as shots, goals and tackles from various positions and the contributions of different players to the team as a part of the **descriptive data analysis**
• Aggregated and visualised player and team performances in the Premier League for better explainability of results

Scholastic Achievements

2020
- Secured All India Rank **207** in **JEE Advanced** among 0.15 million candidate
- Recepient of the Kishore Vaigyanik Protsahan Yojana **(KVPY) Fellowship**
- Qualified for Indian National Chemistry Olympiad **(INChO)** by securing a rank in the **Top 802** in the National Standard Examination in Chemistry **(NSEC)**

Positions of Responsibility

2021-2022*
- **Convener | Ham Radio Club, IIT Bombay**
  A global community of Ham enthusiasts, bringing electronics & communication together
  • Organized a live demonstration of satellite tracking for 70+ attendees to receive signals from NOAA satellites and decode them to get weather images of the earth
  • Constructed a **QFH Antenna** for the VHF band and documented the procedure on a blog
  • Conducted a YouTube seminar with **200+** views on the overview of Ham Radiowith **MARI**

2022
- **Communication Subsystem Head**
  Student Satellite Program, IIT Bombay
  • Led a team of **9 members** to form the communication subsystem of a satellite
  • Organised a day-long workshop for helping **120+ participants** set up their ground station
  • Executed a **three stage recruitment process** to test the **technical skills**, **practical approach** and **team work** of the applicants over 3 weeks; selected **9** out of **70+ candidates**

- **D-AMP Mentor | Department of Electrical Engineering**
  Department Academic Mentorship Program, IIT Bombay
  • Selected into a team of **46 members** out of **100+ prospects** on the basis of **rigorous interviews** to help **6 sophomores** strike a balance between academics and extracurricular activities
  • Actively participated in taking **reviews of projects** undertaken by the students

Technical Skills

Programming	C++, Python, MATLAB, VHDL, Embedded C
Python Libraries	NumPy, Pandas, Scikit-learn, Matplotlib, Tensorflow, OpenCV, PyRPL
Simulation Software	Proteus, Ansys HFSS, Quartus, EAGLE, NGspice, GPGPU-Sim, GNU-Radio

Courses Undertaken

Electrical Engineering	Analog Circuits, Digital Systems, Power Engineering, Signals and Systems, Probability and Random Processes, Microprocessors, Electronic Devices, Control Systems, Markov Chains and Queuing Sytems, Electromagnetic Waves, Communications Systems , Foundation of VLSI CAD
Computer Science	Computer Programming and Utilization, Advanced Computer Architecture
Data Science	Programming for Data Science, Introduction to Machine Learning, Image Processing

Extra Curricular Activities

2020-2021
- Completed **80+ hours** of volunteering service in the **Green Campus** department of **NSS, IIT Bombay**

2022
- Tracked the **ISS** and received **SSTV** images during the **ARISS event**

2018
- Secured **1st place** in the **National Round** of the **Microsoft Office Specialist Championship**

2016
- Placed **First** in the School Science Fair for generating alternating current from wave energy
- Participated in the **Indian International Model United Nations** and the **Billabong High Model United Nations**, receiving the **High Commendation** award in the latter