Swadhin Dash | **210020142**
Electrical Engineering | **B.Tech.**
Indian Institute of Technology Bombay | **Gender: Male**
DOB: 24/07/2003

Examination	University	Institute	Year	CPI / %
Graduation	IIT Bombay	IIT Bombay	2025	
Intermediate	CBSE	DAV Public School, Vasant Kunj	2021	96.40%
Matriculation	CBSE	DAV Public School, Vasant Kunj	2019	97.00%

Pursuing a **Minor** degree in **Machine Learning and Data Science** from **C-MInDS, IIT Bombay**

Scholastic and Technical Achievements

- Currently ranked **9th** in the Department of Electrical Engineering among **200+** second year students *(2023)*
- Achieved a perfect **AA** grade across **14** sophomore and freshman year courses for stellar academic performance *(2023)*
- **World Champions** in **ICUAS UAV-Challenge'23** - simulation stage and ranked **3rd** in live trials held at **Warsaw** *(2023)*
- Awarded **Branch Change** to Electrical Engg (**15 out of 1400+** freshmen) for excellent academic performance *(2022)*
- **Globally ranked 481** out of **8000+** teams, highest in the college, in picoCTF - CMU Cybersecurity Competition *(2022)*
- Secured a rank in top **0.8 percent** in IIT-JEE Advanced 2021 amongst **0.25 million** qualified candidates *(2021)*
- Attained a percentile of **99.89** in JEE-Mains, outperforming over **1 million** registered candidates nationwide *(2021)*
- Obtained a **perfect 100** percentile in **Physics** in the **JEE-Mains** Entrance Examination *(2021)*

Research Project

Autonomous Motion Planning For Unmanned Aerial Vehicles | *Unmesh Mashruwala Innovation Cell, IITB*

Guide: Prof. Dhwanil Shukla, Dept. of Aerospace Engineering - IIT Bombay *(Nov '22 - Present)*

- Senior **Path Planning Engineer** conducting research on state-of-the-art **aerial autonomy** planning algorithms
- Studied and implemented various motion planning algorithms like **A***, **RRT***, **APF** and **Receding Horizon**
- Utilized **Heuristic A*** search for **Guided Navigation Control** of UAVs using **MAVROS** for low-level control in **Gazebo**.
- Deployed **Minimum Snap Trajectories** for quadrotors using jointly time-optimized polynomial segments for agile flight
- Reviewed dynamic motion planning papers like **EGO Planner, TGK Planner, Bubble Planner and CHOMP**
- Implemented **Real-time Avoidance** using **EGO Planner** in simulation and tested on quadcopters in indoor environment

Key Projects

UAV Challenge 2023 | *International Conference on Unmanned Aircraft Systems'23, Poland* *(Feb '23 - June '23)*

International UAV competition organized by LARICS encompassing autonomous exploration, detecting defects, and estimating pose.

- Declared **World Champions** of the Simulation Stage and **2nd-Runners Up** in the Live-Trials held in **Poland**
- Ranked **Third out of 39 teams** in the **Realtime Exploration** benchmark of the arena in the Hardware Stage
- Integrated the **sensor** and **pose estimation** module with a time-optimized **ESDF-free gradient-based** local planning module
- Experimented and customized **10k+ lines** of open-source **EGO-Planner code-base** to accomplish the problem objective
- Incorporated **waypoint memorization, perturbation**, **dynamic obstacle inflation** into **FSM** for **local minima** deadlocks
- Improved **yaw control** with custom **PID control** law tuned for optimal flight behaviour during **crack exploration**
- **Fine-tuned** the exploration and avoidance pipelines using **VICON** Motion Capture and **Intel D435i** for optimal flight

Design of Computing Systems

Course Project | Microprocessors and Digital Circuits *(May '23)*

- Designed **flowcharts, control logic and datapath** for computing systems with their respective **ISA's** provided
- Implemented a **multi-cycle processor**, **IITB-CPU** for a **16-bit** computer system, incorporating **8 registers** and **point-to-point communication** infrastructure utilizing **VHDL**'s capabilities to model the hardware components
- Developed a **16-bit 6-staged pipelined microprocessor**, **IITB-RISC-23** based on the Little Computer Architecture
- Optimized the pipeline for performance using hazard mitigation techniques like **data forwarding** and **branch prediction**
- Developed a scaled-down version of the **Intel 8085** microprocessor, **Mini-8085**, utilizing the **hardware flow chart** method and a **microcode-based** architecture with a **control store** (CS) for storing encoded control signals.

Data Structures and Algorithms

Reading Project | Summer of Science | Maths and Physics Club, IIT Bombay *(May '22 - July '22)*

- Undertook a detailed study on the basics of various Data Structures like Stack, Queue, **Binary Trees**, **Linked Lists**
- Gained insights into Divide and Conquer, Recursive, Greedy, Hashing Algorithms, **Backtracking, Dynamic Programming**
- Surveyed the rich pool of texts on various **Sorting algorithms** like **Wave Sort, Heap Sort, Quick Sort, Bucket Sort**

Application Exploration in Signal Processing

Guide: Prof. Vikram Gadre | Course Project | Signal Processing *(Aug '22 - Nov '22)*

- Explored practical applications in Signal Processing by reviewing articles from **IEEE Signal Processing Magazine**
- Analyzed the properties of music such as pitch, note, timbre, and tempo using **Short Time Fourier Transform** (STFT)
- Used ***librosa*** for frequency analysis of songs and gained insights into beats through novelty function from the **spectogram** image
- Applied signal processing concepts to draw **Mystery Curves** - a linear combination of harmonic signals in **MATLAB**

Digital Logic Design in VHDL

Guide: Prof. Maryam Baghini | Course Project | Digital Circuits Lab *(July '22 - Nov '22)*

- Created a String Detector using a **Mealy type FSM** which detects required sub-sequences in the input sequence of letters
- Designed a **Moore** type **Finite State Machine** (FSM) which acts as a **6-bit sequence generator** in VHDL
- Created an **Arithmetic Logic Unit** (ALU) capable of Adding, Subtracting, Comparing, and Multiplying two binary numbers
- Implemented the logic using **Intel Quartus**, deployed and tested in **Xenon-10 FPGA** board using Scanchain evaluation

Assembly & Embedded C - Embedded Systems with Intel 8051

Guide: Prof. Saravanan Vijayakumaran | Course Project | Microprocessors Lab *(Jan '23 - Apr '23)*

- Programmed **Intel 8051** based **Pt-51** micro-controller using **Assembly** and **Embedded C** to develop Embedded systems
- Implemented **keyboard interfacing**, LCD Display and used **timers** and **external interrupts** for stopwatch and musical notes
- Used serial port interface **(SPI)** to interface an **analog-to-digital converter** (ADC) **MCP3008** with the 8051 micro-controller
- Established **serial communication** using a **USB-UART** module and successfully executed a **Lab Management System**

Reinforcement Learning

WiDS & FinSearch | Analytics Club, IIT Bombay | Finance Club, IIT Bombay *(Dec '22 - Jan '23, *Ongoing)*

- Implemented and analysed the performance of **Bandit Algorithms** such as ϵ **- Greedy, Thompson Sampling** and **UCB-1**
- Learnt standard RL algorithms like **Value and Policy Iteration, Linear Programming, Monte Carlo Control, Q-Learning, SARSA** and **Expected-SARSA** and solved maze modeled as **MDP** and the **mountain car problem**
- *Developing and fine-tuning a self-learning **trading agent** using **Deep Q-Learning** to maximize investment returns, with comprehensive **NIFTY-50** stock data **pre-processing** and a well-designed **state function** representing market conditions

Other Projects

- **CyberSecurity** : Learnt Linux Commands, **Bash Scripting**, **pwntools** exploit development Python library for binary exploitation and took part in various CTFs like Pico CTF, Angstrom CTF, **Google CTF** with CSeC Club, IIT Bombay
- **XLR8** : Built a wifi-controlled differential drive robot using **ESP-8266** wifi-microchip, **L293D** motor driver, developed the code in **Arduino IDE** and controlled it from the phone using a website hosted on the local Wi-Fi
- **TicTacToe** : Developed a turn-based game with AI using the **MiniMax algorithm** and **alpha-beta pruning** in **p5.js** JavaScript Library and designed a **graphic** and **interactive** gameplay, allowing users to play against the computer.
- **Voting System** : Developed a robust smart contract-based voting system in **Solidity** on **Remix IDE**, enabling transparent and secure casting of votes, automatic vote counting, and appointment of Election Committee members.

Positions of Responsibility

Teaching Assistant

Department of Computer Science and Engineering | Department of Mathematics *(Spring '23)*

- Guided over **30+ students** in **CS101 - Computer Programming and Utilization** labs in C programming and algorithms
- Mentored a batch of **40+ students** in **MA108 - Differential Equations** and conducted **Tutorial Problem** solving sessions

Coordinator

Team Aerove | Innovation Cell, IIT Bombay *(Apr '23 - Present)*

- Member of the team in charge of **planning, organizing and publicizing** events under the Innovation Cell
- Coordinated a budget proposal of **1.5 million INR** and a timeline of technical tasks and research goals of the subsystem
- Conducted the team **recruitment drive** and took interviews to shortlist **14** students from a pool of **100+** UGs
- Mentored recruits for an extensive month-long project on design, **motion planning**, controls and perception

Technical Skills

Programming	C++, C, Python, JavaScript, Assembly, Solidity, VHDL, HTML, CSS, SQL, Bash
Software and Tools	Quartus, Keil, NGSpice, Arduino, ROS, Gazebo, Git, Ghidra, LaTeX, Ganache, OpenCV
Libraries	Numpy, Pandas, Matplotlib, Rospy, Roscpp, Ethers, Scipy, Pygame, PointCloud, Keras

Key Courses Undertaken

Core	Microprocessors, Control Systems, Power Engineering, Electronic Devices and Circuits, Digital Systems, Analog Circuits, Signal Processing, Communication Systems*, EM Waves*
Maths & CS	Probability & Random Processes, Linear Algebra, Complex Analysis, Multi-variable Calculus, Differential Equations, Computer Programming and Utilization, Introduction to ML
Miscellaneous	Economics, Biology, Basics of Electricity and Magnetism, Quantum Physics, Engineering Drawing

** To be completed by November, 2023*

Accolades & Extracurriculars

- **Delhi State Winner** of the Smart Vocab Challenger, 2017 in Senior Division out of students of **500+ schools**
- **Coordinated on-ground hospitality** of fest participants through digitalization and queue time reduction in **Mood-Indigo'22**
- Successfully completed one year of training in **NSO Badminton** under Mr. Shelendra Rasaniya in the freshman year
- Awarded **Certificate of Merit** for successful completion of **LaTeX BootCamp** under Learners' Space'22 organised by WnCC
- Participated in **CodeWars v1 : Virus Wars**, a bot-programming contest organized by Web and Coding Club, IIT Bombay
- Successfully built a glider in a **Glider Making Workshop** conducted by the Aeromodelling Club, IIT Bombay