# Mitali Meratwal

Curriculum Vitae

## Education

- **Indian Institute of Technology Bombay** *(2019-(Expected) 2023)*
  *Bachelor of Technology with Honours, Electrical Engineering* *Major CPI:* ***9.56/10***
  *Pursuing a minor in Computer Science* *Minor CPI:* ***9.67/10***

## Publications

- **Multi-camera and multi-person indoor activity recognition for continuous health monitoring using long short term memory** [Paper]
  Mitali Meratwal, Nicolai Spicher, Thomas Deserno *(Published in SPIE Medical Imaging 2022)*

## Scholastic Achievements

- Secured **All India Rank 116** in *JEE Mains* emerging as **City Topper** and **State Girls' Topper** *(2019)*
- Secured **All India Rank 789** in *JEE Advanced* competing against 225 thousand candidates *(2019)*
- Recipient of **KVPY** fellowship awarded to top **1%** by IISc and Government of India *(2019)*

## Internships

### Intelligent Attribution *(May'22 - June'22)*

*Company: Microsoft India | Software Engineering Intern* *Hyderabad, India*

- Worked with the **Digital Security and Resilience** team on intelligent insights from millions of data records
- Designed and implemented a **scoring heuristic** to identify the best resource owner based on dynamic features
- Improved attribution significantly, enforcing **effective remediation** and judicious distribution among owners
- Deployed on **Azure Functions** and created a **PowerBI** dashboard for graphical analysis and comparison
- Received an offer to join full-time after graduation from the company for performance during internship

### Special Discounts *(Dec'22)*

*Company: Fraazo | Tech Intern*
*A D2C delivery startup for fresh farm produce serving 200k households daily* *Mumbai, India*

- Worked as **backend** engineer to develop internal **APIs** using Ruby on Rails and Active Record Query Interface
- Redesigned APIs for management of special discounts by admin users and reduced query time by tenfold
- Improved **efficiency** and **reduced data leakage** in payload of many APIs

### Action Recognition in Smart Homes *(May'21 - Aug'21)*

*Prof. Thomas M. Deserno | Research Internship* *TU Braunschweig, Germany*

- Developed video analysis framework for **multi-camera**, **multi-person activity recognition** in smart homes
- Tested performance of existing work on enhanced **pose estimators** like OpenPose, AlphaPose, LightTrack
- Designed multi-layer **LSTMs** with **attention** block for **temporal modelling** and CNN for spatial dynamics
- Upgraded person tracking with **YOLOv4+Deepsort** to support re-identification and handle occlusions
- Expanded dataset to **300GB** and improved recall on realistic and simulated fall datasets from **79%** to **99%**

## Research and Technical Projects

### Multi-Process Service and FaaS GPU *(Aug'22-Present)*

*Prof. Purushottam Kulkarni and Prof. Umesh Bellur | R&D Project* *CS Dept., IIT Bombay*

- Benchmarked **interference effects** of NVIDIAs MPS on colocation of multiple processes on modern GPUs
- Analysed impact on **GPU performance** with different mixes of workloads and GPU **core restrictions**
- Autogenerated **function variants** across multiple axes and built use case for schedulers in FaaS platforms

### Speech-text alignment *(Aug'22-Present)*

*Prof. Preeti Rao | Bachelor Thesis Project* *EE Dept., IIT Bombay*

- Critically evaluated performance of different stages of Vakyansh **audio processing** toolkit for news broadcasts
- Identified systematic errors and tested on improved **voice activity detection** in presence of background music
- Implemented speech segment to **text alignment** using **string similarity score** in moving ngram windows

### Automatic Speech Recognition *(Jan'22 - April'22)*

*Prof. Preethi Jyothi | CS753 Course Project* *CS Dept., IIT Bombay*

- Performed **main speaker identification** and **localization** using an audio-visual transformer approach
- Fine-tuned Coqui speech to text models pretrained on English to build **Marathi** and **Kannada** ASR systems using extremely low resource **multilingual data** while minimizing word error rates
- Designed **word prediction** and **sentence creation** models using trigram **language model** and **FSTs**

### Low-Light Image Enhancement *(Aug'21 - Nov'21)*

*Prof. Amit Sethi | EE610 Course Project* *EE Dept., IIT Bombay*

- Implemented different methods based on **retinex theory** and **dual-tree complex wavelet transform**, and **illumination map estimation** to enhance visibility of images captured under low light conditions
- Compared the performance against patch-wise, central pixel value predicting CNN model

### Self Driving Car *(Sept'20 - July'21)*

*Autonomous Vehicles, Computer Vision Subsystem | Team SeDriCa, UMIC* *IIT Bombay*

*SeDriCa is a 22 membered student team working to build India's first self-driving car with level 5 autonomy*

- Developed a **Multi-Task Learning** model using uncertainty to weigh losses for **object detection** and **road segmentation** on BDD100K dataset by fusing **Scaled-YOLOv4** and **PSPNet** to reduce computation cost
- Designed and tested **cross connected network** from Faster R-CNN and PSPNet with ResNet50 backbone
- Scrutinized **Hierarchical Multi-scale attention**, **EfficientDet**, **D-LinkNet** to replace existing models

### Multi-Modal Image Registration using Unsupervised Deep Learning *(Jan'21 - April'21)*

*Prof. Suyash Awate | CS736 Course Project* *CS Dept., IIT Bombay*

- Customised **Voxelmorph** to register **cross subject brain scans** of different modalities (MRI and CT)
- Trained **CycleGAN** network to register CT scan images with their MRI counterparts on the same dataset

### Bosch's Traffic Sign Recognition Challenge *(March'21)*

*Inter IIT Tech Meet* *IIT Guwahati*

*Part of 10-member team that won **Bronze** out of **23 teams** which participated*

- Generated **layer wise visualisations** of the model trained by user and embeddings of dataset using **t-SNE**
- Implemented **GradCAM++** and **Lime** to enable the user to investigate incorrect predictions and devised automated scripts for explaining **failures of system** based on confusion matrix, loss and accuracy plots

### Image Super Resolution *(Dec'20)*

*Prof. Amit Sethi | Course Project* *CMInDs Dept., IIT Bombay*

- Implemented **SRGAN** to estimate high resolution images from low resolution with an aim to recover content
- Formulated a VGG based **content loss** using output features of VGG19 model pretrained on ImageNet

### The Tracking and Navigation Challenge *(Aug'20)*

*Autumn of Automation | UMIC* *IIT Bombay*

- Programmed a bot with **ROS** to solve perfect maze while avoiding obstacles using **wall follower** algorithm
- Exploited **OpenCV** and **Canny edge detection** for procuring letters present on the walls of the room
- Performed letter recognition utilizing **transfer learning** and **fine tuning** achieving best accuracy of **93%**

**Fruit Quality Predictor** *(May'20-Jul'20)*

*Institute Technical Summer Project* *IIT Bombay*

- Built a **real time** application for non-invasive **quality assessment** of fruits by leveraging smartphone cameras
- Constructed a custom dataset and employed various **data augmentation** techniques to make the model robust
- Trained custom and SOTA models achieving best accuracy of 99%, 95% and 90% for banana, mango and pear

## Other Projects

**Low Cost POF Link Communication** | *Electronic Design Lab* *(April'22)*

- Built and tested **Polymer Optical Fibre** communication link for digital transmission up to 10 MHz by designing a **PRBS transmitter** with P-I-N photodiode and **trans-impedance amplifier** based receiver

**IITB-RISC** | *EE739 Course Project* *(April'22)*

- Designed and coded a 16-bit, 8-register, 6 stage pipelined processor computer system, IITB-RISC, using VHDL
- Optimized for performance and maximized CPI by including hazard mitigation and branch prediction techniques
- Proposed a design for a 2-way fetch superscalar processor with mitigation and branch prediction techniques

**Temperature Monitor** | *Microprocessors Lab* *(March'21)*

- Interfaced **LM35** temperature sensor using **ADC MCP3008** and displayed it on LCD using **embedded C**
- Played alarm while blinking LEDs at certain frequency if the average temperature falls or rises outside the range

**Front-End Web Development** | *Learner's Space IIT Bombay* *(July'20)*

- Designed and built a responsive personal homepage using **HTML5, CSS** and **JavaScript** in the boot camp

## Positions of Responsibility

**Department Academic Mentor** *(July'21 - Present)*

*Department Academic Mentorship Program* | *Dept. of Electrical Engineering* *IIT Bombay*

- **Heading** the web subgroup of EE-DAMP, in charge of migrating the WordPress website to **GitHub pages**
- Mentoring Academic Rehabilitation Program student, assisting in planning out exit degree options and completion of the course credits while matching their pace of study
- Guided **4 sophomores** in their academic and co-curricular pursuits by leveraging the resources of the institute

## Technical Skills

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|---|---|
| **Languages** | C/C++, Python, KQL, PowerShell, Ruby, VHDL, MATLAB, Julia |
| **Libraries** | PyTorch, Keras, Tensorflow, OpenCV, Numpy/SciPy, Matplotlib, Seaborn, Pandas |
| **Softwares** | Git, Quartus, Keil, LaTeX, AutoCAD, SolidWorks, Audacity |
| **Development** | HTML, CSS, JavaScript |

## Key Courses

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|---|---|
| **Computer Science** | Data Structures And Algorithms, Computer Networks, Operating Systems, Medical Image Computing, Foundations of Intelligent and Learning Agents, Automatic Speech Recognition, Computer Graphics*, Foundations of Network Security and Cryptography*, Convolutional Neural Networks for Visual Recognition by Stanford University† |
| **Electrical Engineering** | Signal Processing, Digital Systems, Microprocessors, Control Systems, Probability and Random Processes, Speech Processing* |
| **Mathematics** | Calculus, Linear Algebra, Differential Equations, Complex Analysis |

* *courses will be completed by Dec'22*

† *online course*

## Extracurricular Activities

- Volunteered for community service under National Service Scheme by recording audio books for visually impaired
- Coordinated the execution of **FInCoF** Freelancers, Interns and Co-founders Platform getting 120+ startups on board and assisted in securing 90+ internships for the students during Covid-19 *(June'20)*
- One among ten students selected for **Science Film Making Workshop** organised by the Vigyan Prasar *Department of Science of Technology*, Govt. of India and *Film society of Surat, Gujarat* *(Oct'2016)*
- Completed a DSLR workshop and served as a member of Delhi Public School Surat Photography Club *(2016)*
- Successfully completed **8 Level Graduate Course** of **IMA** (Intelligent Mental–Arithmetic ABACUS) *(2010)*