Hirali Sangani

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EDUCATION

University of Mumbai - SVKM's Dwarkadas J. Sanghvi College of Engineering August 2022 - May 2026

Bachelor of Technology - Computer Engineering with Honors in Intelligent Computing   *Current GPA: 9.68/10.0*

EXPERIENCE

Research Intern | **Lithuanian Research Council, Vilnius University**   *June 2025 – Present*
- Designed a physics-aware representation learning pipeline for Polychromatic Polarization Microscopy (PPM) to address the collapse of angular collagen signals in supervised encoders.
- Integrated SimCLR embeddings with local orientation histograms, successfully preserving rotational fiber structure during UMAP clustering. Recovered 7 distinct, subtype-aligned collagen micro-architectures without labels.

Research Collaborator | **MedVisAI Lab, Nanyang Technological University**   *April 2025 – Present*
- Built a reproducible experiment engine to benchmark CNN vs. Transformer architectures under site and modality shift across Ultrasound, MRI, echo-cardiography, endoscopy, ophthalmology and MRI datasets.
- Analyzed model collapse modes by quantification of visual features. Developed a modality-aware selection heuristic, enabling radiologists to select architectures strictly aligned with acquisition characteristics.

Research Collaborator | **NCBS–Monash University–NIMHANS Consortium**   *April 2025 – Present*
- Developing Fader Networks with gradient reversal to disentangle light exposure perturbations from intrinsic physiological phase in circadian data.
- Formulating nonlinear limit-cycle oscillator models to mathematically simulate phase shifts induced by variable light intensities, advancing structure-preserving representation learning.

Research Collaborator | **Diabetic Foot Clinic, Singapore**   *April 2025 – July 2025*
- Developed an infrared-thermogram–based detection pipeline that segments and highlights vascular heat-pattern anomalies in diabetic feet using U-Net–derived architectures, enabling early identification of ischemic risk regions.
- Applied unsupervised clustering on vascular feature embeddings to stratify patients into distinct risk cohorts, supporting data-driven clinical follow-up and personalized intervention plans

Research Intern | **National Centre for Biological Sciences**   *September 2024 – August 2025*
- Implemented a Variational Deep Embedding (VaDE) with a circular latent prior and hierarchical mixtures; stabilized training via KL annealing.
- Validated temporal structure using Rayleigh periodicity statistics, successfully recovering biologically coherent cell states even under sparse sampling.

GenAI Intern | **Ernst & Young**   *June 2024 – August 2024*
- Built a conversational chatbot using LangChain, enhancing vocabulary and dialogue management.
- Improved chatbot accuracy from 83% to 91% by fine-tuning a BERT model to incorporate customer feedback on financial data. Developed the model to provide more accurate and reliable responses in financial contexts.
- Integrated generative AI in Excel to automate data analysis and visualisation, boosting efficiency by 20%, enabling quicker and more informed strategic business decision-making.

PUBLICATIONS AND PREPRINTS

Deep Learning Architectures for Off-Target Sequence Prediction and its Likelihood   *Code Repository*
Submitted to International Journal of Medical Informatics
- Designed CRISPR-DWA and CRISPR-PROB, novel frameworks utilizing dynamic windowing and multi-headed attention. Achieved F1 score of 0.984 in predicting off-target editing events in CRISPR-Cas9 systems.

AI-Enhanced Thermal Imaging for Peripheral Arterial Disease Detection in Diabetic Foot Screening
Presented at: Singapore Health and Biomedical Congress (SHBC), 2025
- Presented the U-Net based vascular segmentation pipeline and unsupervised patient stratification framework.

Circadian Phase Inference using Deep Embedding in Circular Latent Spaces
Presented at: Unifying Theories in High-Dimensional Biophysics
- Poster Presentation: Presented the VaDE framework with circular latent priors, demonstrating the impact of topological constraints on manifold learning for periodic biological signals.

Recovering Collagen Micro-Architectures via Physics-Aware Embeddings
LMT Student Research Forum
- Oral Presentation: Presented the contrastive learning pipeline (SimCLR with Orientation Histograms) for Polychromatic Polarization Microscopy, highlighting the recovery of subtype-aligned signatures without labels.

ACADEMIC PROJECTS

MammoAssist-X | *Python, Pytorch* *September 2025*
- Developed MammoAssist-X, a multimodal clinical decision-support system integrating TransUNet-based ultrasound segmentation with EHR-driven cross-modal attention for malignancy-risk triage.
- Implemented interpretable AI pipelines using Grad-CAM and SHAP to provide clinician-facing rationale and automated structured report generation for Routine/Review/Refer triage.

Multicellular Motility Model | *Python, NetLogo* Physics of Life, NCBS, India *July 2024*
- Developed an agent-based model in NetLogo, incorporating diffusion dynamics and stochastic movement rules, to simulate nutrient acquisition and survival of multicellular aggregates, identifying critical thresholds for motility.
- Identified a critical aggregate radius of 4.48 units (translated from simulation units), beyond which active foraging becomes essential for survival due to limitations in nutrient diffusion under standard nutrient diffusion rates.
- Analyzed the relationship between aggregate size, minimum required velocity, and resource availability, contributing to a better understanding of the ecological pressures driving the evolution of motility in early multicellular life.

Multimodal Emotion-Adaptive Music Recommender | *Python, Pytorch* *January 2025*
- Developed a deep learning pipeline integrating EEG data and facial recognition to accurately classify user emotions in real-time.
- Implemented emotion-based music recommendation algorithm utilizing content-based filtering and collaborative filtering with preliminary results indicating significant potential for enhancing user music enjoyment.
- Currently optimizing model performance and refining the recommendation engine to enhance user experience and maximize the accuracy of emotion-based music selection.

TeleWatch | *ReactJS, Flask, Numpy, Pandas* IEEE CS Hackathon, SPIT *March 2024*
- Developed a machine learning pipeline employing XGBoost, K-means clustering, and sentiment analysis to predict customer churn with specificity of 90% and identify key drivers.
- Designed and implemented a real-time anomaly detection system, utilising PCA for dimensionality reduction, that triggers proactive interventions and personalized offers to mitigate churn risk.
- Enhanced model explainability using SHAP (SHapley Additive exPlanations), enabling insights into churn drivers,reducing attrition by 15% and facilitating trust in AI-driven recommendations.

CO-CURRICULARS

DJS Antariksh | *Coding Team Member* *June 2023 - July 2025*
- Developing a rover for autonomous navigation, implementing path planning and obstacle avoidance using ROS, Python, and stereo camera-based perception, enabling the rover to traverse varied environments.
- Worked on building the website for the team and GUI for the rover, utilizing React to create a dynamic interface connected to ROS for real-time camera feed, handling multiple data streams and rover functionalities.
- Gained practical experience programming and interfacing with various microcontrollers, including Arduino and Teensy 3.5, for rover sensor integration and motor control across multiple rover subsystems.

Machine Learning Mentor, Synapse Committee, DJCSE | *Apprenticeship* *July 2024 - July 2025*
- Led a machine learning workshop for college students covering supervised learning, deep learning architectures (Transformers, CNNs), and their applications.
- Provided individual mentorship to 10 students, providing foundational knowledge in core machine learning, deep learning, and artificial intelligence concepts.
- Mentored and guided students in developing research proposals and conducting independent research projects in machine learning.

Machine Learning Developer, Synapse Committee, DJCSE | *Apprenticeship* *September 2023 - July 2024*
- Learnt and implemented different machine learning algorithms, gaining experience with essential libraries, further solidifying my understanding through the development of a research paper on off-target gene sequence prediction.
- Developed proficiency in Natural Language Processing (NLP) techniques, completing projects on chatbot development, text summarization, and machine translation.
- Developed a system to scrape YouTube thumbnails, generate textual descriptions using a text-to-image model, and perform sentiment analysis to gauge video sentiment and potential viewer engagement.

ACHIEVEMENTS

2nd Runner-up in International Rover Challenge	IRC - 2025
1st Runner-up in International Space Drone Challenge	ISDC - 2025
Winner at Innovize (AI/ML Domain) organized by digital.VJTI	February - 2024