Tushar Nayak

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Education

Carnegie Mellon University　　　　　　　　　　　　　　　　　　　　　　　　　Pittsburgh, USA
Master of Science – Biomedical Engineering (Research, Computational Track)　　　　　　　May 2026
Select Coursework: Computer Vision (RI), Visual Learning & Recognition, Image-Based Computational Modelling & Analysis, Visual Learning for 3D Vision, and Clinical Translations of AI.

Manipal Institute of Technology　　　　　　　　　　　　　　　　　　　　　　Manipal, India
Bachelor of Technology – Biomedical Engineering, Minor in Data Science　　　　　　　　May 2023
Select Courses: Pattern Recognition, Digital Image Processing, Digital Signal Processing, Signals & Systems, Regression Models, Statistical Inference, Machine Learning, and R Programming.

Skills

Deep Learning: Convolution Neural Networks, Neural Ordinary Differential Equations, Attention Mechanisms & Transformer models, Physics-informed Neural Networks, Recurrent Neural Networks & Long-Short Term Memory, Encoder-Decoder, Explainable AI.
Computer Vision: Feature detection, Feature description, Geometric Computer Vision, Camera Geometry, 3D Reconstruction, Stereovision, Motion Analysis and Optical Flow, Photometric Stereovision
Image Processing: Image filtering, Feature enhancement, Feature extraction, Object detection, Texture analysis, Morphological analysis, Image Compression & Color processing.
3D Vision: Surface mesh manipulation, deformable models, registration, deformable registration, volume rendering & alignment.
Pattern Recognition: Support Vector Machines, Random Forests, Decision Trees, Clustering, Principal Component & Time-Series Analysis.
Biomedical Engineering: Medical Image Analysis, Image-guided computer-aided surgical systems, Tumor Detection-Classification-Evolution Modelling, Pathological Data Processing, Biomedical Signal Processing, Neuro-imaging analysis: SPM, FSL, ITK-SNAP

Research Projects

Carnegie Mellon University (Master's Degree Research under Dr. Kenji Shimada)　　　Pittsburgh, PA
Image Guided Surgical Platform: Tele-Operated Endovascular Robotic Surgical Platform　August 2024 - present
▪ Generated a mesh dataset using CTAs, with automated multi-branch centerline deformation without known control points.
▪ Estimating deformation based on guidewire movement using physics-informed neural networks and registering deformation to preop volume.
▪ Conducted an extensive review of the vision subsystems of existing literature, sent for and awaiting publication.

Manipal Institute of Technology (Bachelor's Degree Research under Dr. Niranjana Sampathila)　　Manipal, India
"Visualizable Multi-Stage Multi-Modal Detection of Oral Squamous Cell Carcinoma"　January 2022 - May 2023
▪ Modelled a performant yet computationally efficient ConvNet utilizing transfer learning for detection from lesion images & OCT images.
▪ Designed an ensemble neural network that combined three transfer learning based CNNs with self-attention for global feature mapping and regularization techniques for high precision and accuracy for the histology images with class activation maps for enhanced interpretability by clinicians.
▪ Removed training biases due to staining inconsistencies by normalizing the colors of the histology dataset to a reference color LUT.
▪ Achieved accuracies of 0.98/0.91/0.97 and F1 scores of 0.99/0.91/0.97 for detecting cancer across 3 modalities. Manuscript for publication underway.

Research Experience

Carnegie Mellon University　　　　　　　　　　　　　　　　　　　　　　　Pittsburgh, PA
Research Assistant, Neural ODE based Spatiotemporal Glioblastoma Tumor Evolution Prediction　Jan 2025 - present
▪ Developed a neural ordinary differential equation-based model to generate visual production of tumor growth with FLAIR, CT1, T1 & T2.
▪ Augmented the Neural ODE with U-Net and attention-gated convolutional blocks encoder-decoder structure.
▪ Visually predict a future timepoint, allowing for enhanced surgery planning. Working under the guidance of Dr. Pulkit G & Dr. Aswin S.

Worcester Polytechnic Institute　　　　　　　　　　　　　　　　　　　　　　　　Remote
Summer Project Intern, Virtual Immersion in Biomedical Engineering Program　　　　　May 2024 – July 2024
Designed a proof of concept cost effective solution to detect malaria with biomarkers from body fluids using LSPR & a deep neural network.

Indian Council of Medical Research　　　　　　　　　　　　　　　　　　　　　　Remote
Research Intern, Ultrasound-based Fetal Anomaly Detection　　　　　　　　　April 2024 – July 2024
▪ Co-developed a pipeline for automated identification of fetal position as a precursor for the anomaly detection system.
▪ Began elementary work for a feature engineering pipeline for the anomaly detection system, departed due to grad school.

Indian Institute of Technology, Hyderabad　　　　　　　　　　　　　　　　Hyderabad, India
Project Research Associate, Structure Dataset & Neuro-mechanical Dataset creation　　Aug 2023 – May 2024
▪ Created a fully annotated key point dataset of heritage structures, giving archeological insights into heritage sites.
▪ Assisted with the creation of a tri-modal yoga/exercise/atomic-activity dataset including motion capture, video and EMG.

Manipal Institute of Technology　　　　　　　　　　　　　　　　　　　　　Manipal, India
Deep Learning-based Histopathological Lung Cancer Detection & Subtype Classification　Jan 2023 - present
▪ Carried out alongside my oral cancer work, this work also includes incorporating attention mechanisms with CNNs
▪ Coupled EfficientNet-based CNN with spatial attention & convolutional block attention modules
▪ Pre-processed the dataset with contrast limited histogram equalization and normalization for removing staining biases.

Research Assistant, Deep Learning-based Dengue Detection from Blood Smear Images　　Jan 2022- May 2023
▪ Optimization & regularization on convolutional neural networks with transfer learning with explainable AI visualizations.
▪ Training the models to detect the infection of dengue using features extracted from the lymphocyte. Work carried out under Dr. Niranjana S.
▪ Initially worked on monkeypox detection using skin lesion images with explainable AI before assisting *then* doctoral candidate Dr. Hilda M.

Projects

Project from Visual Learning & Recognition
Description goes here
Project from Learning for 3D Vision
Description goes here
Project of Image-Based Computational Modelling & Analysis
Description goes here

Teaching Assistance Experience

Carnegie Mellon University　　　　　　　　　　　　　　　　　　　　　　　Pittsburgh, PA
Teaching Assistant: Applied Deep Learning　　　　　　　　　　　　　　　　　　Spring 2025

▪ Sole TA across all campuses – handling logistics, evaluating assignments, supervising term projects & holding office hours and recitation lectures.
▪ Delivered a lecture about explainable AI using saliency maps/gradient class activation maps & image pre-processing for network training.

Teaching Assistant: Fundamentals of Computational Biomedical Engineering   Fall 2025
▪ Responsibilities included running office hours and doubt solving, creating homework rubrics - grading them and midterm exams.
▪ Assisting students to use MATLAB to solve linear systems of equations, model fit using least squares techniques (linear and nonlinear), interpolate data, perform numerical integration and differentiation, solve differential equations, and visualize data.

Course Assistant: Computer Vision for Engineers   Fall 2025
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Leadership

Open Horizon Robotics: *Mentor & Course Designer*   Apr 2024 - present
Designing a comprehensive series of open-source learning material in the domains of signal processing, image processing, pattern recognition, computer vision & deep learning (alongside material for the prerequisite math), mentoring and assisting student-led projects in the community.

Carnegie Mellon University *Student Ambassador for the Department of Biomedical Engineering*   Apr 2025- present
Representing the dept. to prospective students during the application-onboarding process and serving as a liaison between dept. & student body.

IEEE Engineering in Medicine & Biology Society – Student Chapter Manipal: *Chairperson & Head of Research*   Jun 2021 – May 2023
▪ Conducted workshops on Signal Processing, Image Processing, Deep Learning, Microcontroller & Linux basics events and organized workshop on electrical and electronic circuitry and simulation, interaction session for juniors with alumni and industry experts from Medtronic, Philips Research, Apple, Bosch, BlackRock Neurotech, DRDO
▪ Organized & executed a yearlong mentorship/learning program for juniors in electronics, programming, market analysis & signal processing.
▪ Mentored five junior students and collaborated with other senior members on research activities. Presented work at the National Symposium on Recent Trends in Biomedical Engineering (April 2023) and published in the Journal of Medical Engineering Volume 1.

IEEE Robotics & Automation Society – Student Chapter Manipal: *Webmaster & Head of IT*   Jan 2022 – Feb 2023
Completed work on a website & the blog, conducted a training programme on web development & design, sysadmin tools and Linux.

Awards
▪ Biomedical Engineering Department Head's Fellowship, Carnegie Mellon University   March 2024
▪ Best Paper – AI Track, Second International Conference on Artificial Intelligence, Computational Electronics & Communication   March 2023

Journal Publications
▪ **Tushar Nayak**, Nitila Gokulkrishnan, Krishnaraj Chadaga, Niranjana Sampathila, Hilda Mayrose, and Swathi KS. "Automated histopathological detection and classification of lung cancer with an image pre-processing pipeline and spatial attention with deep neural networks." *Cogent Engineering 11.1 (2024): 2357182.*
▪ **Tushar Nayak**, Krishnaraj Chadaga, Niranjana Sampathila, Hilda Mayrose, Nitila Gokulkrishnan, Srikanth Prabhu, Shashikiran Umakanth, et al. "Deep learning-based detection of monkeypox virus using skin lesion images." *Medicine in Novel Technology and Devices (2023): 100243*
▪ **Tushar Nayak**, Krishnaraj Chadaga, Niranjana Sampathila, Hilda Mayrose, G Muralidhar Bairy, Srikanth Prabhu, Swathi S Katta, and Shashikiran Umakanth. "Detection of Monkeypox from skin lesion images using deep learning networks and explainable artificial intelligence." *Applied Mathematics in Science and Engineering 31.1 (2023): 2225698.*
▪ Hilda Mayrose, Niranjana Sampathila, G Muralidhar Bairy, **Tushar Nayak**, Sushma Belurkar, and Kavitha Saravu. "An explainable artificial intelligence integrated system for automatic detection of dengue from images of blood smears using transfer learning." *IEEE Access (2024): 1-1.*

Conference Presentations
▪ **Tushar Nayak**, Niranjana Sampathila, and Nitila Gokulkrishnan. "Processing and Detection of Lung and Colon Cancer from Histopathological Images using Deep Residual Networks." *2023 IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT)(2023):1-6.*
▪ Nitila Gokulkrishnan, **Tushar Nayak**, & Niranjana Sampathila. "Deep Learning-Based Analysis of Blood Smear Images for Detection of Acute Lymphoblastic Leukemia." *2023 IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT)(2023):1-5.*
▪ Hilda Mayrose, Niranjana Sampathila, G Muralidhar Bairy, **Tushar Nayak**, Sushma Belurkar, and Kavitha Saravu. "Deep learning approach for detection of Dengue fever from the microscopic images of blood smear." *Journal of Physics: Conference Series 2571.1 (2023): 012005*
▪ **Tushar Nayak,** Niranjana Sampathila, Swathi KS, Krishnaraj Chadaga. "Deep Learning Based Diagnosis of Alzheimer's Disease Progression Using Brain MRI Images." *Presented at AICECS 2023*

Symposium & Forum Posters
▪ **Tushar Nayak**, Niranjana Sampathila, and Nitila Gokulkrishnan. "Processing and Detection of Lung and Colon Cancer from Histopathological Images using Deep Residual Networks." *2023 IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT)(2023):1-6.*
▪ Nitila Gokulkrishnan, **Tushar Nayak**, & Niranjana Sampathila. "Deep Learning-Based Analysis of Blood Smear Images for Detection of Acute Lymphoblastic Leukemia." *2023 IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT)(2023):1-5.*
▪ Hilda Mayrose, Niranjana Sampathila, G Muralidhar Bairy, **Tushar Nayak**, Sushma Belurkar, and Kavitha Saravu. "Deep learning approach for detection of Dengue fever from the microscopic images of blood smear." *Journal of Physics: Conference Series 2571.1 (2023): 012005*
▪ **Tushar Nayak** and Niranjana Sampathila. "Automated Oral Squamous Cell Carcinoma Detection from Histopathological Images Using Deep Neural Networks." Journal of Biomedical Engineering Society of India 17 (2023).
▪ Nitila Gokulkrishnan, **Tushar Nayak**, Niranjana Sampathila, Lavanya Dalmia, and Reva Laghate. "Binary Detection of Acute Lymphocytic Leukemia Using Blood Smear Images Using Deep Learning Models." Journal of Biomedical Engineering Society of India 17 (2023). Web.