Abhinav Gupta

Undergraduate Researcher at IIIT Hyderabad

Email | Website | GitHub | Scholars

Education

International Institute of Information Technology, Hyderabad — Aug 2017 - Present
Bachelor of Technology (Honors) in Computer Science and Engineering, GPA: 8.45 — *Hyderabad, India*

- Honors in Robot Vision and Perception, advised by Dr. K. Madhava Krishna
- Undergraduate Research Award, 2019-'20
- Dean's List Awardee (Spring 2020, Monsoon 2020)

Publications

- *DeepMPCVS: Deep Model Predictive Control for Visual Servoing* [Project Page]
  P Katara, Y V S Harish, H Pandya, **A Gupta***, A Sanchawala*, G Kumar, B Bhowmick and KM Krishna.
  4th Annual Conference on Robot Learning (CoRL), 2020, Cambridge, MA, USA

- *RTVS: A Lightweight Differentiable MPC Framework for Real-Time Visual Servoing* [Project Page]
  MN Qureshi*, P Katara*, **A Gupta***, H Pandya, Y V S Harish, A Sanchawala, G Kumar, B Bhowmick and KM Krishna. Under Review at the IEEE International Conference on Intelligent Robots and Systems (IROS), 2021
  **indicates equal contribution*

Patents

- *Systems and Methods For Generating Control Commands For Navigation By An Agent In An Environment*
  P Katara, Y V S Harish, H Pandya, **A Gupta**, A Sanchawala, G Kumar, B Bhowmick and KM Krishna.
  Filed by Tata Consultancy Services Limited

Research Experience

Robotics Research Center — May 2019 – Present
Research in Robotics and Vision, IIIT Hyderabad — *Hyderabad, India*

- Working with **Prof. Madhava Krishna** at the intersection of computer vision, deep learning and robotics, primarily in advancing vision-based robot control techniques.
- Formulated a novel model predictive control framework for visual servoing in six degrees of freedom, conducted extensive experimentation of our approach in Habitat simulation and trained an unsupervised network for flow estimation. **Our work was accepted and published in** CoRL '20.
- Proposed a novel and lightweight visual servoing technique for fast navigation which is 5 times faster than existing state-of-the-art approaches. Utilised an effective sampling strategy for optimal control generation, resulting in a 78% decrease in the servoing time. **Currently under review at** IROS '21.

Centre for Visual Information Technology — January 2020 – Present
Computer Vision Researcher, IIIT Hyderabad — *Hyderabad, India*

- Worked with **Prof. P J Narayanan** on the applications of vision and AI for society, inspired by efforts to battle the coronavirus. Implemented a real-time object detection system which can detect unhygienic face touches and warn the user when the hand reaches fairly close to one's face. Efficiently trained YOLOv3 using transfer learning, achieving a confidence score of 74%, and manually curated a dataset using data augmentation algorithms. [Link]
- Currently working with **Prof. Avinash Sharma** on neuromorphic vision algorithms and 3D human motion detection. Implemented an event trajectory generation system in ROS which sharpens and detects features from event-based data and simulates event streams from high fps conventional data. Trained a deep self-supervised convolutional network for estimating flow from asynchronous events. [Link]

Siemens Corporate Research — May 2020 – July 2020
Computer Vision Intern, Advanced Data Management Research Group — *Bangalore, India*

- Worked extensively in human pose estimation and action recognition in the 'digitalisation and automation' division at Siemens. Carried out an exhaustive qualitative and quantitative analysis of various state-of-the-art pose estimation networks for real-time applications.
- Reproduced results from the 'Quo-Vadis: Action Recognition' paper on custom datasets, and benchmarked such deep learning based approaches against pose-based approaches to action recognition.

Technical Skills

Languages: Python, C/C++, JavaScript, MATLAB, SQL, HTML/CSS, Elm/Racket, Golang, Bluespec
Machine Learning: TensorFlow, PyTorch, ROS, OpenCV, Caffe, keras, pandas
Frameworks and Tools: ReactJS, Node.js, Flask, Git, Docker, Linux, Bash, OpenGL, LaTeX

Academic Projects

3DMV: 3D Semantic Segmentation | *Computer Vision*

- Implemented the popular ECCV Paper "3DMV: 3D Semantic Segmentation", by combining 2D feature maps with 3D voxel data from the ScanNet dataset. Coded up the 2D and 3D deep networks to learn the semantics of the scene and obtained optimal results across the benchmark.

EKF-SLAM | *Mobile Robotics*

- Estimated the 2D pose and trajectory of a robot using sensor measurements from a wheel odometer and laser rangefinder, by applying an Extended Kalman Filter.

Stereo Reconstruction | *Robotic Vision*

- Generated a dense 3D point cloud reconstruction of a scene from stereo images by generating disparity maps for each stereo pair and implemented an iterative PnP algorithm to recover the pose.

Visual Odometry | *Robotic Vision*

- Implemented a monocular visual odometry algorithm from scratch, to recover the trajectory of the drone using a sequence of images and implemented the 8-point algorithm within a RANSAC scheme.

Face Classification | *Machine Learning*

- Trained various learning models on a dataset of real and animated face images by applying different feature transformations and quantitatively analysed the classification results.

Blue Skies: Interactive gaming | *Computer Graphics*

- Built a 2D arcade game and a 3D flight simulator game in OpenGL 3.0 using graphics concepts such as texture mappings, rasterisation and lighting, with support for multiple camera views for a great gameplay.

Metamorphose Compiler | *Compilers*

- Implemented a compiler and interpreter for a toy programming language, which supports basic mathematical operations and functions, performs lexical and semantic analysis and generates machine-understandable code.

Noughts and Crosses: AI Bot | *Artificial Intelligence*

- Built a bot for 3*3 Tic-Tac-Toe board, further divided into more 3*3 blocks using Minimax algorithm with alpha-beta pruning, using an optimal heuristic function.

Linux Shell | *Operating Systems*

- Implemented a Linux Bash shell, a command line interpreter in C. Supports numerous bash commands along with piping, redirection, foreground and background processing.

Other Experience

IIIT Hyderabad August 2019 – Present
Teaching Assistant *Hyderabad, India*

- Taught the principles of digital logic and the architecture of a processor to 300 students, as part of the Digital Logic and Processors course offered in Monsoon 2019
- Taught software engineering principles and coding techniques in Python and JavaScript, as part of the Design and Analysis of Software Systems course offered in Spring 2020
- Responsible for setting assignments and grading papers on various robot navigation algorithms, as part of the Robotics: Planning and Navigation course, Spring 2021.

The Virtual Labs August 2018 - December 2018
Software Engineering and Research Intern *Hyderabad, India*

- Developed full-fledged experiments and interactive artefacts for various data structures and algorithms at The Virtual Labs, a social initiative of the Government of India.
- Worked with Prof. Venkatesh Choppella and developed virtual experiments at the engineering and architecture division of the virtual labs.

Relevant Coursework

Artificial Intelligence: Computer Vision, Statistical Methods in AI, Mobile Robotics
Systems: Advanced Computer Networks, Operating Systems, Compilers
Algorithms: Data Structures, C Programming, Principles of Programming Languages
Mathematics: Probability and Statistics, Linear Algebra, Discrete Structures

Miscellaneous

- Served as President and Head of The Music Club at IIIT Hyderabad. Organised numerous events and activities and handled the finances of the club. A professional drummer and guitarist.
- Served as a writer and penned many articles for Ping!, the college newsletter of IIIT Hyderabad.
- Awarded the prestigious Khimji Ramdas Gold Medal for securing first position in grade 11.
- A proficient speaker and debater. Qualified as a Finalist at the Muscat Daily Listen Up! Inter-School Public Speaking Contest, 2014
- An avid freestyle swimmer. Represented my high school at the CBSE Oman Swimming Clusters, 2015
- Won the third position in Oman for the Bhavalaya National Photography Contest, 2015

Referrals

Prof. K. Madhava Krishna: Professor and Lab Head, Robotics Research Center, IIIT Hyderabad
Prof. P J Narayanan: Professor and Director, IIIT Hyderabad
Dr. Harit Pandya: Research Scientist, Toshiba Research Europe, Cambridge, UK
Prof. Avinash Sharma: Assistant Professor, Centre for Visual Information Technology, IIIT Hyderabad