Pranav Deo

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Outlook

Passionate about research in **Computer Vision**, **Deep Reinforcement learning** and deeply interested their applications in real-life **Autonomous Systems** and **Robotics**.

Education

Bachelor of Technology | Indian Institute of Technology, Bombay — Jul'17 - May'21
Department of Civil Engineering — GPA - **9.26**/10
Bachelor's degree in **Civil Engineering** and a **dual minor degree** in **Computer Science** and **AI and Data Science**

Professional Experience

Robotics Research Engineer, Honda R&D Japan | Deep Reinforcement Learning — Oct'21 - Present
Developing data-driven learning and control methods for in-house robots

- Benchmarked established online and offline algorithms for **dexterous in-hand manipulation** tasks in simulation
- Deployed hybrid learning algorithms on **real in-house robot** hand successfully to learn rolling and reorient tasks
- Utilized multi-modal sensor input to train and deploy enhanced learning algorithms in simulation and real robot
- Collected task demonstrations on real hand using manually designed controllers to compile expert dataset
- Engineered a **robust end-to-end solution** for 6D pose estimation of a marked object using a multi-camera system

Computer Vision Intern, Daikin Japan | Deep Learning — Jun'20
Worked under the theme of Advanced Digital Engineering Technique using AI technology

- Analyzed and benchmarked **12 real-time object detection** algorithms suitable for **edge devices** thoroughly
- Achieved **95%** test accuracy training SSD-MobileNetV2 on a **custom dataset** created using **web-scraped** images
- Created a **browser based interface** for serving the custom detection model using **Tensorflow.js** and JavaScript
- Accomplished **99.4% accuracy** in clustering input data by an **unsupervised algorithm** leveraging **transfer learning**

Software Engineer Intern, Tactopus | Computer Vision — Dec'18
Building multi-sensory, completely engaging learning experiences for toddlers

- Developed an integrated solution using Python for live processing of audio-augmenting print material
- Implemented a real time object detection system for tracking the tokens on playing arena using **OpenCV** library
- Modified the system to work on **live feeds** from **smartphone camera** with a native application for ease of use
- Integrated above system with **Unity3D** engine using serial connection to make a simulation reacting to live feed

Key Technical Projects

Mahindra RISE Driverless Car Challenge | Autonomous Vehicles — Jan'18 - Present
Prof. Amit Sethi
Currently one of the 11 finalists among 259 teams (prize money - **$ 1 million**)

- Part of the team SeDriCa - to develop **India's 1st self-driving car** targeting level 4 autonomy for Indian conditions
- **Stereo Vision:** Implemented object detection and distance estimation using pointcloud and corresponding images
- **Computer Vision:** Designing **multi-task network** for perception; **30%** efficiency increase expected in real-time
- **Localization:** Worked on the **SLAM** of the car using pre-recorded sensor data of 3D lidar, GPS and IMU
- **Vehicle dynamics:** Applied adaptive **PID** and **NMPC** control for **20%** and smoother velocity and steering profile
- **Simulations:** Built a car model with all mounted sensors in **CARLA** environment based on Unreal engine
- **Path Planning:** Implemented **Hybrid A*** and **RRT* informed** algortihms to work in real time in **ROS** environment
- **Fabrication:** Designed, manufactured and installed mounts for all onboard sensors viz. cameras, GPS module, parking sensors, Stereo camera, Lidar, IMU to stage them on car and made them waterproof

StackGAN | Deep learning Nov'19

Prof. Biplab Banerjee

- Implemented a text to photo-realistic image synthesizer based on a published paper in ICCV'17 with improvements
- Built and trained the entire network from scratch with **multiple sequential GANs** using **tensorflow** in Python
- Worked with CAB and Oxford-102 datasets for training and generation of data over the model with text embeddings
- Got photo-realistic output by applying **conditional augmentation** and given **human-written description** of the object

Histopathology Image Retrieval | Deep Learning Apr'20 - May'20

Prof. Amit Sethi

- Developed an encoder-decoder based **multi-task** model for hash code generation of histopathology images
- Trained the multi-task network using **cosine cross entropy** and **Cauchy quantization** for convergence of hash codes
- Achieved **96%** accuracy with **unsupervised clustering** of images and hashes using deep K-nearest neighbour network

COVID-19 Diagnosis | Deep Learning Mar'20 - May'20

Prof. Suyash Awate

- Trained a COVID-19 classification network (Resnet-50) in **Pytorch** using chest X-Ray images with **84% test accuracy**
- Analyzed the latent features of COVID-19 positive X-rays and studied the **intra-class variation** among patients
- Utilized **Big Transfer** by Google Brain Team, '20 for transfer learning to overcome the problem of less training data
- Applied **GradCAM** and **LIME** for better medical interpretability of symptoms in lung area with t-SNE visualizations

International Robotics Challenge | Robotics Sep'17 - Dec'17

Techfest, IIT Bombay

- Designed two bots on Solidworks equipped with **grippers**, **dart thrower** and onboard electrical circuit with sensors
- Built a four-wheeled **autonomous bot** using laser cutting fitted with a gripper, **IR LED array** and **ultrasonic sensors**, controlled by Arduino Uno and Raspberry pi, capable of autonomously solving maze, picking up and placing boxes
- Created a four-wheeled remote-controlled bot equipped with gripper and dart thrower controlled by Arduino Uno

Quadruped Spiderbot | Robotics Apr'19

Prof. Abhishek Gupta

- Built a **mini quadruped** bot from scratch using 8 micro servos with 2 DOF in each leg with inverse rigid body dynamics
- Designed the bot on SolidWorks and used **laser cutting** to make the acrylic body parts and custom connectors
- Programmed **Arduino Uno** microcontroller to control the bot to carry out pre-programmed sequences of motion

ASME Student Design Challenge | Robotics Aug'18 - Dec'18

Prof. Abhishek Gupta

- Stood **first** in **Asia-Pacific** level and qualified for international level of the competition winning prize money of **$ 500**
- Part of the student team that built a bot capable of collecting, storing and transporting balls of varying sizes
- Worked in the **mechanical subsystem** of the project; contributed to design, manufacturing and assembly of robot

Maze Solver Bot | Robotics Feb'18

Electronics And Robotics Club, IIT Bombay

- Built an **autonomous bot** to traverse a maze by checking surrounding distances using ultrasonic and IR sensors
- Programmed the Arduino Uno microcontroller with wall following algorithm to respond to ultrasonic sensors data
- Implemented **PID** algorithm to stabilize and plan the path of the bot to follow the track with accurate turns

International Robowars | Heavy Robotics Dec'17

Techfest, IIT Bombay

- Designed a symmetric **120 lbs** robot equipped with a heavy rotating drum, capable of obliterating the opponent
- Assembled the bot and finalized the design after considering various constraints, **armour materials** and **weapons**

Positions Of Responsibility

Overall Coordinator | Unmesh Mashruwala Innovation Cell, IIT Bombay May'20 - May'21

Heading a team of **50 students** working on autonomous ground and aerial vehicles with international participation

- Orchestrated the **two-month long** recruitment process of **150** aspirants having interviews, training and projects
- Negotiating with IIT Bombay authorities for revamping of a 1400 sq.ft. lab with an estimated budget of **₹4 million**
- Created the UMIC **alumni network** with **50+ alumni** currently, organising regular **lectures** on innovation and AI
- Presented the lab projects to **20+ professors** under TEQIP, IIT Bombay and **90+ visiting officers** from MILIT, Pune

Teaching Assistant | Computer Programming and Utilization Apr'19 - Jul'19

Prof. Sharat Chandran

- Created and evaluated programming assignments for labs for all the registered students in a regular fashion
- Solved queries during labs and helped students with below par performance by taking extra doubt solving sessions
- Assisted with conducting timely thrice-weekly labs, quizzes and the main exams for the entire course duration

Teaching Assistant | Engineering Graphics & Drawing Jan'20 - Apr'20

Prof. Salil S. Kulkarni

- Created detailed weekly solutions on AutoCAD and SolidWorks for the assessment of the lab solutions by students
- Identified discrepancies in the questions and made them clearer for the students in labs and exams

Coordinator | Events, Techfest, IIT Bombay May'18 - Dec'18

Asia's Largest Science and Technology Festival | Audience of 1,75,000 | Reach of 2500+ colleges in India

- Led a team of 8 organisers to plan, organize and execute events for Technoholix, Techfest 2018
- Contacted and arranged 50+ international artists to perform in Technoholix on zero budget basis
- Set a new Guinness World Record by assembling 5000+ School children in one place with self-made solar lamps
- Coordinated with international and national artist groups and arranged their infrastructure and property needs

Scholastic Achievements

- Cleared N4 level in Japanese-Language Proficiency Test (JLPT) '22
- Department Rank 5 in the batch of 102 B.Tech students, Department of Civil Engineering '21
- Recipient of Institute academic prize for consecutive high academic performance at IIT Bombay '20
- Awarded Institute Technical Color (10 out of 2000+) for exceptional contribution to the technical sphere '20
- Secured All India Rank 1681 in JEE Advanced out of nearly 0.2 million candidates '17
- One among 91 other candidates to secure admission offer in Chennai Mathematical Institute '17
- Achieved AIR - 57 with admission offer in Indian Institute of Space Science and Technology (IIST) '17

Skills

Languages	English (*native*), Japanese (intermediate, *JLPT N4*), Hindi(*native*), Marathi(*native*)
Programming	C++, Bash, ROS (Robot Operating System), Python, OpenCV, Pytorch, Tensorflow, HTML
Software	Git, SolidWorks, MATLAB, ANSYS, MSC ADAMS, AutoCAD, Arduino IDE, LaTeX

Key Courses Undertaken

Computer Science	Medical Image Computing, Advanced Machine Learning, Machine Learning for Remote Sensing, Data Structure and Algorithms, Operating systems, Logic for Computer Science, Computer Programming and Utilization, Programming for Data Science
Mathematics	Linear Algebra, Calculus, Differential Equations, Numerical Methods, Optimization methods
Civil Core	Transportation Engineering, Structural Design, Structural Mechanics, Hydraulic Engineering, Geotechnical Engineering, Building Materials and Construction
Others	Electrical and Electronics circuits, Robotics, Environmental Science, Economics

Extra-Curricular Activities

Social Service	• Coordinated the Cyclothon Initiative, IIT-B to spread awareness about risk of heart diseases • Contributed to SoULS initiative and provided training to under-privileged students
Sports	• Part of team which represented hostel in Institute Open Chess General Championship 2017 • Represented school in DSO chess at zonal level in 2014 with first place in district level
Mentorship	• Selected to mentor over 500 freshmen in XLR8 - a robot building competition • Mentored three teams for object detection using CNNs in ITSP - summer projects
Technical	• Made a robot to present before Honourable Prime Minister of India Shri.Narendra Modi
Art and Music	• Cleared the Elementry and Intermediate Grade drawing examinations with distinction • Undertook a year long training in Carnatic Violin under the NSO Culturals scheme