Rahul Sharma

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EDUCATION

Name of Course	Specialization	Name of Institution	Percentage/CGPA	Year
M.Tech.	Robotics and Autonomous Systems	Indian Institute of Science, Bangalore	8.2/10	2024
B.Tech.	Electrical & Electronics Engineering	Uttarakhand Technical University, Dehradun	68%	2013

EXPERIENCE

Senior Research Fellow, Defence Research & Development Organization (DRDO), India **Aug'19 – Aug '22**

- AI- based Target Tracker for Surveillance Systems
  - Conventional Target tracker requires a human in loop to assess and determine which target is to be tracked.
  - Utilized YOLOv5 based model for tracking specified target of interest autonomously without any human intervention.
  - Trained on custom dataset and deployed on jetson Xavier, with accuracy of 93% and system accuracy tolerance of 1mm.
- Developed Uncooled Thermal Image Denoising using deep Convolution neural network**.**
  - Image captured by Thermal cameras are contaminated by noise which can harm image analysis and tracking.
  - Developed and trained an Auto Encoder based Deep CNN for Gaussian, salt &pepper noise denoising of Gaussian, salt & pepper noise on Custom dataset captured via uncooled thermal imager.
  - Achieved PSNR increment of 55% and SSIM increment of 300% between raw and reconstructed image.
- **First time Developed Indigenous Image blur prevention technique for high-speed and long-range (up to 40 kms) Surveillance**.
  - Surveillance systems that have gimbal rotating speeds greater than 40 deg/sec experience blur in captured images.
  - Avoided blur up to 120 deg/sec rotation speeds.
  - deployed on hardware and successfully tested on USAF 1951 charts for real time blur prevention.
  - Achieved 0.78 average SSIM and 19 average PSNR.
- Fire Control system Design for armored Tanks on real system.
- Gimbal stabilization and position control of different gimbles including 3 axis 5 gimble Surveillance systems.
  - Systems tested successfully on field for their Accuracy.
- Schematics design and verification for surveillance system electronics.

Engineer, Gayatri Electricals, Dehradun **Aug'15– July2018**

Designed, simulated, tested, and integrated electric substation and prepared SLD for power generating station.

Quality Check In charge, Beny Industries, Delhi **Jul'13 – Apr'15**

Researched existing methods, conducted tests to automate the process and make it more reliable to increase the quality of product.

Research Publications

- S. Kumar, **R. Sharma** and V. Marale, "Uncooled Thermal Image Denoising using Deep Convolutional Neural Network," *2022 Third International Conference on Intelligent Computing Instrumentation and Control Technologies (ICICICT)*, Kannur, India.
- Manuscript of Image Blur Prevention Technique for High-Speed Surveillance is under internal review process of DRDO.

Master's Project

High speed UAV navigation in unknown environment with computer vision

Under Prof. Jishnu Keshavan, IISc in Collaboration with Indian Space research Organization (ISRO), Bengaluru, India **Aug'23 – Present**

- State of the art visual SLAM **ORB SLAM3** uses **ORB feature extractor** and fails in sparse environments like space, Moon surface, Mars, desert, and many real-world scenarios. And to analyze the scene 3D reconstruction of environment is needed.
- Developed a novel **computer vision** algorithm using **Dynamic time Warping** (DTW) which takes stereo cameras images as input and outputs **dense depth point cloud** in real world environments.
- Developing a **navigation** algorithm using this point cloud to navigate in unknown environment.
- Algorithm simultaneously reconstruct 3D environment.
- Working on **NeRF** (Neural Radiance Field) to make reconstruction more realistic.

PROJECTS

Indian Traffic Sign Image Classification **Sep'22 – Sep'22**

- Research and compared various methods to classify traffic signals with limited dataset of images.
- Best accuracy: Applied **ResNet50-Transfer learning** with **up-sampling** and achieved **92 percent accuracy**.
- Other models explored: **transfer learning (VGG)** with **SVM** and Logistic Regression.

Visual Docking of Satellites **Feb'24 – Present**

ISRO Project

- Satellite Docking is needed if we want to change something in existing satellites or for many other space applications. Current technology uses lasers for docking.
- Developing a **computer vision** algorithm using Image registration and stereo camera for docking of two satellites.

Onboard Gender classification of human faces using PCA **Jan'22 – April'22**

- Olivetti faces dataset was used to perform **PCA** and 10 **eigen faces** were created.
- Faces reconstructed using different number of eigen faces (1,2,5,10,15) to conclude effect of eigen vector and find the optimal number of eigen vectors for good compression and reconstruction.
- Implemented **SVM classifier** to classify this lower dimension data into Male and Female with accuracy of 94%.

Movement Analysis and Action Prediction of User Action on Video

- Implemented mmaction2 toolbox developed by open-mmlab.
- Model was pretrained on 'Skeleton' dataset for 'key point identification' and Kinetic dataset for 'Action Prediction'.
- TSN (temporal segment network) used for Prediction of Action, Faster RCNN for Human Detection, HRNet w32 for Pose Estimation.
- Done Inferencing on local machine on custom videos.

AI based Road Profiling Using IMU Data **sep'23-sep'23**

- Collected **IMU data** of IISc roads to classify them into rough, average, and smooth category.
- Implemented **K means Clustering** for **time series IMU data** with Dynamic time warping (DTW).
- Deployed trained model on hardware for real time inference.

Unsupervised Data Analysis using Statistical Suburb Profiles on Australian Suburbs **Feb'23-Feb'23**

- **Hypothesis Driven Research:** Implemented clustering, multi–Dimensionality Scaling (MDS) approaches to draw conclusions on similarity measures like Sociodemographic, land use, services etc. of 34 Australian Suburbs.
- **Exploratory Data Analysis:** Identified outliers, exploring feature relationship using unsupervised learning**.**

Autonomous Navigation of VOLTA Robot using LIDAR and Camera **March'23-Apr'23**

- Implemented G-mapping algorithm on the VOLTA robot using LIDAR data.
- Implemented **deep learning**-based CNN for tracking and dynamic obstacle avoidance using LIDAR data.
- Implemented autonomous navigation of volta robot.

Fanart Generator using generative AI **Apr'24-Apr'24**

- **Objective**: Generate the images for a given prompt.
- Implemented **Diffusion model pipeline** using **Hugging face** library to generate images from given prompt.
- AbsoluteReality_v1.8, stable-diffusion-v1-4 etc. models were used.
- **Fine tunned model on custom dataset**: *stable-diffusion-v1-4* model with the *pokemon-blip-captions* dataset.
- For inference Pokémon images were generated for a prompt related to Pokémon.

Localization of Corner Casters in Foggy Environment

- Due to low visibility at docks during foggy whether corner casters are not visible, so it creates problems during loading and unloading of cargo on dockyard.
- Used mm wave radar for approximate localization of the corner caster.
- Demonstrated the results on corner caster

Generation of next words for a given sentence

- Tokenized the sentences from a given text, created a corpus of unique tokens.
- Created bigrams and their frequency to predict next 5 five words for a given sentence using probability of bi grams.

RELEVANT COURSEWORK

IISc	Data Science for Smart Cities, Robotic perception, Swarm robotics, Hardware Acceleration and optimization for ML, Bayesian Learning, Robot Learning & Control, Motion Planning, Experimental Technique in Robotics
NPTEL	Deep learning for Computer Vision (Silver medal) NPTEL-IIT Madras

SKILLS

- Computer Vision, Deep Learning, Machine Learning, Data Science, Image Processing
- Natural Language Processing (NLP), Transformers, BERT, LLMs, Diffusion models
- Robotics, Control System design, System Integration, Schematics design and review of gimbal electronics
- Python, NumPy, Scikit-Learn, Pandas, TensorFlow, OpenCV, MATLAB
- Edge Computing, Docker, Git, GitHub